

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

**AMAZON.COM, INC.,
AMAZON.COM SERVICES LLC,
AMAZON WEB SERVICES, INC., and
AUDIBLE, INC.,**
Petitioners,

v.

AUDIO POD IP, LLC,
Patent Owner.

Case No. IPR2025-01003
Patent 9,729,907

DECLARATION OF SYLVIA D. HALL-ELLIS, Ph.D.

I. INTRODUCTION

I, Sylvia D. Hall-Ellis, hereby declare:

1. I have been retained as an expert by Amazon.com, Inc., Amazon.com Services LLC, Amazon Web Services, Inc, and Audible, Inc. (referred to herein as “Petitioners”).

2. I have written this declaration at the request of Petitioners to provide my expert opinion regarding the authenticity and public availability of several publications. My declaration sets forth my opinions in detail and provides the basis for my opinions regarding the public availability of these publications.

3. I reserve the right to supplement or amend my opinions, and bases for them, in response any additional evidence, testimony, discovery, argument, and/or other additional information that may be provided to me after the date of this declaration.

4. I am being compensated for my time spent working on this matter at my normal consulting rate, plus reimbursement for any additional reasonable expenses. My compensation is not in any way tied to the content of this declaration, the substance of my opinions, or the outcome of this proceeding. I have no other interests in this proceeding or with any of the parties.

5. All of the materials that I considered are discussed explicitly in this declaration.

II. QUALIFICATIONS

6. I am currently an Adjunct Professor in the School of Information at San José State University. I obtained a Master of Library Science from the University of North Texas in 1972 and a Ph.D. in Library Science from the University of Pittsburgh in 1985. Over the last fifty years, I have held various positions in the field of library and information resources. I was first employed as a librarian in 1966 and have been involved in the field of library sciences since, holding numerous positions.

7. I am a member of the American Library Association (“ALA”) and its Association for Library Collections & Technical Services (“ALCTS”) Division, and I served on the Committee on Cataloging: Resource and Description (which wrote the new cataloging rules) and as the chair of the Committee for Education and Training of Catalogers and the Competencies and Education for a Career in Cataloging Interest Group. I also served as the Chair of the ALCTS Division’s Task Force on Competencies and Education for a Career in Cataloging. Additionally, I served as the Chair for the ALA Office of Diversity’s Committee on Diversity, as a member of the REFORMA National Board of Directors, and as a member of the Editorial Board for the ALCTS premier cataloging journal, *Library Resources and Technical Services*, as a Co-Chair of the Membership Committee for the Library Research Round Table (LRRT) of the American Library

Association, and as a member of the LRRT Nominating Committee. Currently I serve as a member of the CORE Margaret Mann Citation Committee.

8. I have also given over one-hundred presentations in the field, including several on library cataloging systems and Machine-Readable Cataloging (“MARC”) standards. My current research interests include library cataloging systems, metadata, and organization of electronic resources.

9. My full *curriculum vitae* is attached hereto as Attachment 7 to this declaration.

III. PRELIMINARIES

10. I am not an attorney, nor am I an expert in the law. Therefore, counsel for Petitioners has provided me with guidance as to the applicable law in this matter. The paragraphs below express my understanding of how I must apply current legal principles to my analysis.

11. I understand that an item is considered authentic if there is sufficient evidence to support a finding that the item is what it is claimed to be. I also understand that authenticity can be established based on the contents of the documents themselves, such as the appearance, contents, substance, internal patterns, or other distinctive characteristics of the item, taken together with all of the circumstances. I further understand that an item is considered authentic if it is at least 20 years old, in a condition that creates no suspicion of its authenticity, and

in a place where, if authentic, it would likely be. Lastly, I understand that a document's authenticity can be established by comparison with an authentic specimen.

12. I understand that a printed publication qualifies as publicly accessible as of the date it was disseminated or otherwise made available such that a person interested in and ordinarily skilled in the relevant subject matter could locate it through the exercise of reasonable diligence.

13. While I understand that the determination of public accessibility under the foregoing standard rests on a case-by-case analysis of the facts particular to an individual publication, I also understand that a printed publication may be "publicly accessible" if it is cataloged and indexed by a library such that a person interested in the relevant subject matter, exercising reasonable diligence, could locate it (*i.e.*, I understand that cataloging and indexing by a library may show public accessibility, though there are other ways that a printed publication may qualify as publicly accessible). I understand that the cataloging and indexing by a single library, even in a foreign country, of a single instance of a particular printed publication may show public accessibility. I understand that, even if access to a library is restricted, a printed publication that has been cataloged and indexed therein may be publicly accessible so long as a presumption is raised that the portion of the public concerned with the relevant subject matter would know of the

printed publication. I also understand that the cataloging and indexing of information that would guide a person interested in the relevant subject matter to the printed publication, such as the cataloging and indexing of an abstract for the printed publication, can show public accessibility.

14. I understand that routine business practices, such as general library cataloging and indexing practices, can be used to establish an approximate date on which a printed publication became publicly accessible.

IV. LIBRARY CATALOGING PRACTICES

15. In preparing this declaration, I used authoritative databases, such as the Online Computer Library Center (OCLC) bibliographic database, the Library of Congress Online Catalog, and the Library of Congress Subject Authorities, to confirm citation details of the publication discussed below. It is my opinion that this standard cataloging and classification protocol was followed for the publications discussed below.

16. Based on my experience working in research libraries, it is my opinion that members of the public would have been able to locate the material discussed herein on their own or with the assistance of a research librarian with relative ease using the tools and resources described herein.

A. INDEXING

17. A researcher may discover material relevant to his or her topic in a variety of ways. One common means of discovery is to search for relevant information in an index of periodical and other publications. Having found relevant material, the researcher will then normally obtain it online, look for it in libraries, or purchase it from the publisher, a bookstore, a document delivery service, or other provider. Sometimes, the date of a document's public accessibility will involve both indexing and library date information. However, date information for indexing entries is often unavailable. This is especially true for online indices.

18. Indexing services use a wide variety of controlled vocabularies to provide subject access and other means of discovering the content of documents. The formats in which these access terms are presented vary from service to service.

19. Before the widespread development of online databases to index articles in journals, magazines, conference papers, and technical reports, libraries purchased printed volumes of indices. Graduate library school education mandated that students learn about the bibliographic control of disciplines, the prominent indexing volumes, and searching strategies required to use them effectively and efficiently. Half of the courses that I studied in library school were focused on the bibliography and resources in academic disciplines.

20. Librarians consulted with information seekers to verify citations, check availability in union catalogs, printed books catalogs, and the OCLC database, and make formal requests for materials, *e.g.*, books, conference proceedings, journal articles. Requests were transmitted using Telex machines, rudimentary email systems, and the United States Postal Service. During my career, I have performed and supervised staff who handled these resource sharing tasks.

21. A major firm known for the breadth of subjects and comprehensive treatment in the preparation of index volumes, the H. W. Wilson Company offered these reference resources since the firm was founded in 1898. The *Reader's Guide to Periodical Literature* is one of the best-known titles available from H. W. Wilson. Each volume includes a comprehensive index for 300 of the most popular and important periodicals published in the United States and Canada. Information seekers have subject access expressed in plain language terminology, author access, and cross references to find the desired results from their searches. The family of index titles included *Science & Technology Index*, *Business Periodicals*, *Applied Science & Technology Index*, *Humanities Index*, *Biological & Agricultural Index*, and *Industrial Arts Index*. These printed indices have been superseded by digital database offerings available to information seekers through Ebsco.

22. Online indexing services commonly provide bibliographic information, abstracts, and full-text copies of the indexed publications, along with a list of the documents cited in the indexed publication. These services also often provide lists of publications that cite a given document. A citation of a document is evidence that the document was publicly available and in use no later than the publication date of the citing document.

23. *ResearchGate*.¹ A social networking site designed for scientists and researchers to share papers, ask and answer questions, and find collaborators, *ResearchGate* is the largest academic social network in terms of active users. As of September 2023, ResearchGate had more than 25 million users, with its largest user-bases coming from Europe and North America.²

24. Features available to *ResearchGate* members include following a research interest and the work of other individual participants, a blogging feature for users to write short reviews on peer-reviewed articles, private chat rooms for sharing data, editing documents, or discussing confidential topics, and a research-focused job board. *ResearchGate* indexes self-published information on user profiles and suggests members connect with others who have similar

¹ www.researchgate.net

² <https://en.wikipedia.org/wiki/ResearchGate>

interests. Member questions are fielded to others who have identified relevant expertise on their profiles.

25. *ResearchGate* restricts its user accounts to people at recognized institutions and published researchers. Most of *ResearchGate's* users are involved in medicine, biology, engineering, computer science, agricultural sciences, and psychology. *ResearchGate* publishes a citation impact measurement in the form of an “RG Score,” which is reported to be correlated with existing citation impact measures. *ResearchGate* does not charge fees for putting content on the site and does not require peer review.

26. *Semantic Scholar*.³ A project developed at the Allen Institute for Artificial Intelligence and publicly released in November 2015, *Semantic Scholar* is designed to be an AI-backed search engine for scientific journal articles which uses a combination of machine learning, natural language processing, and machine vision to add a layer of semantic analysis to the traditional methods of citation analysis, and to extract relevant figures, entities, and venues from papers. *Semantic Scholar* is designed to highlight important, influential papers, and to identify the connections between them.

27. As of January 2018, following a 2017 project that added biomedical papers and topic summaries, the *Semantic Scholar* corpus included more than 40

³ <https://www.semanticscholar.org>

million papers from computer science and biomedicine. In March 2018, Doug Raymond, who developed machine learning initiatives for the Amazon Alexa platform, was hired to lead the *Semantic Scholar* project. As of August 2019, the number of included papers had grown to more than 173 million after the addition of the Microsoft Academic Graph records, already used by Lens.org.

28. The *WayBack Machine* is an application using a crawler created by the Internet Archive to search its archive of Web page URLs and to represent, graphically, the date of each crawler capture. The Internet Archive is a non-profit digital library founded in 1996 that maintains an archive of webpages collected from the Internet using software called a crawler. Crawlers automatically create a snapshot of webpages as they existed at a certain point in time. The Internet Archive captures data that is publicly available. Some sites are “not archived because they were password protected, blocked by robots.txt, or otherwise inaccessible to our automated systems. Site owners might have also requested that their sites be excluded from the WayBack Machine.”

29. As of January 1, 2023, the Internet Archive holds more than 38 million print materials, 11.6 million pieces of audiovisual content, 2.6 million

software programs, 15 million audio files, 4.7 million images, 251,000 concerts, and over 832 billion web pages in its *Wayback Machine*.⁴

30. Many Internet Archive captures made by the *WayBack Machine* have a banner at the top with the capture date prominently displayed. Other dates when captures of the same URL have been made are indicated to the right and left of the date provided in the banner. Some captures may lack this banner. In any case, the URL for the capture begins with the identification of the Internet Archive page (e.g., <http://web.archive.org/web/>) followed by information that dates and time stamps the capture as follows: year in yyyy, month in mm, day in dd, time code in hh:mm:ss (e.g., 20071120082013, or November 20, 2007 at 8:20:13 a.m.). These elements are then followed by the URL of the original capture site. When links are active, the *WayBack Machine* is programmed to produce the archived file with the closest available date (not the closest available prior date) to the page upon which the link appeared and was clicked. I and other librarian professionals are familiar with the Internet Archive and the *Wayback Machine*.⁵

⁴ https://en.wikipedia.org/wiki/Internet_Archive

⁵ For more information about the Internet Archive see the WayBack Machine FAQ, https://archive.org/about/faqs.php#The_Wayback_Machine.

B. MARC RECORDS AND THE ONLINE LIBRARY CATALOG

31. I am fully familiar with the library cataloging standard known as the MARC standard, which is an industry-wide standard method of storing and organizing library catalog information.⁶ MARC was first developed in the 1960s by the Library of Congress. A MARC-compatible library is one that has a catalog consisting of individual MARC records for each of its items. Today, MARC is the primary communications protocol for the transfer and storage of bibliographic metadata in libraries.⁷

32. MARC is a framework into which descriptive bibliographic data are transcribed to interact with the software in online library catalogs to provide access to books, journals, and other resources in the collection. The bibliographic data

⁶ The full text of the standard is available from the Library of Congress at <http://www.loc.gov/marc/bibliographic/>.

⁷ Almost every major library in the world is MARC-compatible. *See, e.g., MARC Frequently Asked Questions (FAQ)*, Library of Congress, <https://www.loc.gov/marc/faq.html> (last visited February 17, 2025) (“MARC is the acronym for MACHine-Readable Cataloging. It defines a data format that emerged from a Library of Congress-led initiative that began nearly forty years ago. It provides the mechanism by which computers exchange, use, and interpret bibliographic information, and its data elements make up the foundation of most library catalogs used today.”). MARC is the ANSI/NISO Z39.2-1994 (reaffirmed 2016) standard for Information Interchange Format.

provide points of access and can be searched by a person of ordinary skill in the art (“POSITA”) to identify and obtain resources in the library collection. An information seeker (or POSITA) can search a local online library catalog or the holdings of a group of libraries in a state or region or in the global catalog WorldCat.

33. MARC records are not designed for public viewing. Although a significant number of libraries provide access to the MARC version of a bibliographic record, the public display is designed to show information in a succinct manner that is quickly understood and useful to the information seeker. Libraries determine the default search for the online catalog to make the entry of search terms efficient and result in a successful search. Information seekers can enter a keyword, title, author, or standard number for the item. Libraries may also provide a search capability called “Summon” that allows the information seeker to enter known information about the item to conduct a search.

34. Since at least the early 1970s and continuing to the present day, MARC has been the primary communications protocol for the transfer and storage of bibliographic metadata in libraries.⁸ As explained by the Library of Congress:

⁸ A complete history of the development of MARC can be found in *MARC: Its History and Implications* by Henrietta D. Avram (Washington, DC: Library of Congress, 1975) and available online from the Hathi Trust

You could devise your own method of organizing the bibliographic information, but you would be isolating your library, limiting its options, and creating much more work for yourself. Using the MARC standard prevents duplication of work and allows libraries to better share bibliographic resources. Choosing to use MARC enables libraries to acquire cataloging data that is predictable and reliable. If a library were to develop a “home-grown” system that did not use MARC records, it would not be taking advantage of an industry-wide standard whose primary purpose is to foster communication of information.

Using the MARC standard also enables libraries to make use of commercially available library automation systems to manage library operations. Many systems are available for libraries of all sizes and are designed to work with the MARC format. Systems are maintained and improved by the vendor so that libraries can benefit from the latest advances in computer technology. The MARC standard also allows libraries to replace one system with another with the assurance that their data will still be compatible.

Why Is a MARC Record Necessary? LIBRARY OF CONGRESS,
<http://www.loc.gov/marc/umb/um01to06.html#part2> (last visited February 17, 2025).

(<https://babel.hathitrust.org/cgi/pt?id=mdp.39015034388556;view=1up;seq=1>; last visited February 17, 2025).

35. Examining the MARC records for a specific item reveals the comprehensive data transcribed about a particular item at the time that cataloging and classification occurred. In addition to the creator, title, subjects, and standard numbers, additional information may provide additional and relevant data depending on the type of resource. Understanding the full extent of bibliographic data for an item and the points of access associated with it provides essential information that can be used to determine the indexing and public availability for documents described in this Declaration.

1. MARC RECORDS

36. A MARC record comprises several fields, each of which contains specific data about the work. Each field is identified by a standardized, unique, three-digit code corresponding to the type of data that follow. For example, a work's title is recorded in field 245, the primary author or creator of the work is recorded in field 100, an item's International Standard Book Number ("ISBN") is recorded in field 020, an item's International Standard Serial Number ("ISSN") is recorded in field 022, an item's Library of Congress call number is recorded in field 050, and the publication date is recorded in field 260 under the subfield "c." *Id.*⁹ If a work is a periodical, then its publication frequency is recorded in field

⁹ In some MARC records, field 264 is used rather than field 260 to record publication information. See <http://www.loc.gov/marc/bibliographic/bd264.html>

310, alternate publication frequency is recorded in field 321, and the publication dates (*e.g.*, the first and last publication) are recorded in field 362, which is also referred to as the enumeration/chronology field. *See* <http://www.loc.gov/marc/bibliographic/bd3xx.html> (last visited February 17, 2025).

37. The library that created the record is recorded in Field 040 in subfield “a” with a unique library code. When viewing the MARC record online via Online Computer Library Center’s (“OCLC”) bibliographic database, hovering over this code with the mouse reveals the full name of the library. I used this method of “mousing over” the library codes in the OCLC database to identify the originating library for the MARC records discussed in this Declaration. Where this “mouse over” option was not available, I consulted the Directory of OCLC Libraries to identify the institution that created the MARC record.¹⁰

38. MARC records also include several fields that include subject matter classification information. An overview of MARC record fields is available through the Library of Congress at <http://www.loc.gov/marc/bibliographic/>. For

(last visited February 17, 2025) (“Information in field 264 is similar to information in field 260 (Publication, Distribution, etc. (Imprint)). Field 264 is useful for cases where the content standard or institutional policies make a distinction between functions”).

¹⁰ <https://www.oclc.org/en/contacts/libraries.html>

example, 6XX fields are termed “Subject Access Fields.” *See* <http://www.loc.gov/marc/bibliographic/bd6xx.html>. Among these, for example, is the 650 field; this is the “Subject Added Entry – Topical Term” field. *See* <http://www.loc.gov/marc/bibliographic/bd650.html>. The 650 field is a “[s]ubject added entry in which the entry element is a topical term.” *Id.* These authenticated subject entries “are assigned to a bibliographic record to provide access according to generally accepted thesaurus-building rules (*e.g.*, *Library of Congress Subject Headings* (LCSH), *Medical Subject Headings* (MeSH)).” *Id.*

39. Further, MARC records include call numbers, which themselves indicate a subject and physical location within the library collections. For example, the 050 field is the “Library of Congress Call Number.” *See* <http://www.loc.gov/marc/bibliographic/bd050.html> (last visited February 17, 2025). A defined portion of the Library of Congress Call Number is the classification number, and “source of the classification number is *Library of Congress Classification* and the *LC Classification-Additions and Changes*.” *Id.* Thus, included in the 050 field is a subject matter classification. Each item in a library has a single classification number. A library selects a classification scheme (*e.g.*, the Library of Congress Classification scheme just described or a similar scheme such as the Dewey Decimal Classification scheme or the National Library of Medicine Classification scheme) and uses it consistently. When the Library of

Congress assigns the classification number, it appears as part of the 050 field. If a local library assigns the classification number, it appears in a 090 field. In either scenario, the MARC record includes a classification number that represents a subject matter classification.

40. Each item in a library has a single classification number. A library selects a classification scheme (*e.g.*, the Library of Congress Classification scheme just described or a similar scheme such as the Dewey Decimal Classification scheme) and uses it consistently. When the Library of Congress assigns the classification number, it appears as part of the 050 field, as discussed above. For MARC records created by libraries other than the Library of Congress (*e.g.*, a university library or a local public library), the classification number may appear in a 09X (*e.g.*, 090) field. See <http://www.loc.gov/marc/bibliographic/bd09x.html> (last visited February 17, 2025).

2. OCLC

41. The OCLC was created “to establish, maintain and operate a computerized library network and to promote the evolution of library use, of libraries themselves, and of librarianship, and to provide processes and products for the benefit of library users and libraries, including such objectives as increasing availability of library resources to individual library patrons and reducing the rate of rise of library per-unit costs, all for the fundamental public purpose of furthering

ease of access to and use of the ever-expanding body of worldwide scientific, literary and educational knowledge and information.”¹¹ Among other services, OCLC and its members are responsible for maintaining the WorldCat database (<http://www.worldcat.org/>), used by independent and institutional libraries throughout the world.

42. OCLC also provides its members online access to MARC records through its OCLC bibliographic database. When an OCLC member institution acquires a work, it creates a MARC record for this work in its computer catalog system in the ordinary course of its business. MARC records created at the Library of Congress were initially tape-loaded into the OCLC database through a subscription to MARC Distribution Services daily or weekly. Once the MARC record is created by a cataloger at an OCLC member institution or is tape-loaded from the Library of Congress, the MARC record is then made available to any other OCLC members online, and therefore made available to the public. Accordingly, once the MARC record is created by a cataloger at an OCLC member institution or is tape-loaded from the Library of Congress or another library anywhere in the world, any publication corresponding to the MARC record has

¹¹ Third Article, Amended Articles of Incorporation of OCLC Online Computer Library Center, Incorporated (available at <https://www.oclc.org/content/dam/oclc/membership/articles-of-incorporation.pdf>).

been cataloged and indexed according to its subject matter such that a person interested in that subject matter could, with reasonable diligence, locate and access the publication through any library with access to the OCLC bibliographic database or through the Library of Congress.

43. When an OCLC member institution creates a new MARC record, OCLC automatically supplies the date of creation for that record. The date of creation for the MARC record appears in the fixed field (008), characters 00 through 05. The MARC record creation date reflects the date on which, the item was first acquired or cataloged. Initially, field 005 of the MARC record is automatically populated with the date the MARC record was created in year, month, day format (YYYYMMDD) (some of the newer library catalog systems also include hour, minute, second (HHMMSS)). Thereafter, the library's computer system may automatically update the date in field 005 every time the library updates the MARC record (*e.g.*, to reflect that an item has been moved to a different shelving location within the library). Field 005 is visible when viewing a MARC record via an appropriate computerized interface. The initial field 005 date (*i.e.*, the date the MARC record was created) does appear. The date upon which the most recent update to field 005 occurred also appears in field 005. Thus, when an item's MARC record has been printed to hardcopy—as is the case with the

exhibits to this report—the date reflected next to field 008 is necessarily on or after the date the library first cataloged and indexed the underlying item.

44. Once one library has cataloged and indexed a publication by creating a MARC record for that publication, other libraries that receive the publication do not create additional MARC records—the other libraries instead rely on the original MARC record. They may update or revise the MARC record to ensure accuracy, but they do not replace or duplicate it. This practice does more than save libraries from duplicating labor, it also enhances the accuracy of MARC records. It also allows librarians around the world to know that a particular MARC record is authoritative. In contrast, a hypothetical system wherein duplicative records were created would result in confusion as to which record is authoritative.

45. The date of creation of the MARC record by a cataloger at an OCLC member institution reflects when the underlying item is accessible to the public. Upwards of two-thirds to three-quarters of book sales to libraries come from a jobber or wholesaler for online and print resources. These resellers make it their business to provide books to their customers as fast as possible, often providing turnaround times of only a single day after publication. Libraries purchase a significant portion of the balance of their books directly from publishers themselves, which provide delivery on a similarly expedited schedule. In general, libraries make these purchases throughout the year as the books are published and

shelve the books as soon thereafter as possible in order to make the books available to their patrons. Thus, books are generally available at libraries across the country within just a few days of publication.

C. JOURNALS

46. Catalogers can create MARC records for all types of print, online, and digital resources. For example, MARC records cover serial publications, including both serially-published monographs and journals. OCLC hosts MARC records for more than 320 million serial publications. Serial publications are those publications that have the same collective title but are intended to be continued indefinitely with enumeration such as a volume or issue number (*e.g.*, magazines, journals, etc.). In the OCLC bibliographic database, the first issue of the serial publication is typically cataloged (*i.e.*, a corresponding MARC record is created), but the date is left open-ended with the use of a punctuation mark such as a dash. OCLC serial publication MARC records represent the entire run of the serial title. With knowledge of the first issue published, future issues can be predicted based on the information provided in the MARC record, for example in field 362. In my extensive professional experience, is it highly unusual for a library to stop collecting and shelving a serial publication prior to the end of its publication run. If a subscription to a serial publication ends its run or is cancelled before the end of

its run, the library will denote that it has stopped receiving new volumes by filling in the end date in the MARC record.

47. The handling of printed journal subscriptions is shown on the cover or the first few pages of individual issues. As was the best practice among libraries, issues arrived at a central facility and were immediately received, verified as part of a subscription, checked in, and stamped or labeled with the institution's name and date. Determining that the issue was part of the library subscription ensured that the entire set of publications for the year had been received so that they could be professionally bound and retained. This process also verified that all of the published issues arrived so that the library staff did not have to request or claim an issue that did not arrive as expected. In large public libraries with branches and multi-campus libraries within academic institutions, the journals were sorted and delivered to the subscribing unit. The new issue was placed in the public area; the older issue was stored so that it remained available.

48. The foregoing process has been standard library practice longer than I have been working in the profession. I first learned the steps in the process in the late 1970s and later supervised it. Although the checking in process has become automated and now links electronically to holdings records for the MARC record for each serial title, the manual placement of a stamp or label and placing the issue in a public area has not changed for 50 years. Unless I note otherwise below in

reference to a specific serial publication, it is my expert opinion that this standard protocol was followed for all of the serial publications discussed below.

V. PUBLICATIONS

A. “Content Delivery Network Architecture for Mobile Streaming Service Enabled by SMIL Modification” by Takeshi Yoshimura, Yoshifumi Yonemoto, Tomoyuki Ohya, Minoru Etoh, and Susie Wee [Exhibit 1006]

49. Attached hereto as Attachment 5 is a copy of the journal article titled “Content Delivery Network Architecture for Mobile Streaming Service Enabled by SMIL Modification” by Takeshi Yoshimura, Yoshifumi Yonemoto, Tomoyuki Ohya, Minoru Etoh, and Susie Wee (hereafter “Yoshimura”). The Yoshimura article was published in Volume E86-B, Number 6 of the journal *IEICE Transactions on Communications* and was found in the Linda Hall Library of Science, Engineering & Technology (Kansas City, Missouri). The Yoshimura article appears beginning on page 1778 of this issue dated June 2003. Attachment 5 is a true and correct copy of the Yoshimura article (pages 1778-1787) that I understand is being submitted as an exhibit in this proceeding. Specifically, the text of the article is complete; no pages are missing, and the text on each page appears to flow seamlessly from one page to the next; further, there are no visible alterations to the document. Attachment 5 was found within the custody of a library – a place where an authentic copy of this journal would likely be. Attachment 5 is a true and correct copy in a condition that creates no suspicion

about its authenticity. I have reviewed Exhibit 1006 of the concurrently filed petition and Attachment 5, and, based on this review, Exhibit 1006 is a true and correct copy of the Yoshimura article.

50. The Yoshimura article is also available in the digital repository *ResearchGate*.¹²

51. Attached hereto as Attachment 1A is a true and correct copy of the MARC record for the journal titled *IEICE Transactions on Communications* in the Linda Hall Library of Science, Engineering & Technology online catalog. The library ownership is indicated by the presence of the library's code ("LHL") in field 049. The library continues to update this MARC record and enhanced the MARC record to meet current cataloging rules. The most recent enhancement to Attachment 1A occurred on October 29, 2019, as shown in field 005 ("20191029"). I personally identified and retrieved the MARC record that is Attachment 1A.

52. Based on finding a print copy of the Yoshimura article in the Linda Hall Library of Science, Engineering & Technology and MARC record in its online library catalog attached as Attachment 1A, it is my opinion that the

¹²

https://www.researchgate.net/publication/293454774_Content_Delivery_Network_Architecture_for_Mobile_Streaming_Service_Enabled_by_SMIL_Modification

Yoshimura article published in the journal *IEICE Transactions on Communications* was publicly available on or shortly after September 29, 2003, as shown by the library's stamp on the cover. In common practice these stamps are applied at or around the time the volume is entered into the library's collection and the volume is made available to library patrons within a short time thereafter. Attachment 1A also shows that Attachment 5 was catalogued with a descriptor term reading "Telecommunication \$v Periodicals" (see Attachment 1B, Library of Congress subject heading sh2008112739) in the 650 field.

53. As noted in the holdings information (362 field), the Linda Hall Library of Science, Engineering & Technology has received the journal *IEICE Transactions on Communications* since January 1991 and continues to receive the publication.¹³ In view of the MARC record for Attachment 5, the Yoshimura article was publicly available on or shortly after September 29, 2003, because the

¹³ The publication was originally titled *Abstracts of IECE Transactions* (January 1974-December 1975), which changed the title to *The Transactions of the Institute of Electronics and Communication Engineers of Japan, Section E: English* (January 1976-December 1986), which became *The Transactions of the Institute of Electronics, Information and Communication Engineers* (January 1987-December 1990), followed by the *IEICE transactions on Communications, Electronics, Information, and Systems* (January 1991-December 1991) before adopting the current title in January 1991.

serial title had been received, cataloged, and indexed at the Linda Hall Library of Science, Engineering & Technology and made part of its online catalog database.

54. Attached hereto as Attachment 1C is a true and correct copy of the MARC record for the journal titled *IEICE Transactions on Communications* obtained from the OCLC bibliographic database. As previously noted, the library that created the record is recorded in field 040 with a unique library code. For Attachment 1C, that library code is “COD,” which means that the MARC record for this serial was cataloged at the University of Colorado – Boulder Libraries. As can be seen in field in the MARC record for this exhibit, a cataloger at the Library of Congress created OCLC record number 25533083 on March 26, 1992 (“920326”), as shown in field 008 (Date entered on file”). The library continues to update and enhance the MARC record to meet current cataloging rules. The most recent enhancement to Attachment 1C occurred on August 10, 2022, as shown in field 005 (“20220810”). I personally identified and retrieved the MARC record that is Attachment 1C. The “Bibliographic Level” entry in Attachment 1C is “s,” which indicates that the journal titled *IEICE Transactions on Communications* is a serial publication. Field 310 of Attachment 1C reads “Monthly.” Accordingly, the MARC record for Attachment 5 corresponds to the journal titled *IEICE Transactions on Communications* from the time the serial title adopted the current title and includes the date of the Yoshimura article.

55. Attachment 1C includes an entry in field 050 (“TK5101.A1 \$b I329”)—as described above, a subject matter classification number consistent with the Library of Congress classification system (analogous to the Dewey Decimal classification system). Attachment 1C further includes a descriptor term reading “Telecommunication \$v Periodicals” (see Attachment 1B, Library of Congress subject heading sh2008112739) in the 650 field. Thus, as of its cataloging, the publication corresponding to the MARC record attached hereto as Attachment 1C was indexed according to its subject matter by virtue of at least two classifications: the field 050 entry and the field 650 entry. As of March 26, 1992, the MARC record attached hereto as Attachment 1C was accessible through any library with access to the OCLC bibliographic database or the online catalog at a library that subscribed to the serial, which means that the corresponding publication was publicly available on or before that same date through any library with access to the OCLC bibliographic database or through an individual library.

56. WorldCat indicates that the journal titled *IEICE Transactions on Communications* as cataloged at the University of Colorado – Boulder Libraries is currently available from 543 libraries.¹⁴ In view of the above, this issue of the journal titled *IEICE Transactions on Communications* was publicly available on or shortly after September 29, 2003, because by that date it had been cataloged and

¹⁴ <https://search.worldcat.org/title/25533083>

indexed at the University of Colorado – Boulder Libraries, made part of the OCLC bibliographic database, and received at the Linda Hall Library of Science, Engineering & Technology. For these reasons, it is my opinion that Exhibit 1006 was published and accessible to the public on or shortly after September 29, 2003.

**B. SMIL 2.0: Interactive Multimedia for Web and Mobile Devices
by Dick C. W. Bulterman and Lloyd Rutledge [Exhibit 1007]**

57. I obtained Exhibit 1007 of the concurrently filed petition from counsel. Exhibit 1007 is a copy of excerpts from a book titled *SMIL 2.0: Interactive Multimedia for Web and Mobile Devices* by Dick C. W. Bulterman and Lloyd Rutledge (hereafter “Bulterman”) and issued by Springer with a 2004 copyright date. Exhibit 1007 is a true and correct copy of excerpts of Bulterman including the front cover, title page, copyright page, preface, table of contents, acknowledgements, introduction, sections 1, 3, 5, 7, and 16, index, and back cover as held by the Hillman Library at the University of Pittsburgh (Pittsburgh, Pennsylvania). I obtained a copy of the title page, copyright page, and table of contents from the Hillman Library at the University of Pittsburgh (see Attachment 2D). I also reviewed a complete electronic copy of Bulterman obtained from counsel, from which the excerpts in Exhibit 1007 are taken. Exhibit 1007 is a true and correct copy of excerpts of Bulterman. The text in the complete electronic copy I reviewed is complete; no pages are missing, and the text on each page appears to flow seamlessly from one page to the next; further, there are no visible

alterations to the document. The same is true of Exhibit 1007. An examination of Exhibit 1007 and Attachment 2D indicates that Exhibit 1007 represents excerpts of the same book. Therefore, Exhibit 1007 is a true and correct copy in a condition that creates no suspicion about its authenticity.

58. Attached hereto as Attachment 2A is a true and correct copy of the MARC record for this monograph from the Hillman Library at the University of Pittsburgh online catalog. The library ownership is indicated by the presence of the library's code ("PIT") in the 049 field. The most recent enhancement to the MARC record occurred on November 22, 2019, ("20191122") as shown in the field 005. I personally identified and retrieved the library catalog record which is Attachment 2A.

59. The International Standard Book Number (ISBN) on Exhibit 1007 (3-540-20234-X) matches the ISBN in field 020 of Attachment 2A. Therefore, Exhibit 1007 is the same book as the one that the cataloger at the Library of Congress used to create the MARC record that is Attachment 2A. Therefore, the book titled *SMIL 2.0: Interactive Multimedia for Web and Mobile Devices* (Exhibit 1007) was present and cataloged in the Hillman Library at the University of Pittsburgh after January 2, 2004. It would have been able to be located by a person of ordinary skill in the art using the library catalog system and was thus publicly accessible as of this date.

60. Attached hereto as Attachment 2B is a true and correct copy of the MARC record for the book titled *SMIL 2.0: Interactive Multimedia for Web and Mobile Devices* obtained from the OCLC bibliographic database. I personally identified and retrieved the MARC record that is Attachment 2B. As previously noted, the library that created the record is recorded in field 040 with a unique library code. For Attachment 2B, that library code is “DLC,” which means that the MARC record for this book was created at the Library of Congress as part of the Cataloging in Publication Program (CIP) Program.¹⁵ A cataloger prepares basic information about the forthcoming book which is included on the verso of the title page (also called the copyright page). The information is provided to save time needed for the cataloging process at the library after the book is purchased. The CIP data includes the author (field 100), title and subtitle (field 245), ISBN (field 020), suggested subject headings (field 650), classification numbers for the Library of Congress classification number (field 050), and the Dewey Decimal classification number (field 082). These data elements are included in the MARC record that the Library of Congress contributes to the OCLC bibliographic database.

61. As can be seen in field 008 (“Date entered on file”) in the MARC record for this exhibit, a cataloger at the Library of Congress created OCLC record

¹⁵ <https://www.loc.gov/publish/cip/>.

number 54007139 on January 2, 2004 (“040102”). The library continues to update and enhance this MARC record to meet current cataloging rules. The most recent enhancement to Attachment 2B occurred on November 5, 2024, as shown infield 005 (“20241105”). I personally identified and retrieved the MARC record that is Attachment 2B.

62. Attachment 2B further includes an entry in field 050 (“QA76.76.H94 \$b B858 2004”)—as described above, this includes a subject matter classification number consistent with the Library of Congress classification system (analogous to the Dewey Decimal classification system) and an entry in field 082 (“006.7/4”), a subject matter consistent with the Dewey Decimal classification system. Attachment 2B further includes a descriptor term reading “SMIL (Document markup language)” (see Attachment 2C, Library of Congress subject heading sh2001003034) in the 650 field. Thus, as of its cataloging, the publication corresponding to the MARC record attached hereto as Attachment 2B was indexed according to its subject matter by virtue of at least three independent classifications: the field 050 entry, the field 082 entry, and the field 650 entry. Further, as of January 2, 2004, the MARC record attached hereto as Attachment 2B was accessible through any library with access to the OCLC bibliographic database or the online catalog at a library that added this book to its collection, which means that the corresponding publication was publicly available on or

before that same date through any library with access to the OCLC bibliographic database or through an individual library.

63. The Association of Computing Machinery website indicates that the Bulterman book was published on May 1, 2004.¹⁶

64. WorldCat indicates that the Bulterman book titled *SMIL 2.0: Interactive Multimedia for Web and Mobile Devices* as cataloged at the Library of Congress is currently available from 84 libraries.¹⁷ In view of above, the Bulterman book titled *SMIL 2.0: Interactive Multimedia for Web and Mobile Devices* was publicly available on or shortly after May 1, 2004, because by that date it had been cataloged and indexed at the Library of Congress, made part of the OCLC bibliographic database, and received in the Hillman Library at the University of Pittsburgh. For these reasons, it is my opinion that Exhibit 1007 was published and accessible to the public on or shortly after May 1, 2004.

C. *Specifications for the Digital Talking Book: an American National Standard* developed by the National Information Standards Organization. [Exhibit 1003]

65. Exhibit 1003 to the concurrently filed petition is a true and accurate copy of the *Specifications for the Digital Talking Book: an American National Standard* developed by the National Information Standards Organization (hereafter

¹⁶ <https://dl.acm.org/doi/10.5555/983488>

¹⁷ <https://search.worldcat.org/title/54007139>

“ANSI/NISO Z39.86-2002”). I searched for this document on the Internet and downloaded it from the American National Institute of Standards (ANSI) webstore.¹⁸ Exhibit 1003 accurately reflects the contents of the above website link and has not been changed or altered in any way—the text of the ANSI document in Exhibit 1003 is complete; no pages are missing; and, further, there are no visible alterations to the document. I understand that the appearance, contents, substance, and distinctive characteristics of Exhibit 1003 create no suspicion about its authenticity. As such, it is my opinion that Exhibit 1003 is authentic.

66. I understand that prior to December 12, 2005, ANSI would have been known to persons at least of ordinary skill in the art as a non-profit organization that “administers and coordinates the U.S. voluntary standards and conformity assessment system” through close collaboration with industry and government stakeholders to identify and develop standards- and conformance-based solutions to national and global priorities.¹⁹ Furthermore, I understand that persons of ordinary skill in the art would have reasonably considered this organization and its website – <https://www.ansi.org/> – as reliable and useful sources of information for

¹⁸

<https://webstore.ansi.org/standards/niso/ansinisoZ39862002?srsltid=AfmBOorxj6JSQRXKS9Yta7LsFBEC07hKKqCVrfZGYh2oZITfTJwKQdWZ>

¹⁹ <https://www.ansi.org/about/introduction>

research, study, development, or design of standards. It is my opinion that the ANSI document is a reliable authority for research, study, development, or design of standards for digital talking books.

67. The Library of Congress issued a formal press release on March 19, 2002, to announce the adoption of the ANSI/NISO Z39.86-2002 document (see Attachment 3A). Following five years of national and global partner efforts, the standard was developed by the National Institute of Standards Organization (NISO) and adopted by ANSI on March 6, 2002 (see Exhibit 1003, page 1). Information in the Library of Congress press release included the NISO website from which the ANSI/NISO Z39.86-2002 document could be downloaded by clicking on the “pdf” or “html” tab. (see Attachment 3B). Based on information provided by web crawler protocols that capture snapshots of websites on the Internet, this web page was available on the Internet as least as of March 28, 2002, when the ANSI/NISO Z39.86-2002 document was posted at 7:08:48 p.m. (see Attachment 3B (archived URL timestamp of “20020328190848”)). The ANSI/NISO Z39.86-2002 document was added and remains a part of the official Library of Congress *Sustainability of Digital Formats: Planning for Library of Congress Collections* website in the “Format Description Category” for digital talking book (DTB) (see Attachment 3C).

68. Attached hereto as Attachment 3D is a true and correct copy of the MARC record for the ANSI/NISO Z39.86-2002 document obtained from the OCLC bibliographic database. I personally identified and retrieved the MARC record that is Attachment 3D. As previously noted, the library that created the record is recorded in field 040 with a unique library code. For Attachment 3D, that library code is “CPV,” which means that the MARC record for this document set was created at the City University of Hong Kong Library (Kowloon, Hong Kong). As can be seen in field 008 (“Date entered on file”) in the MARC record for this exhibit, a cataloger at the City University of Hong Kong Library created OCLC record number 50902883 on October 30, 2002 (“021030”). The library continues to update and enhance the MARC record to meet current cataloging rules. The most recent enhancement occurred on December 10, 2024, as shown in field 005 (“20241210”).

69. Attachment 3D further includes an entry in field 050 (“Z5347 \$b .N38 2002”)—as described above, a subject matter classification number consistent with the Library of Congress classification system (analogous to the Dewey Decimal classification system) and an entry in field 082 (“070.5/73”)—as described above, a subject matter classification number consistent with the Dewey Decimal classification system. Attachment 3D also shows that Exhibit 1003 was catalogued with two descriptor terms reading “Talking books \$x Standards” (see Attachment

3E, Library of Congress subject heading sh85132098 and Attachment 3F, Library of Congress subject heading sh85127314) and “Sound \$x Recording and reproducing \$x Digital techniques \$x Standards” (Attachment 3G, Library of Congress subject heading sh98007202) in the 650 fields. Thus, as of its cataloging, the publication corresponding to the MARC record attached hereto as Attachment 3D was indexed according to its subject matter by virtue of at least three independent classifications: the field 050 entry, the field 082 entry, and the field 650 entries. Further, as of October 30, 2002, the MARC record attached hereto as Attachment 3D was accessible through any library with access to the OCLC bibliographic database or the online catalog at a library that acquired the conference proceedings volume, which means that the corresponding publication was publicly available on or before that same date through any library with access to the OCLC bibliographic database or through an individual library.

70. WorldCat indicates that the ANSI/NISO Z39.86-2002 document as cataloged at the City University of Hong Kong Library is currently available from 32 libraries.²⁰ In view of the above, the ANSI/NISO Z39.86-2002 document was publicly available on or shortly after March 19, 2002, because by that date it had been added to the NISO website. For these reasons, it is my opinion that Exhibit 1003 was published and publicly accessible on or shortly after March 19, 2002.

²⁰ <https://search.worldcat.org/title/50902883>

D. “Design and Implementation of the just-in-time Retrieving Policy for Schedule-Based Distributed Multimedia Presentations” by Chun-Chuan Yang and Yi-Zheng Yang [Exhibit 1045]

71. Attached hereto as Attachment 6 is a copy of the journal article titled “Design and Implementation of the just-in-time Retrieving Policy for Schedule-Based Distributed Multimedia Presentations” by Chun-Chuan Yang and Yi-Zheng Yang (hereafter “Yang”). The Yang article was published in Volume 71, Issues 1-2 of *The Journal of Systems and Software* and was found in the Linda Hall Library of Science, Engineering & Technology (Kansas City, Missouri). The Yang article appears beginning on page 49 of this issue dated April 2004. Attachment 6 is a true and correct copy of the Yang article. Specifically, the text of the article is complete; no pages are missing, and the text on each page appears to flow seamlessly from one page to the next; further, there are no visible alterations to the document. Attachment 6 was found within the custody of a library – a place where an authentic copy of this journal would likely be. Attachment 6 is a true and correct copy in a condition that creates no suspicion about its authenticity. I have reviewed Exhibit 1045 of the concurrently filed petition and Attachment 6, and, based on this review, Exhibit 1045 is a true and correct copy of the Yang article.

72. The Yang article is also available from the publisher, Science Direct,²¹ and in the digital repository *ResearchGate*.²² The publisher's website indicates that the Yang article was published on February 20, 2004.

73. Attached hereto as Attachment 4A is a true and correct copy of the MARC record for the journal titled *The Journal of Systems and Software* in the Linda Hall Library of Science, Engineering & Technology online catalog. The library ownership is indicated by the presence of the library's code ("LHL") in field 049. The library continues to update this MARC record and enhanced the MARC record to meet current cataloging rules. The most recent enhancement to Attachment 4A occurred on September 6, 2023, as shown in field 005 ("20230906"). I personally identified and retrieved the MARC record that is Attachment 4A.

74. Based on finding a print copy of the Yang article in the Linda Hall Library of Science, Engineering & Technology and MARC record in its online library catalog attached as Attachment 4A, it is my opinion that the Yang article published in *The Journal of Systems and Software* was publicly available on or

²¹ <https://www.sciencedirect.com/science/article/abs/pii/S0164121202001395>

²²

https://www.researchgate.net/publication/222575679_Design_and_implementation_of_the_just-in-time_retrieving_policy_for_schedule-based_distributed_multimedia_presentations

shortly after February 20, 2004, as indicated on the publisher's website. Attachment 4A also shows that Exhibit 1045 was catalogued with two descriptor terms reading "Electronic digital computers \$v Periodicals" (see Attachment 4B, Library of Congress subject heading sh2008119307) and "Computer programming \$v Periodicals" (see Attachment 4C, Library of Congress subject heading sh2008101498) in the 650 fields.

75. As noted in the holdings information (362 field), the Linda Hall Library of Science, Engineering & Technology received copies of *The Journal of Systems and Software* from the Nortel Networks Library and the Engineering Societies Library (see fields 590) and has subscribed to the publication since volume 1 published in 1979 (see fields 310 and 321). In view of the MARC record for Exhibit 1045, the Yang article was publicly available on or shortly after February 20, 2004, because the serial title had been received, cataloged, and indexed at the Linda Hall Library of Science, Engineering & Technology and made part of its online catalog database.

76. Attached hereto as Attachment 4D is a true and correct copy of the MARC record for *The Journal of Systems and Software* obtained from the OCLC bibliographic database. As previously noted, the library that created the record is recorded in field 040 with a unique library code. For Attachment 4D, that library code is "NSD," which means that the MARC record for this serial was cataloged as

part of the National Serials Data Program at the Library of Congress. As can be seen in field in the MARC record for this exhibit, a cataloger at the Library of Congress created OCLC record number 4583109 on January 25, 1979 (“790125”), as shown in field 008 (Date entered on file”). The library continues to update and enhance the MARC record to meet current cataloging rules. The most recent enhancement to Attachment 4D occurred on October 23, 2023, as shown in field 005 (“20231023”). I personally identified and retrieved the MARC record that is Attachment 4D. The “Bibliographic Level” entry in Attachment 4D is “s,” which indicates that *The Journal of Systems and Software* is a serial publication. Field 310 of Attachment 4D reads “Eight no. a year, \$b <Jan. 1989->.” Accordingly, the MARC record for Exhibit 1045 corresponds to *The Journal of Systems and Software* from the time the serial title began publication and includes the date of the Yang article.

77. Attachment 4D includes an entry in field 050 (“QA76.5 \$b .J74”)—as described above, a subject matter classification number consistent with the Library of Congress classification system (analogous to the Dewey Decimal classification system) and an entry in field 082 (“001.64/05”)—as described above, a subject matter classification number consistent with the Dewey Decimal classification system. Attachment 4D further includes three descriptor terms reading “Electronic digital computers \$v Periodicals” (see Attachment 4B, Library of Congress subject

heading sh2008119307), “Computers \$v Periodicals” (see Attachment 4E, Library of Congress subject heading sh2008101482), and “Computer programming \$v Periodicals” (see Attachment 4C, Library of Congress subject heading sh2008101498) in the 650 fields. Thus, as of its cataloging, the publication corresponding to the MARC record attached hereto as Attachment 4D was indexed according to its subject matter by virtue of at least three classifications: the field 050 entry, the field 082 entry, and the field 650 entries. As of January 25 1979, the MARC record attached hereto as Attachment 4D was accessible through any library with access to the OCLC bibliographic database or the online catalog at a library that subscribed to the serial, which means that the corresponding publication was publicly available on or before that same date through any library with access to the OCLC bibliographic database or through an individual library.

78. WorldCat indicates that *The Journal of Systems and Software* as cataloged at the Library of Congress is currently available from 861 libraries.²³ In view of the above, this issue of *The Journal of Systems and Software* was publicly available on or shortly after February 20, 2004, because by that date it had been cataloged and indexed at the Library of Congress, made part of the OCLC bibliographic database, and received at the Linda Hall Library of Science,

²³ <https://search.worldcat.org/title/4583109>

Engineering & Technology. For these reasons, it is my opinion that Exhibit 1045 was published and accessible to the public on or shortly after February 20, 2004.

VI. SUMMARY OF OPINIONS

79. In view of the foregoing, it is my opinion that the publications described above were publicly available no later than the corresponding date listed in the table below:

Exhibit	Publication	Publicly Available On or After
1006	Yoshimura, Takeshi, Yoshifumi Yonemoto, Tomoyuki Ohya, Minoru Etoh, and Susie Wee. "Content Delivery Network Architecture for Mobile Streaming Service Enabled by SMIL Modification." <i>IEICE Transactions on Communications</i> , vol. E86-B, no. 6 (June 2003): 1778-1787.	September 29, 2003
1007	Bulterman, Dick C. W., and Lloyd Rutledge. <i>SMIL 2.0: Interactive Multimedia for Web and Mobile Devices</i> . Berlin, Germany: Springer, 2004.	May 1, 2004
1003	National Information Standards Organization. <i>Specifications for the Digital Talking Book, ANSI/NISO Z39.86-2002</i> . In National information standards series. New York: NISO Press, 2002.	March 19, 2002
1045	Yang, Chun-Chuan, and Yi-Zheng Yang. "Design and Implementation of the just-in-time Retrieving Policy for Schedule-Based Distributed Multimedia Presentations." <i>The Journal of Systems and Software</i> , vol. 71, issues 1-2 (April 2004): 49-63.	February 20, 2004

In signing this Declaration, I recognize that the Declaration will be filed as evidence in a case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Date: May 9, 2025


Sylvia D. Hall-Ellis, Ph.D.

ATTACHMENT 1A

leader 02162cas a22004695a 4500
 001 992751873405961
 005 20191029185710.0
 008 920326c19919999ja mr p 0 a0eng d
 010 ##\$a 92643444 \$zsn 92019276
 012 ##\$a2 \$i9205
 022 ##\$a0916-8516
 030 ##\$aITRCEC \$zITCMEZ
 035 ##\$a(OCOLC)25533083
 035 ##\$9381148
 035 ##\$a(MoKL)275187-lhalldb
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 040 ##\$aCOD \$cCOD \$dNST \$dWAU \$dDLC \$dNST \$dEYM \$dCAS \$dWAU \$dMYG \$dDLC
 \$dCAS
 042 ##\$alc
 049 ##\$aLHLA
 050 00\$aIN PROCESS
 050 14\$aTK5101.A1 \$bl37
 245 00\$aEICE transactions on communications.
 246 10\$aEICE transactions
 246 10\$aInstitute of Electronics, Information and Communication Engineers transactions on
 communications
 246 10\$aTransactions on communications
 260 ##\$aTokyo, Japan : \$bInstitute of Electronics, Information and Communication Engineers,
 \$cc1992-
 300 ##\$av. : \$bill. ; \$c29 cm.
 310 ##\$aMonthly
 362 0#\$aVol. E74, no. 1 (Jan. 1991)-
 500 ##\$a2001 includes Proceedings of the 7th Asia-Pacific Conference on Communications on
 CD-ROM: 472.
 515 ##\$aBeginning 1992, vols. called v. E75B-
 580 ##\$alssues for Jan. 1991-Mar. 1992 also issued as a separately numbered section of Denshi
 Jōhō Tsūshin Gakkai ronbunshi. B-I, Tsūshin I, and Denshi Jōhō Tsūshin Gakkai ronbunshi. B-II,
 Tsūshin II.
 650 #0\$aTelecommunication \$vPeriodicals
 710 2#\$aDenshi Jōhō Tsūshin Gakkai (Japan)
 777 1#\$tDenshi Jōhō Tsūshin Gakkai ronbunshi. B-I, Tsūshin I \$x0915-1877 \$w(DLC) 92648301
 \$w(OCOLC)21258646
 777 1#\$tDenshi Jōhō Tsūshin Gakkai ronbunshi. B-II, Tsūshin II \$x0915-1885 \$w(DLC) 92648302
 \$w(OCOLC)21258732
 780 01\$tIEICE transactions on communications, electronics, information, and systems \$x0917-
 1673 \$w(OCOLC)23290152 \$w(DLC) 91641214
 850 ##\$aCSt \$aCU-A \$aCoU \$aDLC \$aCarbS \$aInLP \$aMCM \$aMiEM \$aMiU \$aNIC \$aNRU
 \$aNcD \$aPU \$aRPB-S \$aTxHR \$aWaU
 890 ##\$aEICE transactions on communications.
 901 ##\$cSer
 936 ##\$aVol. E75-B, no. 3 (Mar. 1992) LIC
 945 ##\$aI.E.I.C.E. transactions on communications.

948 ##\$aLTI 09/01/2008
948 ##\$aLTI 04/27/2010

ATTACHMENT 1B

[The Library of Congress](#)>> [Go to Library of Congress Online Catalog](#)

LIBRARY OF CONGRESS AUTHORITIES

[Help](#)[New Search](#)[Search History](#)[Headings List](#)[Start Over](#)< [Previous](#)[Next](#) >[MARC Display](#)[Labelled Display](#)

LC control no.: sh2008112739

LCCN Permalink: <https://lcn.loc.gov/sh2008112739>

HEADING: Telecommunication Periodicals

000 00528cz a2200169n 450

001 7470976

005 20110729160851.0

008 080311|| anannbabn |n ana

010 __ |a sh2008112739

035 __ |a (DLC)389242

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040 __ |a DLC |b eng |c DLC

150 __ |a Telecommunication |v Periodicals

667 __ |a Record generated for validation purposes.

670 __ |a Work cat.: Denshi Jōhō Tsūshin Gakkai ... Jōhō Shisutemu Sosaiei Taikai kōen ronbunshū =,

906 __ |t 8888 |u te00 |v 0

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< [Previous](#)[Next](#) >**Save, Print or Email Records (View [Help](#))**Select Download Format:

Email Text (Labelled Display) to:

[Help](#) - [Search](#) - [Search History](#) - [Headings List](#) - [Start Over](#)**Library of Congress**URL: <https://www.loc.gov/>

Mailing Address:

101 Independence Ave,
S.E.
Washington, DC 20540**Library of Congress Authorities**URL: <http://authorities.loc.gov/>**Library of Congress Online Catalog**URL: <https://catalog.loc.gov/>Questions, comments, error reports: [Contact Us](#)

ATTACHMENT 1C

Bibliographic Record - OCLC Number: 25533083

LDR	Record Status	'c' - Corrected or revised
	Type of Record	'a' - Language material
	Bibliographic Level	's' - Serial
	Type of Control	' ' - No specified type of control
	Encoding Level	' ' - Full level
	Descriptive Cataloging Form	'a' - AACR2
001	25533083	
005	20220810200524.5	
008	Date Entered on File	'920326'
	Type of Date/Publication Status	'd' - Continuing resource ceased publication
	Date1/Beginning Date of Publication	'1991'
	Date2/Ending Date of Publication	'2014'
	Place of Publication, Production, or Execution Code	'ja ' - Japan
	Frequency	'm' - Monthly
	Regularity	'r' - Regular
	Type of Continuing Resource	'p' - Periodical
	Form of Original Item	' ' - None of the following
	Form of Item	' ' - None of the following
	Nature of Entire Work	' ' - No specified nature of entire work
	Nature of Contents	' '
	Government Publication	' ' - Not a government publication
	Conference Publication	'0' - Not a conference publication
	Original Alphabet or Script of Title	'a' - Basic Roman
	Entry Convention	'0' - Successive entry
	Language Code	'eng' - English
	Modified Record	' ' - Record is not modified
	Cataloging Source Code	'c' - Cooperative cataloging program
010	92643444 \$z sn 92019276	
040	COD \$b eng \$c COD \$d NST \$d WAU \$d DLC \$d NST \$d EYM \$d CAS \$d WAU \$d MYG \$d DLC \$d CAS \$d CUS \$d WAU \$d DLC \$d MYG \$d HNK \$d CIT \$d EEM \$d MYG \$d OCLCQ \$d UKMGB \$d OCLCQ \$d ORZ \$d OCLCQ \$d OCLCF \$d COD \$d OCLCO \$d DLC \$d PUL	
012	2 \$i 9205	
016	7 009845118 \$2 Uk	
019	255589695 \$a 1062036161	
022	0 0916-8516 \$l 0916-8516 \$2 9	
030	ITRCEC \$z ITCMEZ	
042	pcc	
050	0 0 TK5101.A1 \$b I329	
210	1 IEICE trans. commun.	
222	0 IEICE transactions on communications	
245	0 0 IEICE transactions on communications.	
246	3 Institute of Electronics, Information and Communication Engineers transactions on communications	

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 246 3 0 Transactions on communications
 246 1 7 IEICE trans. commun. \$f <1993->
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ATTACHMENT 3A

LIBRARY

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MARCH 19, 2002

National Standard Developed for the Digital Talking Book

Press Contact: Audrey Fischer (202) 707-0022**Public Contact:** Robert Fistick (202) 707-9279

A national standard for the Digital Talking Book (DTB) has recently been adopted by the National Information Standards Organization (NISO).

The five-year effort to develop the NISO DTB standard (ANSI/NISO Z39.86-2002) was coordinated by the National Library Service for the Blind and Physically Handicapped (NLS) in the Library of Congress in partnership with an international committee. The NISO DTB standard will make electronic resources presented in DTB format more accessible to print-disabled readers worldwide.

"This single standard addresses the requirements of a range of agencies serving users with a wide variety of reading needs, said NLS Director Frank Kurt Cylke. "It is truly a universal standard that will benefit the blind community for generations to come."

A Digital Talking Book is a collection of electronic files arranged to present information to the blind and physically handicapped reader through alternative media. The most common medium will be human speech. However, a DTB produced in accordance with the new standard can include a file containing the contents of the document in text form, thereby permitting output through synthetic speech, refreshable braille display devices, or visual display in large print.

The NISO DTB standard was built on existing standards and specifications to make use of programming skills and software tools that were originally developed for other purposes. The standard was also based on specifications formulated by blind and visually impaired users who were included in the development effort. Partner agencies include 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.

NISO is the only U.S. group accredited by the American National Standards Institute (ANSI) to develop and

promote voluntary technical standards for use in information delivery services for libraries, publishers, and related information technology organizations. NISO standards are developed by consensus under the guidance of experts and practitioners in the field to meet the needs of both the information user and the producer. For its work on the DTB standard, NISO was one of the recipients of the 2001 Collaboration and Coordination Award presented by the International Coalition of Access Engineers and Specialists. For information about NISO's current activities or to download NISO standards, including the NISO DTB standard, visit the NISO Web site at www.niso.org.

For more than 70 years, NLS has been a leader in providing library services to blind and physically handicapped individuals. Each year it distributes 23 million books and magazines to a readership of more than 759,000 individuals through a network of 141 regional and subregional libraries. For more information about NLS, visit its Web site at www.loc.gov/nls.

###

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ATTACHMENT 3B

The Wayback Machine - <https://web.archive.org/web/20020328190848/http://www.niso.org:80/>

National Information Standards Organization

Standards: Putting Innovation to Work

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What's a Standard?

A NISO standard developed through consensus, identifies model methods, materials, or practices for libraries, bibliographic and information services, and publishers.

Keeping up with NISO

NISO Calendar

- [Digital Talking Book Standard Now Available](#)
The national standard for the Digital Talking Book (ANSI/NISO Z39.86-2002) is approved and published. It's available for free download in [PDF](#) and [HTML](#).
- [E-metrics on NISO Fast Track](#)
NISO Statistics standards committee chaired by Denise Davis will release an e-metrics data dictionary in a web-accessible database in May.
- [Linking News](#)
A recent NISO/NFAIS Workshop "Your Content and Mine" provided a wealth of practical information on integrating content from multiple providers. The workshop revealed good news: research shows that the average linking scenario saves the user 42 separate steps, saving time and money.
- [Ongoing NISO Initiatives](#)
Workshops, programs, other activities.

NISO Standards

NISO Press

NISO is the only standards organization that makes its [standards available freely on the web](#). Link here to NISO's top sellers.

[ANSI/NISO Z39.50 - 1995](#)

Information Retrieval : Application Service
Definition & Protocol Specification

[ANSI/NISO Z39.84 - 2000](#)

Syntax for the Digital Object Identifier

[Voting Members Login >](#)
[Alliance Members Login >](#)
[Board Login >](#)

[ANSI/NISO Z39.79 - 2001](#)

Environmental Conditions for Exhibiting Library and Archival Materials

[ANSI/NISO Z39.86 - 2002](#)

Specifications for the Digital Talking Book

NISO Calendar
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ATTACHMENT 3C

[Sustainability of Digital Formats:](#) [Planning for Library of Congress](#) [Collections](#)

[Introduction](#) | [Sustainability Factors](#) | [Content Categories](#) | [Format Descriptions](#) | [Contact](#)
[Format Description Categories](#) >> [Browse Alphabetical List](#)

DTB (Digital Talking Book), 2002

[>> Back](#)

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- [Identification and description](#)
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- [Sustainability factors](#)
- [Quality and functionality factors](#)
- [File type signifiers](#)
- [Notes](#)
- [Format specifications](#)
- [Useful references](#)

Format Description Properties

- ID: fdd000053
- Short name: DTB_2002
- Content categories: text, sound
- Format Category: encoding, file-format
- Other facets: container-bundle, text, structured, symbolic
- Last significant FDD update: 2022-04-13
- Draft status: Full

Identification and description

Full name	Digital Talking Book. ANSI/NISO Z39.86-2002
Description	The NISO Digital Talking Book Standard, ANSI/NISO Z39.86-2002, defines the format and content of the electronic file set that comprises a digital talking book (DTB) and establishes a limited set of requirements for DTB playback devices. It uses established and new specifications to delineate the structure of DTBs whose content can range from XML text only, to text with corresponding spoken audio, to audio with little or no text. DTBs are designed to make print material accessible and navigable for

	blind or otherwise print-disabled persons. The standard comprises a set of files, including a mandatory package file, which incorporates a <i>manifest</i> listing all the other component files and a <i>spine</i>, which indicates logical reading order. Component files can be of several types, including: textual content (in XML); audio files; image files; synchronization files (in SMIL); navigation control files (in XML); bookmark/highlight files (in XML).
Production phase	This bundle of files is likely to be used primarily as a middle-state format, with dissemination to end-users managed through publishers or aggregators who provide in a form appropriate for viewers/players that enforce limitations on access and use consistent with terms imposed by copyright holders.
Relationship to other formats	
Contains	OEBPS_1_0 , OEBPS, Open Ebook Forum Publication Structure 1.0.1
Defined via	XML_DTD , XML Document Type Definition (DTD)
May contain	WAVE_LPCM , WAVE Audio File with LPCM Audio
May contain	MP3_ENC , MP3 Audio Encoding
May contain	AAC_MP4 , Advanced Audio Coding (MPEG-4)
Has modified version	DTB_2002_NLS , Digital Talking Book, NLS extension for AMR-WB+ Speech Codec. NLS is the National Library Service for the Blind and Print Disabled (NLS) , a part of the Library of Congress. The NLS variant of DTB_2002 permits a restricted set of features and uses an audio codec that is not allowed for in the base standard.
Has later version	DTB_2005 , DTB (Digital Talking Book), 2005

Local use

LC experience or existing holdings	The National Library Service for the Blind and Print Disabled (NLS) , which is part of LC, has been actively involved in the development of this standard. The unit employs an extended version, DTB_2002_NLS .
LC preference	Suggested format for digital talking books. A DTB_2002 or DTB_2002_NLS incorporating the full text of a work is among the useful XML-based formats for textual works, assuming no encryption or DRM is applied.

Sustainability factors

Disclosure	Open standard
Documentation	ANSI/NISO Z39.86-2002. Specifications for the Digital Talking Book . ISSN: 1041-5653

Adoption	The National Library Service for the Blind and Physically Handicapped (NLS) is using DTB 2002 NLS, the extended version of the standard for the production of NLS talking books. As of April 2009, none of the NLS talking books include full text and there are no plans to produce books with full text. Bookshare.Org, which provides full-text books to print-handicapped users, makes the full text (without audio) of books available in several formats, including the NISO DTB standard (aka DAISY 3). A forty-member panel representing educators, publishers, technology specialists, and advocacy groups, sponsored by Office of Special Education Programs at the U. S. Department of Education recommended, in a report released in July 2004, that a specific application (or profile) of the NISO DTB standard be adopted as version 1 of the National Instructional Materials Accessibility Standard (NIMAS). The National Center on Accessible Instructional Materials provides a list of hardware and software supporting DTB and DAISY specifications.
Licensing and patents	None
Transparency	See information on the encoding formats employed for the files that comprise a DTB file set: XML , LPCM , MP3 , AAC_MP4 . XML and LPCM both rate highly for transparency.
Self-documentation	The Package file can include Dublin Core metadata and an extended set of elements intended to record information about rights and the provenance and generation of the talking book from a source text.
External dependencies	None. The format is designed to support effective use of special hardware and software players for the visually impaired, but does not require them.
Technical protection considerations	None in relation to the sets of files that comply with the ANSI/NISO Z39.86-2002 specification. Digital Talking Books are likely to be distributed to end users via mechanisms that do impose technical protections. Hence it is probable that LC will need to receive such files direct from publisher or aggregator by a special transmittal process rather than by harvesting as if an end user.

Quality and functionality factors

Sound	
Normal rendering	Good support.
Fidelity (high audio resolution)	Not intended for audio quality beyond CD quality. DTB players must support sample rates of 44.1, 22.05, and 11.025 kHz at a depth of 16 bits per sample. Compressed audio must be encoded such that the output sampling rate is restricted to one of the above three rates and uses a constant bit rate.

Multiple channels	DTB Players are not required to support multiple channels, but must recognize stereo and render at least as monaural.
Support for user-defined sounds, samples, and patches	Not investigated at this time.
Functionality beyond normal rendering	Synchronization with text transcription.
Text	
Normal rendering	Good support.
Integrity of document structure	The logical structure of a document is an important part of a DTB with textual content. See DAISY Structure Guidelines .
Integrity of layout and display	This standard focuses on the textual content, the logical structure, and the synchronization of text with audio of the text being read. Layout is not of primary significance in rendering for the visually impaired.
Support for mathematics, formulae, etc.	Not supported
Functionality beyond normal rendering	Supports embedding of audio, images, and synchronization of text with audio of the text being read.

File type signifiers and format identifiers

Tag	Value	Note
Filename extension	opf	For the required Package file. Documented in NISO standard.
Filename extension	xml	For textual content files. Documented in NISO standard.
Filename extension	ncx	For navigation control files. Documented in NISO standard.
Filename extension	aac	For AAC_MP4 audio files. Documented in NISO standard.
Filename extension	mp3	For MP3 audio files. Documented in NISO standard.
Filename extension	wav	For WAVE_LPCM audio files. Documented in NISO standard.
Pronom PUID	See note.	PRONOM has no corresponding entry as of April 2022.
Wikidata Title ID	Q1151676	See https://www.wikidata.org/wiki/Q1151676 .

Notes

General	The standard supports any of the following classes of digital talking
----------------	---

	book: • Audio with Title element only: DTB without structure. This is the simplest class of DTB and is used for books where structure will not be applied. The XML textual content file may not be present, or if it is, contains only the title of the book, and other required notation. The book must be read linearly. Direct access to points within the DTB is not possible. • Audio with NCX only (Navigation Control): DTB with structure. The XML textual content file, if present, contains only the structure of the book and may contain links to features such as narrated footnotes, etc. This is the most common form of DTB and is ideal for stand-alone players. • Audio with NCX and partial text: DTB with structure and some additional text. The XML textual content file contains only the structure of the book and the text of components where keyword searching and direct access to the text would be beneficial, e.g., index, glossary, etc. • Audio and full text: DTB with structure and complete text and audio. This form of a DTB is the most complex but provides the greatest level of access. The XML textual content file contains the structure and the full text of the book. The audio and the text are synchronized. • Full text and some audio: DTB with structure, complete text and limited audio. The XML textual content file contains the structure and the text of the book. The audio files contain recordings of parts of the text. This type of DTB could be used for a dictionary where only pronunciations were provided in audio form. • Text and no audio: E-text with structure. The XML textual content file contains the structure and text of the book. There are no audio files.
History	This format is also known as DAISY 3, being the third in a sequence of talking book formats. From the point of view of long-term sustainability, the earlier DAISY formats are less likely to be appropriate for LC collections. The previous version was Daisy 2.02, which was based on XHTML rather than XML. Link available via Internet Archive.

Format specifications

- [ANSI/NISO Z39.86-2002. Specifications for the Digital Talking Book](https://web.archive.org/web/20110805190514/http://www.niso.org/workrooms/daisy/Z39-86-2002.html) (https://web.archive.org/web/20110805190514/http://www.niso.org/workrooms/daisy/Z39-86-2002.html). From NISO as HTML. Available via Internet Archive capture from August 5, 2011.
- [Specifications for the Digital Talking Book \(ANSI/NISO Z39.86-2002\), Use and Maintenance](https://web.archive.org/web/20070726014154/http://www.loc.gov/nls/niso/dtd.htm) (https://web.archive.org/web/20070726014154/http://www.loc.gov/nls/niso/dtd.htm). Versions of the specifications presented by the National Library Service for the Blind and Physically Handicapped (NLS). Available

via Internet Archive capture from July 26, 2007.

- [Digital Talking Book Expanded Document Type Definition Documentation for Version V1.1.0](https://web.archive.org/web/20080327052703/https://www.loc.gov/nls/z3986/v100/dtbook110doc.htm) (https://web.archive.org/web/20080327052703/https://www.loc.gov/nls/z3986/v100/dtbook110doc.htm). HTML version of DTD for textual component of DTB. Available via Internet Archive.
- ANSI/NISO Z39.86 - 2002 Specifications for the Digital Talking Book. ISBN: 1-880124-54-8

Useful references

URLs

- [Daisy Consortium, maintenance agency for NISO Z39.86](https://daisy.org/activities/standards/daisy/) (https://daisy.org/activities/standards/daisy/).
- [Working Papers on the Digital Talking Book Standard from the National Information Standards Organization \(NISO\)](https://web.archive.org/web/20070630053202/www.loc.gov/nls/z3986/) (https://web.archive.org/web/20070630053202/www.loc.gov/nls/z3986/). Available via Internet Archive capture from June 30, 2007.
- [Supporting Documentation for ANSI/NISO Z39.86, Specifications for the Digital Talking Book](https://web.archive.org/web/20051128065641/www.loc.gov/nls/z3986/) (https://web.archive.org/web/20051128065641/www.loc.gov/nls/z3986/). A previous version of the above web page, from before the standard's approval by NISO. Includes a link to "Advisory Committee Activities." Available via Internet Archive capture from November 28, 2005.
- [Theory Behind the DTBook DTD](https://daisy.org/info-help/document-archive/archived-publications/theory-behind-the-dtbook-dtd/) (https://daisy.org/info-help/document-archive/archived-publications/theory-behind-the-dtbook-dtd/).
- [DAISY Structure Guidelines](https://web.archive.org/web/20130220060453/http://www.daisy.org/structure-guidelines/) (https://web.archive.org/web/20130220060453/http://www.daisy.org/structure-guidelines). Available via Internet Archive capture from February 20, 2013.
- [National Instructional Materials Accessibility Standard Report -- Version 1](https://web.archive.org/web/20210122123954/https://aem.cast.org/about/publications/2004/ncac-nimas-report-national-file-format.html). (https://web.archive.org/web/20210122123954/https://aem.cast.org/about/publications/2004/ncac-nimas-report-national-file-format.html). 2004. Available via Internet Archive.
- [Technologies for AIM \(Accessible Instructional Materials\) and NIMAS \(National Instructional Materials Accessibility Standard\)](https://aem.cast.org/nimas-nimac/nimas-nimac) (https://aem.cast.org/nimas-nimac/nimas-nimac).
- [Wikidata entry for Q1151676](https://www.wikidata.org/wiki/Q1151676) (https://www.wikidata.org/wiki/Q1151676). Information in Wikidata about DAISY Digital Talking Book. Wikidata Title ID: Q1151676.

Last Updated: 09/01/2023

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ATTACHMENT 3D

Bibliographic Record - OCLC Number: 50902883

LDR Record Status 'c' - Corrected or revised
 Type of Record 'a' - Language material
 Bibliographic Level 'm' - Monograph/Item
 Type of Control ' ' - No specified type of control
 Encoding Level ' ' - Full level
 Descriptive Cataloging Form 'a' - AACR2

001 50902883
 005 20241210044822.4
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 Type of Date/Publication Status 's' - Single date
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 Date2/Ending Date of Publication ' '
 Place of Publication, Production, or Execution Code 'mdu' - Maryland
 Illustrations ' '
 Target Audience ' ' - Unknown or unspecified
 Form of Item ' ' - None of the following
 Nature of Contents Code 'b' '
 Government Publication ' ' - Not a government publication
 Conference Publication '0' - Not a conference publication
 Festschrift '0' - Not a festschrift
 Index '0' - No index
 Literary Form '0' - Not fiction
 Biography ' ' - No biographical material
 Language Code 'eng' - English
 Modified Record ' ' - Record is not modified
 Cataloging Source Code 'd' - Other

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 050 4 Z5347 \$b .N38 2002
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 110 2 National Information Standards Organization (U.S.) \$1 <https://id.oclc.org/worldcat/entity/E39QQPVp7K3wqBRjCQXdtk4hTR>
 245 1 0 Specifications for the digital talking book : \$b an American national standard / \$c developed by the National Information Standards Organization.
 260 Bethesda, Md. : \$b NISO Press, \$c ©2002.
 300 xii, 124 pages ; \$c 28 cm
 336 text \$b txt \$2 rdacontent
 337 unmediated \$b n \$2 rdamedia
 338 volume \$b nc \$2 rdacarrier
 490 1 National information standards series, \$x 1041-5653
 500 "ANSI/NISO Z39.86-2002."

500 "Approved March 6, 2002 by the American National Standards Institute."
 504 Includes bibliographical references.
 520 3 This standard defines the format and content of the electronic file set that comprises a digital talking book (DTB) and establishes a limited set of requirements for DTB playback devices. It uses established and new specifications to delineate the structure of DTBs whose content can range from XML text only, to text with corresponding spoken audio, to audio with little or no text. DTBs are designed to make print material accessible and navigable for blind or otherwise print disabled persons.
 650 0 Talking books \$x Standards.
 650 0 Sound \$x Recording and reproducing \$x Digital techniques \$x Standards.
 650 6 Livres audio pour personnes ayant une déficience visuelle \$x Normes.
 650 6 Son \$x Enregistrement et reproduction \$x Techniques numériques \$x Normes.
 650 7 Sound \$x Recording and reproducing \$x Digital techniques \$x Standards \$2 fast
 710 2 American National Standards Institute. \$1 <https://id.oclc.org/worldcat/entity/E39QH7Jmqt47xhFPYMKrtCpX9t>
 776 0 8 \$i Online version: \$a National Information Standards Organization (U.S.). \$t Specifications for the digital talking book. \$d Bethesda, Md. : NISO Press, ©2002 \$w (OCoLC)605466677
 776 0 8 \$i Online version: \$a National Information Standards Organization (U.S.). \$t Specifications for the digital talking book. \$d Bethesda, Md. : NISO Press, ©2002 \$w (OCoLC)606282751
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035 __ |a (DLC)275347

035 __ |a (DLC)7752166

035 __ |a (DLC)sp 85132098

035 __ |a (DLC)414101

040 __ |a DLC |c DLC |d DLC

053 _0 |a Z5347

150 __ |a Talking books

550 __ |w g |a Audiobooks

550 __ |w g |a Blind |x Books and reading

680 __ |i Here are entered works on spoken texts recorded specifically for use by the blind or people with visual disabilities.

906 __ |t 0905 |u tc09 |v 0

910 __ |a Record saved by td14 on 12/01/2015 at 16:19:16

953 __ |a xx00 |b td14

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035 __ |a (DLC)122890

040 __ |a DLC |c DLC |d DLC

150 __ |a Standards

260 __ |i subdivision |a Standards |i under topical headings for descriptions of the example or model set up and established by authority as the measure of quantity, quality, value, extent, weight, etc., to be followed, e.g. |a Automobiles--Standards; Corn--Standards

906 __ |t 8738 |u fk07 |v 0

953 __ |a xx00 |b fj25

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906 __ |t 9845 |u te04 |v 0

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953 __ |a te04

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 246 13\$aJSS
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 300 ##\$av. \$bill. \$c29 cm.
 310 ##\$aEight no. a year, \$b<Jan. 1989->
 321 ##\$aQuarterly, \$b1979-
 362 0#\$av. 1-
 510 1#\$aABI/INFORM, \$bWinter 1979-
 510 1#\$aComputer & control abstracts, \$x0036-8113 \$b1979-
 510 1#\$aElectrical & electronics abstracts, \$x0036-8105 \$b1979-
 510 1#\$aPhysics abstracts. Science abstracts. Series A, \$x0036-8091 \$b1979-
 510 2#\$aEngineering index annual (1968), \$x0360-8557
 510 2#\$aEngineering index bioengineering abstracts, \$x0736-6213
 510 2#\$aEngineering index energy abstracts, \$x0093-8408
 510 2#\$aEngineering index monthly (1984), \$x0742-1974
 510 2#\$aInternational aerospace abstracts, \$x0020-5842
 510 2#\$aMathematical reviews, \$x0025-5629
 590 31\$aSelected volumes/issues donated by Nortel Networks, April 1999.
 590 11\$aTransferred from the Engineering Societies Library, January 1995.
 650 #0\$aElectronic digital computers \$vPeriodicals
 650 #0\$aComputer programming \$vPeriodicals
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901 ##\$cSer
936 ##\$aJan. 1989
945 ##\$aJournal of systems and software. \$bJournal of systems and software.
948 ##\$aLTI 09/01/2008
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948 ##\$aLTI 04/27/2010

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667 __ |a Record generated for validation purposes.

670 __ |a Work cat.: Wirtschaftsinformatik, c1990-

906 __ |t 8888 |u te00 |v 0

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	Descriptive Cataloging Form	' ' - Non-ISBD
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	Date2/Ending Date of Publication	'9999'
	Place of Publication, Production, or Execution Code	'nyu' - New York
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	Regularity	'x' - Completely irregular
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	Nature of Entire Work	' ' - No specified nature of entire work
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	Government Publication	' ' - Not a government publication
	Conference Publication	'0' - Not a conference publication
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 210 0 J. syst. softw.
 222 4 The Journal of systems and software
 245 0 4 The Journal of systems and software.
 246 1 3 JSS
 260 [New York] **\$b** [Elsevier North Holland] **\$c** 1979-
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 310 Eight no. a year, **\$b** <Jan. 1989->
 321 Quarterly, **\$b** 1979-
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on Communications



Special Issue on Content Delivery Networks

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Content Delivery Network Architecture for Mobile Streaming Service Enabled by SMIL Modification

Takeshi YOSHIMURA^{†a)}, Regular Member, Yoshifumi YONEMOTO[†], Nonmember, Tomoyuki OHYA[†], Minoru ETOH[†], Regular Members, and Susie WEE^{††}, Nonmember

SUMMARY In this paper, we present a CDN (Content Delivery Network) architecture for mobile streaming service in which content segmentation, request routing, pre-fetch scheduling, and session handoff are controlled by SMIL (Synchronized Multimedia Integration Language) modification. In this architecture, mobile clients simply follow modified SMIL files downloaded from a portal server; these modifications enable multimedia content to be delivered to the mobile clients from the *best* surrogates in the CDN. The key components of this architecture are 1) content segmentation with SMIL modification, 2) on-demand rewriting of URLs in SMIL, 3) pre-fetch scheduling based on timing information derived from SMIL, and 4) SMIL updates by SOAP (Simple Object Access Protocol) messaging for session handoffs due to client mobility. This architecture enhances streaming media quality for mobile clients while utilizing network resources efficiently and supporting client mobility in an integrated and practical way. The current status of our prototype on a mobile QoS testbed "MOBIQ" is also reported in this paper.

key words: CDN, mobile network, streaming media, SMIL

1. Introduction

With the birth and growth of the Internet and high-speed access links, Internet users can enjoy large amounts of web content on the Internet. However, network congestion and server overload have become major concerns for content delivery. To mitigate these effects, CDNs (Content Delivery Networks) are attracting a great deal of attention. In CDNs, web content is distributed to cache servers located at the edge of the Internet close to clients, and the cache servers deliver content to clients if they cached the requested content beforehand. Since the cached content does not have to be delivered from the origin servers to clients, this leads to lower latency for users, better network resource utilization for network operators, and scalable service provisioning for content providers. At the moment, several commercial companies provide CDN service on world-wide scales [1].

In mobile environments, Internet access has become very popular as represented by i-mode [2] and WAP (wireless access protocol) [3]. In addition, IMT-

2000 (International Mobile Telecommunications-2000) has begun in Japan [4], and users can now access the Internet at up to 384 kbit/s through mobile devices. In the near future, mobile CDNs will be needed with the increasing number of IMT-2000 users.

At the same time, multimedia streaming service is becoming popular over the Internet. Mobile networks are also expected to provide IP-based multimedia streaming service in addition to web access service. From this requirement, 3GPP (3rd Generation Partnership Project), a standardization body of IMT-2000, has defined "packet streaming service (PSS) specifications [5]" as a standard for streaming service over 3G mobile networks.

Streaming service, however, presents a lot of challenges for network engineers. Unlike TCP applications, streaming service requires a certain amount of bandwidth to ensure the bit-rate needed by each media stream and the strict delay variation (i.e., jitter) needed to avoid buffer underflow at streaming clients. For such streaming service, CDNs are a very effective solution to relieve network congestion and to keep jitter at tolerable levels. Several papers have already considered how to cache streaming content effectively. In [6]–[8], streaming content is encoded with layered coding techniques and a proxy cache manages the number of layers to be stored for each stream. [9] proposed a prefix caching scheme that stores only the beginning of the content to minimize storage while decreasing waiting time for playback. [10] also utilizes the idea of prefix caching and describes resource management issues on cache systems. Selective caching was proposed in [11] as a generalization of prefix caching by storing various segments of the stream, specifically those that are subject to causing buffer underflow at clients. In [12], streaming content is divided into variable-sized segments in order to improve caching efficiency. Content-aware segmentation and a cache system using video summarization were proposed in [13]. In this system, streaming content is segmented at key frames and users can start streaming from any segment while watching the key frames.

Although these segment caching technologies have potential for enhancing network resource utilization and caching efficiency, they do not describe how to manage the segmented content and how to specify the

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locations of the proxy caches. Especially in mobile networks, since network and radio link conditions are dynamically changed depending on the time and place, it is required to specify the best cache locations flexibly. In addition, the best cache locations could be changed during a streaming session when a mobile client moves from one location to another location. The mechanism to update the cache locations is necessary for a mobile streaming media CDN. In [14], a streaming CDN architecture that has content naming, content management, and redirection mechanisms is described, but it does not consider network dynamics and client mobility expected in mobile networks.

The main goal of our work is to design a mobile streaming media CDN (MSM-CDN) that enhances streaming media quality in environments including mobile, while utilizing network resources efficiently and supporting client mobility in an integrated and practical way. To achieve this, we propose a dynamic SMIL framework in which all of the CDN technologies including content segmentation, request routing, pre-fetch control, and session handoff, are controlled by SMIL (Synchronized Multimedia Integration Language) [15] modification. The reasons for focusing on SMIL are itemized below.

- Since SMIL includes content location information, client requests can flexibly be redirected to the best cache servers by replacing the original content locations by the cache locations selected based on the network and caching conditions.
- To improve caching efficiency, large streaming content is likely to be divided into several segments. In this case, SMIL can easily manage the timing and spatial relations among these segments.
- SMIL makes user access patterns more predictable because it provides timing information about when a client is likely to request each segment. This enables efficient pre-fetch control to cache servers.
- Since SMIL is based on XML (eXtensible Markup Language) [16], XML-related technologies can be applied to this system.
- 3GPP PSS adopts SMIL as the scene description language. Our dynamic SMIL framework follows the 3GPP-compliant specifications. This is important for deploying this CDN system over 3G mobile networks.
- Content providers can easily create SMIL files for describing streaming content because SMIL is a standard and popular scene description language.

Figure 1 shows the concept of the dynamic SMIL framework. In this system, content providers register their streaming content with SMIL files describing the layout and media synchronization about the content, and do not need to worry about the existence of cache servers. Mobile clients, on the other hand, download the modified SMIL files from a portal server in the CDN. By simply following the downloaded SMIL

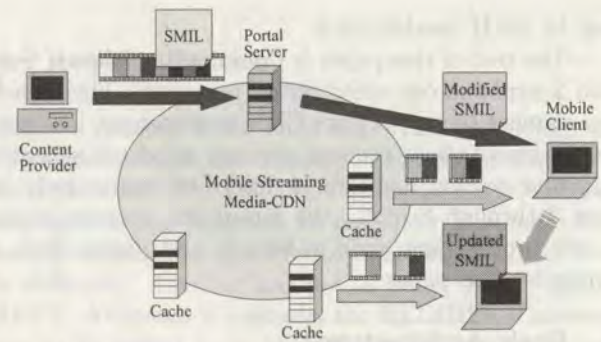


Fig. 1 Concept of dynamic SMIL framework.

files, the clients can receive multimedia content from the best cache servers. Even when mobile clients move to another location, the clients can continue multimedia streaming from the best cache servers by updating the SMIL files. The key elements of this system are as follows.

1. The CDN provides content segmentation functionality to enable segment caching and to improve cache efficiency without complicating management of the segments. It accepts content registered from content providers and divides the content into several segments if it is too large. At the same time, it modifies the SMIL file corresponding to the segmented content to describe the timing relations among the segments.
2. On-demand URL rewriting described in [17] is applied to SMIL. That is, when clients request a SMIL file, the original content locations in the SMIL file are replaced by the cache server locations, and the modified SMIL file is sent to the clients. The clients, then, request session setup to the cache servers according to the modified SMIL file.
3. To minimize the waste of the network resources and cache memory, streaming segments are scheduled to be pre-fetched just before clients request the segments while the clients are receiving streaming segments. The request times are derived from the timing information described in SMIL files.
4. When mobile clients move from one location to another location, the clients request an update of the SMIL file. The portal server, then, updates the SMIL file to indicate the best cache server locations and creates the SOAP (Simple Object Access Protocol) [18] message that includes the update information from the previous SMIL file. After the clients reproduce the updated SMIL file from the SOAP message, they continue the streaming session according to the updated SMIL file.

The first three items enumerated above are effective in both wired and mobile networks though the last one is related only to mobile networks. Our proposed framework covers all of these features in an integrated

way by SMIL modification.

The rest of this paper is organized as follows. Section 2 explains our architecture overview. Then, each key element to support our CDN architecture, i.e., content segmentation, request routing, pre-fetch scheduling, and session handoff, is described respectively in Sect. 3 through Sect. 6. We report the current status of our prototyping work in Sect. 7, and finally, Sect. 8 concludes this paper.

2. Basic Architecture

The MSM-CDN architecture we propose is shown in Fig. 2. This architecture consists of the wired core network and the radio access network. The CDN overlays the core network, and the CDN control plane is in the middle of the CDN.

The CDN is composed of portal servers, content servers, surrogates, and a content location manager (CLM). The portal servers accept content registrations from content providers and provide content segmentation and SMIL modification functionality. The content servers are simple HTTP (Hypertext Transfer Protocol) [19] and RTSP (Real-Time Streaming Protocol) [20] servers and store a large number of streaming segments derived from the original media content. They do not have caching functionality, and work as HTTP servers for the surrogates and RTSP servers for mobile clients. The surrogates are the RTSP servers that temporarily store streaming segments and serve mobile clients as streaming servers via RTSP session control. The CLM is a server located in the CDN control plane, and it takes charge of managing content locations and scheduling pre-fetches.

The mobile clients can connect to the CDN via the radio access network. They are the RTSP clients that request multimedia content delivery according to the SMIL files sent from the portal server.

From the next section, we describe each key element of our architecture in more detail.

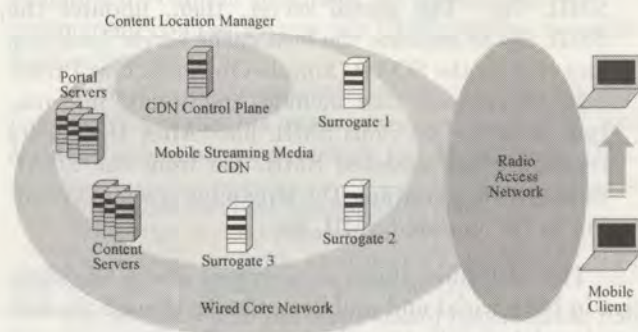


Fig. 2 Basic architecture of mobile streaming media CDN.

3. Content Segmentation

Content segmentation is effective especially for large streaming content. By dividing content into several segments, surrogates can store and remove the content at the granularity of the segments, which leads to efficient cache memory and network resource utilization. Prefix caching [9], selective caching [11], variable-sized segmentation [12], and content-aware segmentation [13] have been proposed as the intelligent variants of segment caching.

We also introduce content segmentation in our CDN architecture to improve cache efficiency. The problem with content segmentation, however, is to complicate the management of these segments. In other words, content segmentation increases the number of the files to be managed. And to realize such intelligent caching schemes proposed in [9]–[13], the servers in the CDN have to know the relations among the segments. Thus, how to manage the segments is an important issue.

For this purpose, we bind a SMIL file to the segments divided from a streaming content. Since SMIL provides the timing information for playing or displaying, it can easily manage the timing relations among the segments. By parsing the SMIL file, mobile clients and other servers can determine which segments are the next to the segments currently served and how long the segments will last.

The procedure of content segmentation is shown in Fig. 3. First, content providers register their own streaming content with the portal server. Here, the content providers also attach the SMIL files describing the layout and media synchronization about their streaming content. By registering content with SMIL files, content providers can specify how the content is displayed at mobile clients. If the size of the registered content is larger than a certain threshold, the portal server divides the content into smaller segments. At the same time, the portal server modifies the SMIL file attached to the content to describe the timing relations among these segments. Then, it sends the segments to a content server and requires it to store them.

Then, let us see an example of SMIL modification. Here, there is a streaming content whose length is sixty minutes, and its SMIL file is shown in Fig. 4. The SMIL

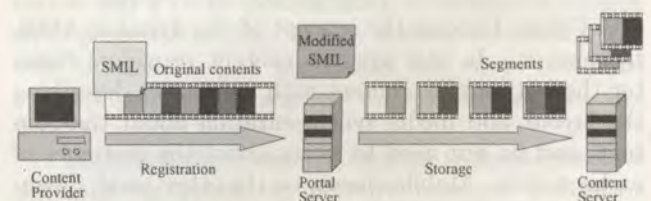


Fig. 3 Content segmentation and SMIL modification at portal server.

shows that content names are "content-A.mp4" for audio content and "content-V.mp4" for video content, and their durations are sixty minutes.

We assume the content is divided into three segments, and each segment is ten, twenty and thirty minutes long, respectively. In this case, the SMIL file is modified at the portal server as shown in Fig. 5. According to the modified SMIL file, these segments are renamed as "content-A-{1,2,3}.mp4" for audio segments and "content-V-{1,2,3}.mp4" for video segments, and the durations of the segments are ten, twenty, and thirty minutes long from the top segments. Since the part located between <seq> and </seq> indicates that these segments are sequentially played and displayed from the top segments, the timing relation among them is evident.

In this way, SMIL files are modified along with content segmentation, and the modified SMIL files indicate the names, durations, and relations of the segments.

```
<!DOCTYPE smil PUBLIC "-//W3C//DTD SMIL 2.0//EN"
"http://www.w3.org/2001/SMIL20/SMIL20.dtd">
<smil xmlns="http://www.w3.org/2001/SMIL20/Language">
<head>
<layout>
<region id="v" top="5" left="5" width="180" height="180"/>
</layout>
</head>
<body>
<par dur="60min">
<audio src="rtsp://content-server/content-A.mp4" />
<video src="rtsp://content-server/content-V.mp4" region="v" />
</par>
</body>
</smil>
```

Fig. 4 Example of original SMIL file.

```
<!DOCTYPE smil PUBLIC "-//W3C//DTD SMIL 2.0//EN"
"http://www.w3.org/2001/SMIL20/SMIL20.dtd">
<smil xmlns="http://www.w3.org/2001/SMIL20/Language">
<head>
<layout>
<region id="v" top="5" left="5" width="180" height="180"/>
</layout>
</head>
<body>
<seq>
<par dur="10min">
<audio src="rtsp://content-server/content-A-1.mp4" />
<video src="rtsp://content-server/content-V-1.mp4" region="v" />
</par>
<par dur="20min">
<audio src="rtsp://content-server/content-A-2.mp4" />
<video src="rtsp://content-server/content-V-2.mp4" region="v" />
</par>
<par dur="30min">
<audio src="rtsp://content-server/content-A-3.mp4" />
<video src="rtsp://content-server/content-V-3.mp4" region="v" />
</par>
</seq>
</body>
</smil>
```

Fig. 5 Modified SMIL file after content segmentation.

4. Request Routing

Request routing is the most important technology for CDN. Several request routing methods have already been proposed [17]. One popular method is DNS-based request routing. However, its resolution is domain level and, therefore, fine-grain request routing at object level is difficult. Another method is using RTSP REDIRECT. Although it's simple, the REDIRECT message has to be issued from original content servers to mobile clients each time the clients request a streaming segment, and this leads to session setup latency.

In our CDN architecture, we apply on-demand URL rewriting [17] to SMIL. Request routing is done by modifying SMIL files at the portal server when mobile clients request the SMIL files. In other words, the portal server replaces the content locations in SMIL files by the surrogate locations, and returns the modified SMIL files to mobile clients. The advantages of this request routing are:

- Request routing is done before clients request a streaming session by RTSP. This enables faster pre-fetching described in the next section.
- There is no extra procedure such as DNS-based request routing or RTSP REDIRECT method to set up a streaming session between clients and surrogates. This leads to low latency of session setup.

Figure 6 shows the request routing procedure by SMIL modification.

When a mobile client requests a SMIL file to start multimedia content streaming (1), the portal server reads the SMIL file corresponding to the streaming content stored in its memory. Then, the portal server queries CLM about the locations of the segments described in the SMIL file (2). At this time, the portal server notifies the estimated time when each segment will be requested, by parsing the timing information in the SMIL file. CLM utilizes this information for pre-fetching control described later. The client location (IP address) is also notified to CLM.

CLM selects the best surrogates for each segment

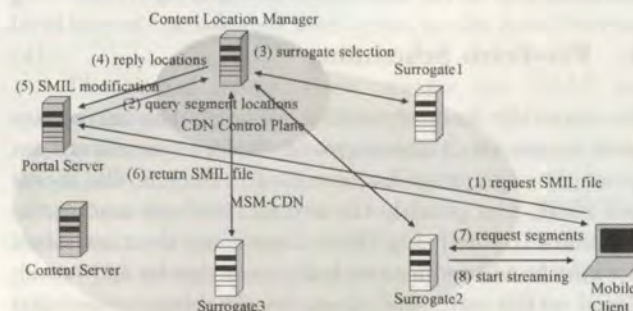


Fig. 6 Request routing procedure by SMIL modification.

```

<!DOCTYPE smil PUBLIC "-//W3C//DTD SMIL 2.0//EN"
"http://www.w3.org/2001/SMIL20/SMIL20.dtd">
<smil xmlns="http://www.w3.org/2001/SMIL20/Language">
<head>
<layout>
<region id="v" top="5" left="5" width="180" height="180"/>
</layout>
</head>
<body>
<seq>
<par dur="10min">
<audio src="rtsp://surrogate2/content-server/content-A-1.mp4"/>
<video src="rtsp://surrogate2/content-server/content-V-1.mp4" region="v"/>
</par>
<par dur="20min">
<audio src="rtsp://surrogate2/content-server/content-A-2.mp4"/>
<video src="rtsp://surrogate2/content-server/content-V-2.mp4" region="v"/>
</par>
<par dur="30min">
<audio src="rtsp://surrogate3/content-server/content-A-3.mp4"/>
<video src="rtsp://surrogate3/content-server/content-V-3.mp4" region="v"/>
</par>
</seq>
</body>
</smil>

```

Fig. 7 Modified SMIL file to indicate surrogate locations.

based on the client location, network condition, caching status, surrogate load, and so on (3). In this paper, we do not specify how to select the surrogate locations. After the selection, it responds the locations of the selected surrogates to the portal server (4).

The portal server, then, replaces the original content locations in the SMIL file by the surrogate locations (5). Figure 7 shows an example of the SMIL file whose content locations are modified to indicate the surrogate locations. The original URLs of the segments shown in Fig. 5 are replaced by the surrogate URLs. The locations of the segments could be different. In the SMIL file shown in Fig. 7, surrogate2 is selected for the top four segments, while surrogate3 is selected for the last two segments.

After the modification of the SMIL file, the portal server returns the modified SMIL file to the mobile client (6). The mobile client receives the SMIL file and requests streaming sessions by RTSP according to the SMIL file (7). The surrogate requested to start the streaming session delivers RTP (Real-time Transport Protocol) [21] media packets that include audio and video payloads to the mobile client (8).

As long as the mobile client follows the SMIL file downloaded from the portal server, it always requests session setup to the surrogates selected by CLM.

5. Pre-Fetch Scheduling

To smoothly start streaming sessions, the surrogates have to pre-fetch the segments before the clients request the segments. As described in Sect. 3, the modified SMIL files provide the timing relations among the segments. By utilizing this information, the time when the clients will request each segment can be estimated. Based on the estimated times, pre-fetching is scheduled to be finished before the clients request the segments.

Figure 8 shows the sequence of segment pre-

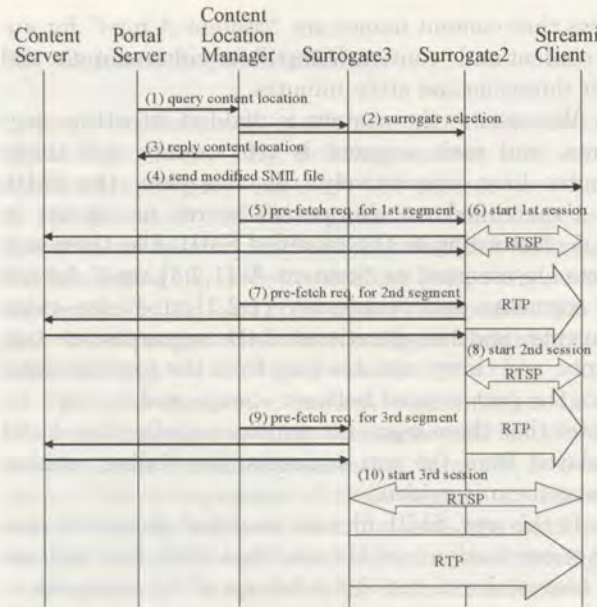


Fig. 8 Sequence of pre-fetching scheduled by content location manager.

Session ID	123456789				
Client IP address	10.20.30.40				
Start time	12:34				
Pre-fetch status	ACTIVE				
#	Time	Dur.	Seg. Name	Orig. Loc.	Surrogate
1	0 m	10 m	content-A-1.mp4	content-server	surrogate2
2	0 m	10 m	content-V-1.mp4	content-server	surrogate2
3	10 m	20 m	content-A-2.mp4	content-server	surrogate2
4	10 m	20 m	content-V-2.mp4	content-server	surrogate2
5	30 m	30 m	content-A-3.mp4	content-server	surrogate3
6	30 m	30 m	content-V-3.mp4	content-server	surrogate3

Fig. 9 Pre-fetch scheduling table.

fetching. In our CDN architecture, CLM takes charge of pre-fetch scheduling.

When the portal server queries CLM about segment locations, it also notifies the timing information for the segments derived from the SMIL file (1). After the surrogate selection is done based on the client location, network condition, caching status, and surrogate load (2), it replies the locations of the selected surrogates (3).

At the same time, CLM creates pre-fetch scheduling table as shown in Fig. 9. The table is composed of session ID, client IP address, start time, pre-fetch status, and pre-fetch information for each segment. Pre-fetch information includes estimated request times, segment durations, segment names, original locations, and surrogates selected to serve the segment.

Based on this table, CLM starts pre-fetching. As shown in Fig. 8, the first audio and video segments are pre-fetched (5) while the client is requesting the segments (6). Before the client finishes receiving the whole

first segments, the second segments are pre-fetched (7). The third segments are pre-fetched to surrogate3 while the client is receiving the second segments from surrogate2 (9).

If the client pauses the streaming session, the surrogate serving the client notifies CLM of the pause. CLM, then, changes the pre-fetch status in the pre-fetch scheduling table to PAUSE and stops pre-fetch requests to surrogates. When the client restarts the streaming, the surrogate notifies CLM of the restart. CLM recalculates the start time and the request times for each segment, and changes the pre-fetch status to ACTIVE. The same procedure is taken when the client skips or goes back to the segments.

6. Streaming Session Handoff

When a mobile client moves from one location to another location, the best surrogate serving it could be changed. One way to redirect the client's request to the new surrogate is sending RTSP REDIRECT from the surrogate currently serving the client. In this case, however, the client will request the next segments from the obsolete surrogate if it is still guided by the SMIL file downloaded when starting the multimedia content delivery. Another way is client-driven session handoff. That is, the client disconnects the current surrogate and requests the new surrogate for a session setup. The problem with this is how the client gets to know the best surrogate locations for itself.

To enable session handoff for all of the streaming segments, the mechanism to update SMIL files is necessary when the best surrogates are changed due to client mobility. In our CDN architecture, a SOAP message is used for this purpose. When a mobile client moves to another location and the best surrogates are changed, the portal server sends the SOAP message that includes the locations of the new surrogates serving the client. The client, then, updates its SMIL file and continues to receive the streaming segments from the new surrogates by following the updated SMIL file.

The advantages of sending SOAP messages to update SMIL files are:

- The SOAP messages can explicitly notify the update of the current SMIL file.
- If the SMIL file to be updated is elaborate for describing the layout and if its size is very large, sending the updated SMIL file itself consumes network resources. In that case, the SOAP message that tells only the update information of the surrogate locations is more cost-effective.
- Both SMIL and SOAP are based on XML. The same modules to parse XML documents can be used at mobile clients. In addition, most of the mobile clients are expected to be SOAP-capable in the near future. This requires only small modification on the clients.

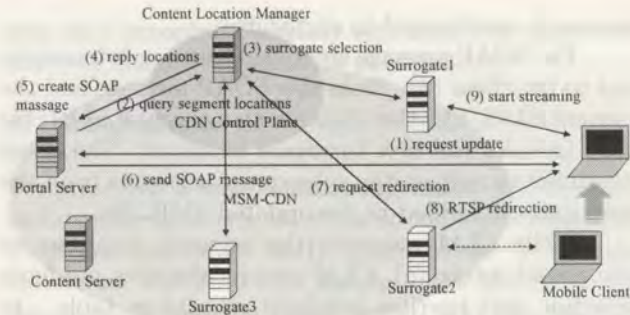


Fig. 10 SMIL update procedure when client moves.

```
<SOAP-ENV:Envelope
xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
SOAP-ENV:encodingStyle=
"http://schemas.xmlsoap.org/soap/encoding/">
<SOAP-ENV:Body>
<m:update xmlns:m="http://docomo.ne.jp/dynamicSMIL">
<oldSrc>/smil/body/seq/par[2]/audio/@src</oldSrc>
<newSrc>rtsp://surrogate1/content-server/content-A-2.mp4</newSrc>
<oldSrc>/smil/body/seq/par[2]/video/@src</oldSrc>
<newSrc>rtsp://surrogate1/content-server/content-V-2.mp4</newSrc>
<oldSrc>/smil/body/seq/par[3]/audio/@src</oldSrc>
<newSrc>rtsp://surrogate1/content-server/content-A-3.mp4</newSrc>
<oldSrc>/smil/body/seq/par[3]/video/@src</oldSrc>
<newSrc>rtsp://surrogate1/content-server/content-V-3.mp4</newSrc>
</m:update>
</SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

Fig. 11 Example of SOAP message to update SMIL file.

Figure 10 shows the procedure of SMIL update when a mobile client moves. In this figure, we assume the best surrogates are changed from surrogate2 to surrogate1.

When a mobile client moves from one location to another location and detects its movement, the mobile client requests the portal server to update the SMIL file by the SOAP request message (1). After receiving the update request, the portal server requests CLM to recalculate the locations of the best surrogates (2). As similar to the case described in Sect. 4, CLM selects the best surrogates for each segment based on the client location, network condition, caching status, and surrogate load (3). After the selection, CLM responds the locations of the selected surrogates to the portal server (4).

The portal server, then, creates the SOAP response message to inform the client of the new surrogate locations for each segment (5). An example of the SOAP response is shown in Fig. 11. The parts located between <oldSrc> and </oldSrc> indicate the locations to be replaced in XPath (XML Path Language) [22] description. The next parts located between <newSrc> and </newSrc> indicate the URLs of the new surrogates selected by CLM. In Fig. 11, the surrogates serving the second and the third audio/video

segments are changed to surrogate1.

The SOAP message created in this way is transmitted to the client (6). From this SOAP message and the current SMIL file, the client creates the new SMIL file that includes the new surrogate locations. The client continues to request the subsequent segments from the surrogates described in the updated SMIL file.

While CLM responds the segment locations to the portal server (4), CLM also recalculates pre-fetch schedule and rewrites pre-fetch scheduling table. In addition, it may request the surrogate currently serving the client (surrogate2) to redirect the client's request to the newly selected surrogate (surrogate1) (7). Then, surrogate2 issues RTSP REDIRECT method to the client (8), and the client requests surrogate1 to send the segments currently being transmitted from surrogate2 (9). Note that surrogate2 does not need to issue RTSP REDIRECT methods for the subsequent segments because the client requests surrogate1 to deliver them directly according to the updated SMIL file.

This SMIL update mechanism may generate vast signaling traffic if a mobile client moves fast and frequently changes its location. Obviously there is trade-off relation between accuracy of best surrogate locations and the cost of the signaling traffic. In this mechanism, the signaling cost can be flexibly controlled by a counter or timeout mechanism to prohibit the SMIL update for a while. And in an environment where multiple types of radio access networks (RANs) are connected, the change of the RAN type is a good indication for the SMIL update. That is, the best surrogate is expected to be changed with high probability when a mobile client changes its access network, for example, from 3G RAN to a wireless LAN. On the other hand, the best surrogate is expected to be the same as before when a mobile client merely changes its access point in wireless LANs. Some mechanisms to trigger the SMIL update from network to mobile clients may also be possible and more effective if the network knows the coverage area of each surrogate.

7. System Prototype

We have built the first version of MSM-CDN over our mobile QoS testbed called "MOBIQ [23]" as shown in Fig. 12. MOBIQ consists of Diffserv [24]-based IP core network and 3G RAN and IEEE802.11 wireless LAN. The core network is composed of FreeBSD routers with ALTQ [25] module, which provides functionality needed by Diffserv. The 3G RAN includes W-CDMA (Wideband Code Division Multiple Access) RAN emulator [26] and header compression nodes [27] to enable efficient IP packet delivery over 3G wireless links. We have also developed streaming servers, live streaming servers, and mobile clients. All of these streaming servers and clients are compliant with 3GPP-PSS standard.

The MSM-CDN overlay has been prototyped on this testbed. It includes the portal server, the content location manager (CLM), and the surrogates. At this moment, only the request routing procedure shown in Fig. 6 has been implemented. The CLM always selects the closest surrogate to mobile clients by requesting the surrogates to measure round trip times (RTTs) between mobile clients and themselves.

One of the features of this prototype is that all of the interfaces between the above CDN nodes are implemented by SOAP interfaces. Since SOAP is based on XML, these interfaces can be easily extended to include various security features including confidentiality, integrity, and access control. Another advantage of using SOAP interfaces is that content providers or other enterprises connecting to the Internet can easily utilize these interfaces and the CDN functions because SOAP is widely used in the Internet.

We have also developed live streaming splitters in our CDN prototype. In the live streaming case, there is no content to be cached on the surrogates. Instead of the surrogates, the splitters receive live streams from the live streaming servers and copy the streams to their clients. The same request routing procedure can be

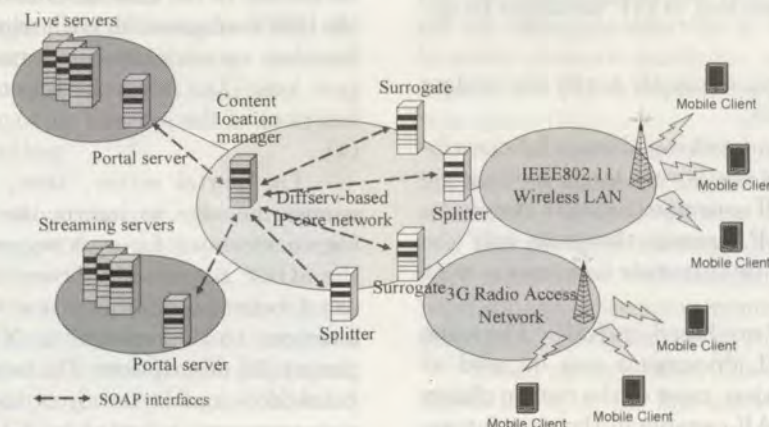


Fig. 12 Prototype of MSM-CDN on mobile QoS testbed.

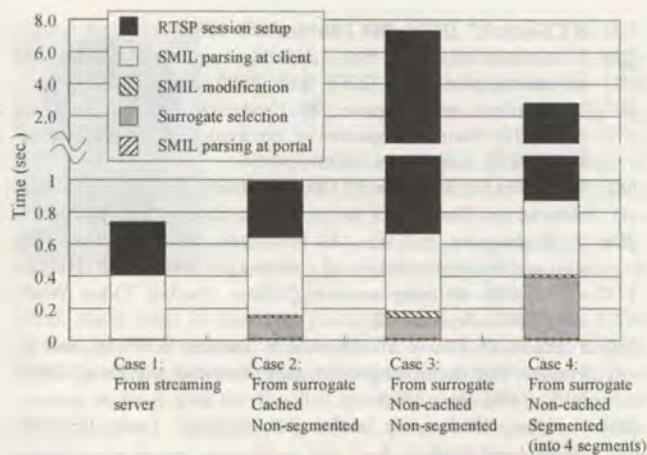


Fig. 13 Time needed for SMIL modification operation and RTSP session setup.

applied to the live streaming.

On this prototype, we can see better media quality with MSM-CDN than without it, when the bottle neck link in the core network is congested. However, mobile clients have to wait more for playback because of the SMIL modification operation including SMIL parsing/modification at the portal server and surrogate selection by CLM. Then, we measured the time needed for the SMIL modification operation as well as the time needed for SMIL parsing at clients and RTSP session setup in several test cases.

Figure 13 shows the results of the above measurement. The test case 1 is a usual streaming case without CDN. In this case, approximately 700 ms was necessary for parsing SMIL at clients and RTSP session setup. The case 2 is a streaming case from the closest surrogate that has already cached the requested content. Compared with the case 1, it took a little bit longer time because the SMIL modification operation was involved. The primary factor of this was the time for surrogate selection. However, we think the time is negligible because it was less than 200 ms. The case 3 is that the requested content whose size is 5.4 MB had not been cached. Here, the bandwidth of the bottle neck link in the core network was 10 Mbit/s. In this case, the time needed for RTSP session setup was nearly seven seconds because the surrogate could not respond RTSP DESCRIBE message until it finished downloading the requested content. On the other hand, the test case 4 where the content was divided into four segments shows that the time for session setup decreased by tolerable level due to shorter download time of the first segment. And our mobile clients could receive and playback the subsequent segments seamlessly. However, we can see slight increase in the time for surrogate selection. This is because the modified SMIL file became complicated and had more URLs in it by content segmentation. Therefore, segmentation of streaming con-

tent into unnecessarily many segments may cause bad effect on the waiting time for playback.

8. Conclusions

We presented a mobile streaming media (MSM)-CDN architecture in which all of the technologies related to CDN are enabled by SMIL modification. In this architecture, mobile clients simply follow the SMIL file downloaded from the portal server, and this leads to multimedia content delivery from the best surrogates in the CDN. The key components of this architecture are as follows.

1. To improve cache efficiency, content segmentation is provided along with SMIL file modification to describe the timing relations among the segments.
2. To redirect client requests to the best surrogates, the content locations in the SMIL file are modified to indicate the best surrogate locations.
3. Segment pre-fetching is scheduled just before clients request segments in order to minimize the waste of the network resources and cache memory. The request times are derived from SMIL files.
4. SOAP messages to update SMIL files are defined. This is necessary when mobile clients move and the best surrogates for them are changed.

The current status of our prototype was also reported. We have already built the MSM-CDN over our mobile QoS testbed called "MOBIQ." The MSM-CDN is completely compliant with 3GPP-PSS standard, and all of the CDN nodes have SOAP interfaces to control each other. We also showed that the time needed for the SMIL modification operation was negligible.

We are now investigating segmentation and resource management algorithms. These algorithms require choosing a media segment size for the content segmentation operation. An appropriately chosen segment size will consider client mobility, since each segment boundary provides an opportunity for a session hand-off. Segment size also influences content use statistics, since knowledge that users only tend to view the first 30 seconds of a media clip can help the system efficiently allocate its storage resources. Resource management and caching algorithms can also benefit from knowledge of content popularity, since content that is likely to be accessed by other users should be left in cache storage whenever possible.

Interaction with the underlying QoS network is another research topic. Notice that the pre-fetch scheduling table gives a deadline for when the segment must be pre-fetched to the surrogate, however it does not specify a precise time for the pre-fetch to occur. This flexibility allows the CLM and surrogates to schedule the actual pre-fetch time while taking the underlying QoS base network resource usage into account.

We are also interested in personalized mobile

streaming. Since users have limited devices and time especially in mobile environments, it is important to deliver multimedia content dynamically and automatically summarized depending on user preferences and/or network conditions. Towards this, personalization of SMIL files [28] and MPEG-7 based personalization [29] have already been proposed. We are considering the integration of these personalization technologies into our MSM-CDN architecture.

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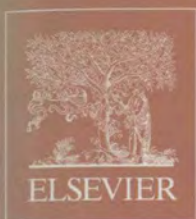
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ATTACHMENT 6



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Design and implementation of the just-in-time retrieving policy for schedule-based distributed multimedia presentations

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Abstract

In order to provide the smooth playback of a distributed multimedia presentation, the object-retrieving engine for the player must fetch each object before its playback time. In this paper, a smart object-retrieving engine is proposed, which adopts a retrieving policy named the just-in-time policy. The policy expects the retrieval process of an object to finish right before the playback time of the object to achieve a better buffer utilization and network bandwidth efficiency. The proposed object-retrieving engine focuses on SMIL1.0-based multimedia presentations. By converting the synchronization relationship of objects in the SMIL1.0 document to Real-Time Synchronization Model, which simplifies the handling of the synchronization relationship, and considering the end-to-end bandwidth as well as the user interactions, the object-retrieving engine determines the object request time for each object. The engine issues the request to fetch each object for the ongoing presentation at the object request time, and provides the player with proper media objects. The feasibility and better performance of the proposed just-in-time retrieving policy had been proved by performance measurements of system implementation.

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Keywords: Distributed multimedia presentation; User interaction; Synchronized Multimedia Integration Language (SMIL); Real-Time Synchronization Model (RTSM); Object retrieving

1. Introduction

With the development of high-speed networking and computer technologies, multimedia information systems like the *distributed multimedia presentation* (Shih and Davis, 1997; Moreno and Mayer, 1999; Liew et al., 1999; Bertino et al., 2000; Palacharla et al., 1997; Carneiro et al., 1999) are becoming more accessible to a variety of audiences. The distributed multimedia presentation is concerning with viewing a presentation via the network. The presentation system should provide VCR-like functions, such as *play/stop*, *pause/restart*, *fast forward/backward*, and *sliding*, to support user interactions. Some or all the media objects in the presentation could be somewhere in the network instead of the local site. Issues for the distributed multimedia presentation

include: the overall design of the system (Shih and Davis, 1997; Moreno and Mayer, 1999; Liew et al., 1999; Bertino et al., 2000), the scheduling (retrieving) of the objects and resource management under the network environment (Palacharla et al., 1997; Carneiro et al., 1999; Hwang and Prabhakaran, 2000), the mechanisms for dealing with the temporal relationship (synchronization) of objects in the presentation (Jeong et al., 1997; Huang and Wang, 1998; Cruz and Mahalley, 1999; Song et al., 1999; De Lima et al., 1999), the supporting of the user interactions (Bertino et al., 2000; Huang et al., 1998; Yoon and Berra, 1998; Jeng et al., 1999), etc.

The common objective of the issues for the distributed multimedia presentation is to provide a smooth playback for viewing the presentation. Since the objects in a multimedia presentation may reside in remote data servers, the critical problem is to guarantee that temporally related objects from different data servers and different network channels will play synchronously at the client site—even with random user interactions. The

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quality of the presentation depends on the ability of the player in dealing with the network behavior and user interactions. More specifically, when a presentation is ongoing, the *object-retrieving engine* for the player (or the player itself) should retrieve proper media objects before the object's playback time according to the synchronization relationship of the presentation. Hence, the object-retrieving engine plays an important role on the quality of the presentation.

Two extreme policies for object retrieving could be adopted. First, retrieve all objects before starting the presentation, or second, do not make the request to retrieve the object until the object's playback time. The first policy is called the *pre-loading policy*, and the second policy is called the *passive-loading policy* in the paper. The pre-loading policy guarantees the smooth playback in the cost of a long initial delay and a large buffer for all objects in the presentation. Moreover, since the viewer could activate hyperlinks or VCR-like functions in an ongoing presentation, it is improper to pre-fetch all media objects in advance. Minimal buffer is required for the passive-loading policy, but it introduces gaps between the request time and the finish time of object retrieval because of the network delay. It implies that the smooth playback is impossible for the passive-loading policy.

The proposed object-retrieving engine adopts a better policy that is called the *just-in-time policy*. The policy expects the retrieval process for an object to be finished right before the playback time of the object so that the player could continue the presentation smoothly. Under such policy, the object-retrieving engine only buffers necessary objects for the smooth progress of the presentation, thus it has a better buffer utilization and network bandwidth efficiency.

The main problem for the just-in-time object-retrieving policy is the computation (estimation) of the request time for object-retrieval made by the object-retrieving engine. The request time for retrieving an object is called the *object request time* in the paper. Two factors need to be considered in the computation of the object request time: (1) the playback time for the object and (2) the total time for retrieving the object via the network. The playback time for each object depends on the temporal relationship of the objects in the presentation and the user interactions. The total time for retrieving the object from the remote server depends on the size of the object and the effective network bandwidth from the server to the client. Under the just-in-time retrieving policy, the object request time could be estimated as the playback time of the object minus the total time for retrieving the object.

Before we further discuss the mechanisms for supporting the just-in-time policy, the representation of the multimedia presentation should be addressed. In order to compose a multimedia presentation, a method (e.g. a

script language) is necessary to specify the spatial relationship and the temporal (synchronization) relationship for the objects in the presentation. Different multimedia presentation systems usually have different formats of presentation. However, it is better to adopt a popular language as the format of the multimedia presentation (Chang, 1999). From the popularity point of view, SMIL (*Synchronized Multimedia Integration Language*) (W3C, 1998; W3C, 2001) seems to be a good candidate. SMIL was developed by the *WWW Consortium (W3C)* to address the lack of HTML for multimedia over WWW. It provides an easy way to compose multimedia presentations. With the efforts of W3C, SMIL is becoming a popular language in authoring multimedia presentations, and it is currently supported by the newest versions of the commercial browsers.

This paper focuses on the SMIL-based presentations and proposes proper mechanisms for the just-in-time retrieving policy. Currently, two versions of SMIL specification had been proposed by W3C: *SMIL1.0* (W3C, 1998) and *SMIL2.0* (W3C, 2001). The SMIL1.0 model is primarily a scheduling model, but with some flexibility to support continuous media with unknown duration. SMIL2.0 extends SMIL1.0 and introduces event-based activation or termination to let users define a dynamic activation path. Because of dynamic activation of elements, a SMIL2.0 presentation's entire timing might be changed at the run-time, which makes it difficult to implement the just-in-time retrieving policy. Therefore, the proposed object-retrieving engine deals with schedule-based (SMIL1.0) presentations only. Research of object retrieving for event-based (SMIL2.0) presentations is left as the future work.

The object-retrieving engine has to handle the synchronization relationship of the objects in the SMIL script. In order to deal with the synchronization relationship efficiently during the parsing process for the SMIL script, a synchronization model (Little and Ghafoor, 1989; Qazi et al., 1993; Yang and Huang, 1996; Lin et al., 1998; Prabhakaran and Raghavan, 1993; Huang et al., 1998; Yoon and Berra, 1998; Jeng et al., 1999), which provides a systematic view of the synchronization relationship, is helpful for the object-retrieving engine. In the literature, *DEFSM (Dynamic Extended Finite State Machine)* (Huang et al., 1998) is proposed to model the synchronization relationship for interactive multimedia presentations. However, the approach requires two models, an "actor" DEFSM and a "synchronizer" DEFSM, for an interactive multimedia presentation, and is hence complicated.

A more compact and Petri-net based model namely *OCPN (Object Composition Petri Net)* (Little and Ghafoor, 1989; Qazi et al., 1993) was proposed to model the synchronization relationship among media objects. Extensions of OCPN for supporting user interactions (Yoon and Berra, 1998; Jeng et al., 1999) were also

proposed. However, we had shown that OCPN or other Petri-net based models are not suitable for real-time network applications, and instead Real-Time Synchronization Model (RTSM) was proposed (Yang and Huang, 1996). Moreover, the synchronization behaviors that could be specified by SMIL1.0 make RTSM more suitable than Petri-net based models. For example, SMIL allows the author to set the explicit beginning time, duration, or end time for an element in the presentation. RTSM could easily model this kind of the synchronization behavior, but OCPN could not. Therefore, RTSM is adopted to model the synchronization relationship of the multimedia presentation scripted by SMIL.

To sum up, the proposed object-retrieving engine first parses the input SMIL document to extract and to represent the synchronization relationship of the objects in the presentation by RTSM. Next, the object request time for each object is determined by considering the user interaction, the playback time of the object, and effective network bandwidth to retrieve the object. The request for retrieving the object is then issued by the object-retrieving engine at the object request time.

The remainder of the paper is organized as follows. First, we make a brief survey for SMIL1.0 and RTSM in Section 2. The overview of the process for the object-retrieving engine is presented in Section 3. The conversion of the synchronization relationship of SMIL to RTSM during the parsing process is presented in Section 4. The calculation of the object request time is explained in Section 5. In Section 6, the implementation and some results of performance measurement for the proposed object-retrieving policy are presented. Finally, Section 7 concludes this paper.

2. Previous work

2.1. Survey of SMIL1.0

As mentioned in Section 1, SMIL was developed by W3C to address the lack of HTML for multimedia over WWW. With the introduction of SMIL, Web multimedia creators have a new tool for building time-based multimedia presentations that combine audio, video, images, and text. The proposed SMIL standard defines an XML-based language that allows control over what, where, and when of media elements in a multimedia presentation with a simple clear markup language similar to HTML.

In other words, SMIL could be used to describe both the spatial relationship and the temporal relationship of a multimedia presentation. The spatial relationship is concerning with the visual layout of media objects in the presentation, while the temporal relationship is concerning with timing control of media objects. The ele-

ments for spatial relationship in SMIL1.0 include the *<layout>* element and the *<region>* element. The *<layout>* element determines how the elements in the document's body are positioned. The *<region>* element controls the position, the size, and scaling of media object elements.

The synchronization elements in SMIL1.0 for the temporal relationship include the *<seq>* element, the *<par>* element, and the class of media object elements such as **, *<video>*, *<audio>*, and *<text>*. The *<seq>* element defines a sequence of elements in which elements play one after the other. The *<par>* element defines a simple parallel time grouping in which multiple elements can play back at the same time. Both *<seq>* and *<par>* allow the nested structure that means the children element of them could be any of the synchronization elements. The media object elements allow the inclusion of media objects into an SMIL presentation. Media objects are included by reference (using a *URI*).

Besides, some synchronization related attributes such as "begin", "dur", and "end" could be associated with these synchronization elements. The "begin" attribute specifies the time for the explicit begin of an element. The "end" attribute specifies the explicit end of an element. The "dur" attribute specifies the explicit duration of an element.

2.2. Survey of real-time synchronization model

RTSM (Yang and Huang, 1996) was proposed to address the lack of Petri-net based models for dealing with real-time synchronization. The elements in RTSM include *place*, *token*, and *transition* as in OCPN (Little and Ghafoor, 1989). However, there are two kinds of places in RTSM, *regular places* and *enforced places*. A different firing rule for enforced places is defined. The rule specifies that once an enforced place becomes unblocked (in other words, the related action with the place is completed), the transition following the place will be immediately fired regardless the states of other places feeding the same transition.

An example of RTSM is shown in Fig. 1 in which a single circle is for the regular place, a double circle is for the enforced place, and a bar is drawn for the transition.

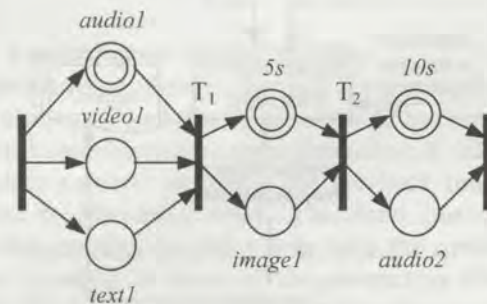


Fig. 1. An example of RTSM.

The RTSM in Fig. 1 requires that audio segment *audio1*, the video clip *video1*, and the text data *text1* be played simultaneously. Since *audio1* is an enforced placed, transition T_1 is fired right after *audio1* is finished, no matter if *video1* or *text1* is finished or not. After firing transition T_1 , *image1* is displayed for 5 s then transition T_2 is fired. Finally, *audio2* is played for 10 s after transition T_2 fires. Note that the enforced place of “5 s” in the figure is not a media object but a virtual medium that is called *Time Medium* (Yang and Huang, 1996). The time medium is used to represent time duration.

3. Overview of the object-retrieving process

The object-retrieving process is responsible for retrieving proper media objects and dealing with user actions for the presentation. The operation model of the proposed object-retrieving engine is illustrated in Fig. 2. The object-retrieving engine first accepts the SMIL script from the player, and converts the synchronization relationship to RTSM. By analyzing the RTSM model and collecting object related information from data servers, the playback duration for each object under normal play mode is calculated. The object-retrieving engine then uses the obtained playback duration of each object as a base to handle the user actions and determines the object request time for objects. Proper objects are retrieved and then delivered to the player by the object-retrieving engine according to the object request time.

Functions of user interactions supported by the proposed object-retrieving engine include *play*, *stop*, *pause/restart*, *fast forward*, *fast backward*, and *sliding*. To de-

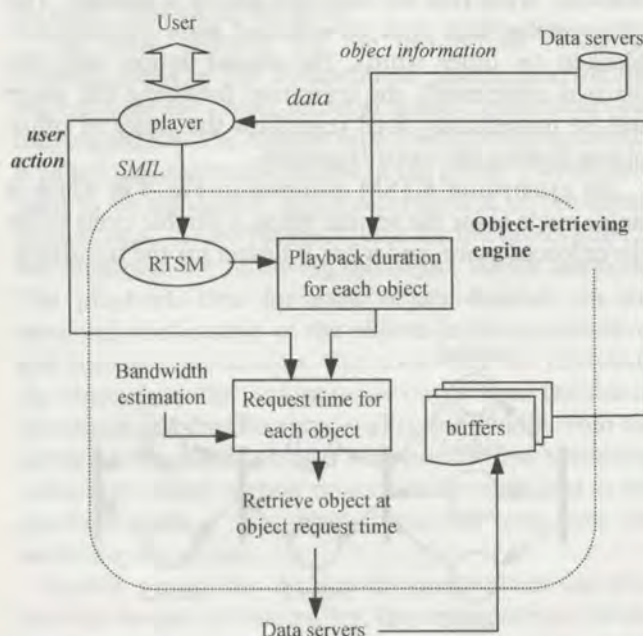


Fig. 2. Overview of the object-retrieving process.

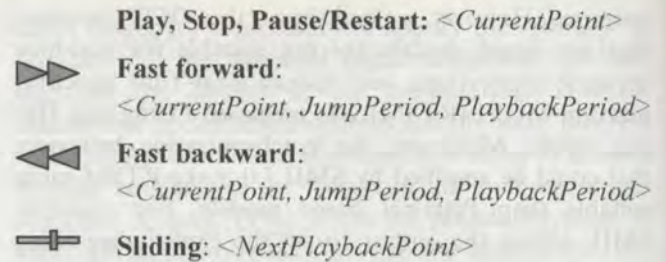


Fig. 3. User actions and corresponding parameters.

fine the user interactions precisely, some parameters are associated with the user actions as shown in Fig. 3. For example, three parameters should be passed to the object-retrieving engine for the fast forward mode: *CurrentPoint*, *JumpPeriod*, and *PlaybackPeriod*. *CurrentPoint* is used to indicate the time point within the overall presentation time at which the user action is made. It is a relative value timed from the start of the presentation, and it means fast forwarding of the presentation should be started from the point indicated by *CurrentPoint*. *JumpPeriod* and *PlaybackPeriod* are used to define how does the player achieve the fast forward/backward operation as explained in the following.

Since it is impossible to speed the presentation of a multimedia document physically as in the VCR system, we need a new way to define fast forward/backward operation. We define *JumpPeriod* as the period to be skipped in fast forward/backward operation and *PlaybackPeriod* as the period to be played. By using these two parameters, we could achieve the functionality of fast forward/backward, and the play speed of the presentation becomes $(\text{JumpPeriod} + \text{PlaybackPeriod}) / \text{PlaybackPeriod}$. The playback patterns for fast forward and fast backward are shown in Fig. 4 in which the only difference between fast forward and fast backward is the reverse ongoing directions. As for the sliding action, the object-retrieving engine only needs to know the next playback point, which is denoted by *NextPlaybackPoint*, so that it could retrieve proper objects.

When some user action is made, the object-retrieving engine tries to locate the objects that should be played next under the new mode. However, there are always cases that only part of an object needs to be played, such as a sub-segment of an audio object or a sub-clip of a video object. So it is assumed that data servers have the ability of sub-sampling a continuous object like audio or video, and the object-retrieving engine only retrieves necessary part of the object instead of retrieving the whole object.

4. Converting SMIL to RTSM

In this section, we present the algorithm for converting the input SMIL script to RTSM. Since the

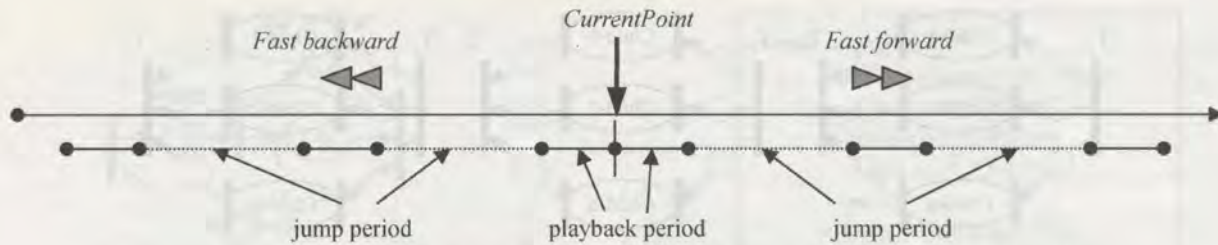


Fig. 4. Playback patterns for fast forward/backward.

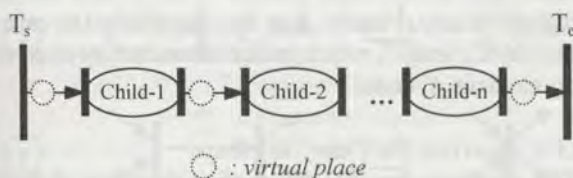
temporal relationship is the main concern of RTSM, only the synchronization elements in SMIL1.0 are examined. There are three kinds of synchronization elements to be converted: the $\langle seq \rangle$ element, the $\langle par \rangle$ element, and the class of media object elements such as $\langle img \rangle$, $\langle video \rangle$, $\langle audio \rangle$ and $\langle text \rangle$. Besides, some synchronization related attributes such as “begin”, “dur”, and “end” could be associated with these synchronization elements. We assume that the player has checked the syntax of the SMIL document, so the object-retrieving engine only performs necessary conversion.

4.1. Converting the $\langle seq \rangle$ element

The $\langle seq \rangle$ element defines a sequence of elements in which elements play one after the other. The children elements of the $\langle seq \rangle$ element could be any of the synchronization elements such as $\langle seq \rangle$, $\langle par \rangle$, or the media object elements, so the conversion is a recursive procedure. Since the children of a $\langle seq \rangle$ element form a temporal sequence, we concatenate each child of $\langle seq \rangle$ one by one in RTSM as illustrated in Fig. 5. Note that there are *virtual places* (denoted by the dashed circle) in the figure. They are used to maintain the consistency of RTSM, since the arc could only be the link between a transition and a place. In fact, the virtual place is a regular place that maps to the time medium with zero duration.

4.2. Converting the $\langle par \rangle$ element

The $\langle par \rangle$ element defines a simple parallel time grouping in which multiple elements can play back at the same time. Thus, all children of $\langle par \rangle$ should be within the same pair of transition (T_s , T_e) as illustrated in Fig. 6. There are three variations for $\langle par \rangle$ since a special

Fig. 5. Convert the $\langle seq \rangle$ element to RTSM.

attribute, “endsync”, could be associated with $\langle par \rangle$. The “endsync” attribute controls the end of the $\langle par \rangle$ element, as a function of children. Legal values for the attribute are “last”, “first”, and “id-ref”.

The value of “last” requires $\langle par \rangle$ to end with the last end of all the child elements, and the corresponding RTSM is shown in Fig. 6(a), in which transition T_e could not be fired unless all children end. The value of “first” requires $\langle par \rangle$ to end with the earliest end of all the child elements. Therefore, we should change the places between each child element and transition T_e to *virtual enforced places* as illustrated in Fig. 6(b) so that the child that ends first will fire transition T_e . A virtual enforced place is an enforced place that maps to the time medium with zero duration. The value of “id-ref” requires $\langle par \rangle$ to end with the specified child. So we change the place between the specified child and transition T_e to the virtual enforced place as shown in Fig. 6(c).

Other synchronization attributes, such as “begin”, “end”, and “dur”, could also be associated with $\langle seq \rangle$ and $\langle par \rangle$, but the conversion is similar to that in the media object elements that we present in the following.

4.3. Converting the media object elements

The media object elements allow the inclusion of media objects into a SMIL presentation. Media objects are included by reference (using a URI). One media object element naturally represents a regular place in RTSM. However, the attributes associated with the element require some more complex conversion. We examine and convert attributes “begin”, “end”, and “dur” respectively in the following.

4.3.1. Converting the “begin” attribute

This attribute specifies the time for the explicit begin of an element. Two types of values could be contained in the attribute: *delay-value* and *event-value*. A delay value is a clock-value to postpone the playback time of the element by the delay value. Therefore, one enforced place representing the delay time with the specified duration is added in front of the element as illustrated in Fig. 7(a). The event-value requires the element begin when a certain event occurs. According to the

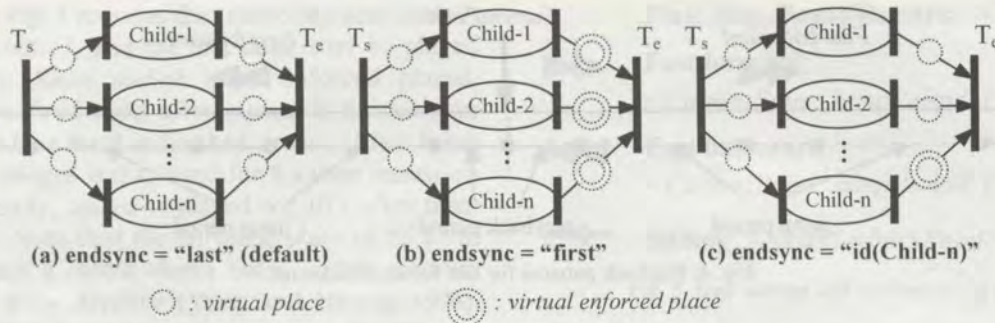
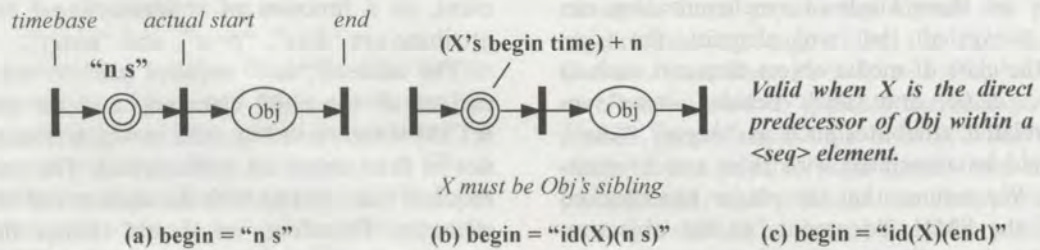
Fig. 6. Convert the $\langle par \rangle$ element to RTSM.

Fig. 7. Effect of "begin" attribute on RTSM.

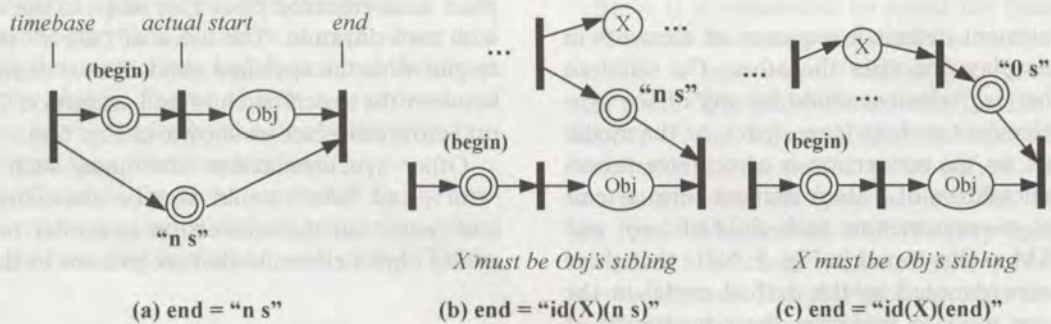


Fig. 8. Effect of "end" attribute on RTSM.

specification of SMIL1.0, the element X generating the event must be "in scope", in other words, X must be a sibling of the element that contains the "begin" attribute. There are two variations for the event-value, which is shown in Fig. 7(b) and (c) respectively.

In Fig. 7(b), the " $id(X)(n s)$ " value of "begin" attribute means that element Obj begins after its sibling X has begun for n seconds. So one enforced place representing the delay time with value of summation of " X 's begin time" and " n seconds" is added in front of Obj element. Actually, from the semantic point of view, the case in the Fig. 7(b) is only valid when elements X and Obj are child elements in a $\langle par \rangle$ element. The other value of event-value for "begin" attribute is " $id(X)(end)$ ", which means the Obj element begins right after element X ends. The case is actually the function of $\langle seq \rangle$. Therefore, the value is only valid when X is the direct predecessor of the element Obj in a $\langle seq \rangle$ element, and it introduces nothing to RTSM.

4.3.2. Converting the "end" attribute

This attribute specifies the explicit end of an element. There are also three possible values for the attribute as in the "begin" attribute. We illustrate the conversion of them in Fig. 8. In Fig. 8(a), a clock value represents the end time from the original timebase of the element. So one enforced place with the clock value is added between the original start transition and the end transition. In Fig. 8(b), the " $id(X)(n s)$ " value of "end" attribute means that element Obj ends when its sibling X has begun for n seconds. Therefore, there is a enforced place between the actual start transition of X and the end transition of Obj . Finally, Fig. 8(c) illustrates the case of value " $id(X)(end)$ ", which means element Obj must end when element X ends.

4.3.3. Converting the "dur" attribute

This attribute specifies the explicit duration of an element. Therefore, the value of the "dur" attribute, which

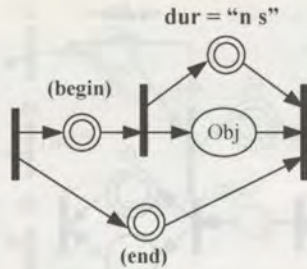


Fig. 9. Effect of "dur" attribute on RTSM.

is a clock value, forms an enforced place between the actual start transition and the end transition. We illustrate the effect of the attribute in Fig. 9.

4.4. Hyperlinks in SMIL

As specified in the SMIL1.0 specification, the hyperlink element $\langle a \rangle$ is transparent when playing the presentation until the user activates the link and starts a new presentation. Thus, only child elements of the element $\langle a \rangle$ are converted to RTSM, which is the same as previous sections.

4.5. Simplifying the obtained RTSM

As mentioned in the above section, some virtual (enforced) places are added in the RTSM during the converting process. However, there are some cases of RTSM that could be simplified by applying three rules, which are shown in Fig. 10. First, if the only input of a transition is a media place and the only output of the transition is a virtual place, we could naturally replace the case with the media place only since the virtual place is actually dummy (Fig. 10(1)). Second, if the only output of the transition in rule (1) is a virtual enforced place, it means the firing of the media place will enforce to fire the following transition of the virtual enforced place. We could replace the case by changing the media place to an enforced one as shown in Fig. 10(2). Third, if there is only one virtual place between two transitions,

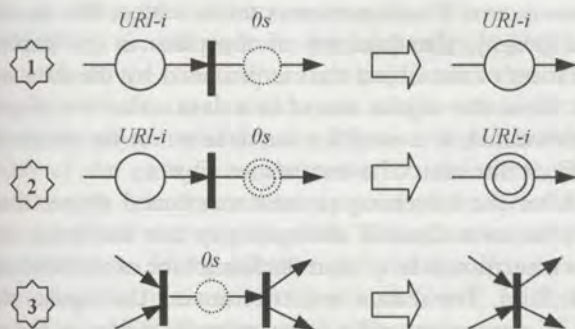


Fig. 10. Three rules to simplify RTSM.

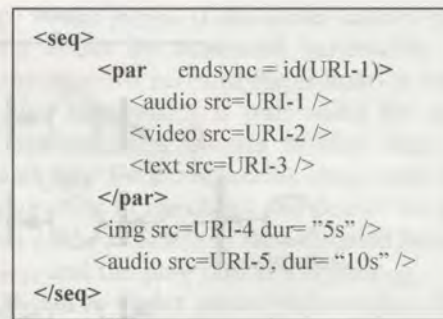


Fig. 11. A SMIL code snippet.

the two transitions could be combined into one transition as shown in Fig. 10(3).

4.6. An example for the conversion

Fig. 11 shows a sample SMIL code snippet, in which only temporal information is displayed. The initial RTSM right after the converting process is shown in Fig. 12 and the simplified RTSM for the example is shown in Fig. 13.

SMIL1.0 also introduced the "repeat" attribute, which is used to repeat a media element or an entire time container, such as $\langle seq \rangle$ or $\langle par \rangle$. With the presence of the "repeat" attribute, the RTSM model for the element is copied for the number of times specified by the value of the "repeat" attribute.

5. Determine the object request time

The object request time indicates the time to issue the request to retrieve the object. However, the object playback time depends on the play mode, which is dynamically activated by the user. The object request time thus needs to be re-computed each time the user action is made. Before computing the object request time for the user action, the object-retrieving engine has to know the *original playback duration* for each object under normal play mode (i.e. play speed = 1). The original playback duration is then used as a base to compute the object request time as well as the new playback time for each object under specific user action. The original playback duration is computed by traversing the RTSM obtained from the converted process mentioned in Section 4.

5.1. Compute the original playback duration

The playback time for an object is actually the firing time of the starting transition, and the end time of the object is the firing time of the ending transition of the object in RTSM. To compute the firing time for each

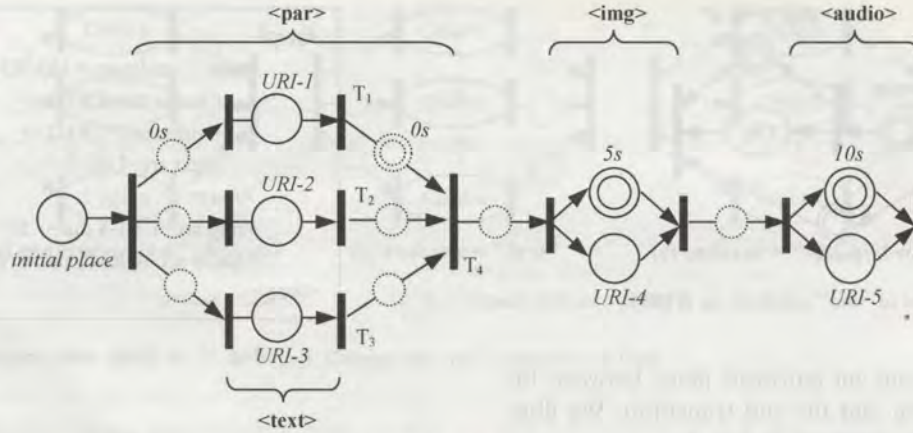


Fig. 12. RTSM for the sample SMIL snippet.

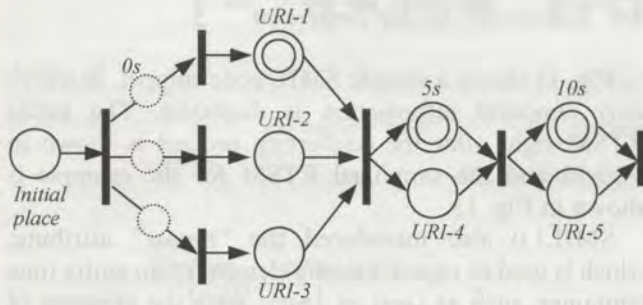


Fig. 13. Simplified RTSM for the sample SMIL snippet.

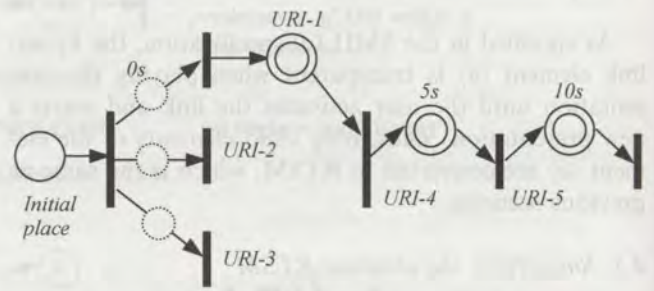
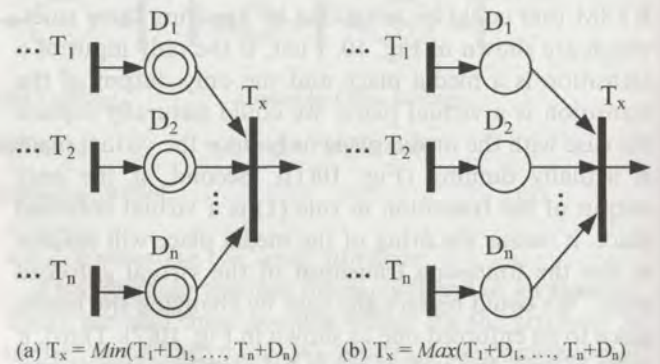


Fig. 14. Reduced RTSM for the sample SMIL snippet.

transition, we have to traverse the RTSM. Since there is usually more than one place that feeds to a transition, the behavior of a transition depends on the type of places that feed into it. If a transition is fed by some enforced places, the enforced places will dominate the behavior of the transition. In other words, if a transition is fed by some enforced places, the other regular places cannot affect the firing time of the transition at all. Therefore, we reduce the RTSM by removing the regular places that feed to a transition with enforced places. The reduced RTSM for the example in Fig. 13 is shown in Fig. 14.

The firing time for each transition is then computed by traversing the reduced RTSM. There are only two possibilities for one transition in the reduced RTSM: (1) places that feed to the transition are all enforced places, or (2) places that feed to the transition are all regular places. For case (1), the firing time of the transition is the minimal value of “the firing time of the preceding transition” + “the duration of the following place”, which is illustrated in Fig. 15(a). The firing time of the transition for case (2) is instead the maximum value of its predecessors as illustrated in Fig. 15(b). The duration of each place depends on the type of the media object. For an enforced place of time medium, the duration of the place is the value of the time duration. For static media objects, such as ** and *<text>*, the duration of the

Fig. 15. Determine the firing time for transition T_x .

place is zero. For continuous media object like *<audio>* and *<video>*, the duration of the place is the implicit duration of the object that is provided by the data server. Since the objects stored in a data server are all pre-orchestrated, it is easy for the data server to obtain the implicit duration of a continuous object.

After the traversing process mentioned above, there may be some cases of inconsistency that the firing time of a transition is later than the firing time of its following transition. The reason is that removing the regular places of a transition with some enforced places in the reduction stage only affects the firing time of the following

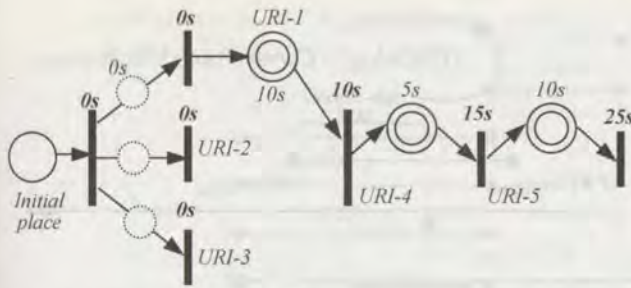


Fig. 16. The firing time for each transition for the sample SMIL snippet.

transitions. However, the enforced firing of a transition should also make all the preceding transitions fire simultaneously. Thus, the solution to remove the inconsistency is to replace the firing time of a transition with the firing time of its following transition while the firing time of the transition is later than that of its following transition. Assuming that the intrinsic duration of the audio object *URI-1* in Fig. 14 is 10 s, the firing time of each transition for the example is shown in Fig. 16.

5.2. Calculate the object request time for user actions

The objects that should be retrieved (played) depend on the user action since different user actions result in different playback patterns and different playback times of objects. In this section, the mechanism to determine the proper object (or part of an object) to be played as well as the object request time for each user action is presented.

As mentioned in Section 5.1, the data server provides the intrinsic duration of each object to determine the original playback duration. Moreover, in order to determine the proper objects to play and the object's playback time as well as the object request time under possible user actions, the object-retrieving engine has to collect other information for each object from the data server. When the object-retrieving engine accepts the SMIL script, it sends probe packets to all data servers for asking the object information, which includes *object size*, *estimated bandwidth*, and *play rate*.

The data server estimates the bandwidth for the object to the object-retrieving engine. The *estimated bandwidth* is used to estimate the delay of an object from the server to the client. There are two factors that affect the item: (1) the transmission rate of the server for the requested object, and (2) the effective network bandwidth of the path from the server to the client. The transmission rate depends on the load of the server and the capacity of the outgoing link. The effective network bandwidth could be measured by some bandwidth measuring mechanisms (Bolliger and Gross, 1999; Lai and Baker, 1999; Paxson, 1999). The estimation of the end-to-end bandwidth for retrieving an object is beyond

the scope of the paper. If the server cannot provide information about the estimated bandwidth, it should inform the client to perform the estimation by itself.

The *play rate*, which is only valid for continuous objects, indicates the amount of data that is played within unit time for a continuous object and is used for locating any part of the object. We denote the object size for object *URI-*i** as $Size_{URI-i}$, the estimated bandwidth as $EstBW_{URI-i}$, and the play rate as $PlayRate_{URI-i}$.

In addition to object related information, the object-retrieving engine also has to estimate the time for the request packet arrived to the data server. We use the round trip delay, denoted by $RTDelay_{URI-i}$ as the estimated value for the delay of the request packet to the server. Thus, the total time to retrieve an object is the summation of the delay of the request packet and the transmission time of the object from the data server to the client site. That is, the retrieving time for object *URI-*i** is estimated as $(Size_{URI-i}/EstBW_{URI-i}) + RTDelay_{URI-i}$. The object-retrieving engine then fills in the *object information table*, which is shown in Fig. 17, as a reference for computing the object request time.

5.2.1. Play action

For each action made by the user, the player passes the action ID and associated parameters to the object-retrieving engine as presented in Section 3. *CurrentPoint* is the only parameter that is passed to the engine, and it is a time point within the total presentation time to indicate the starting point of the playback. The default action for viewing a presentation should be the play action with *CurrentPoint* = 0 s, i.e. the beginning of the presentation.

The original playback duration in the object information table is used as a reference to identify the objects that should be played for the user action. Note that the values of the original playback duration ($PBTime_{URI-i}$, $PBEnd_{URI-i}$) for an object in the table are relative to the beginning (*CurrentPoint* = 0 s) of the presentation.

ID	By RTSM		By Data Server			
	<i>PBTime</i>	<i>PBEnd</i>	<i>Size</i>	<i>EstBW</i>	<i>PlayRate</i>	<i>RTDelay</i>
URI-1	5 sec	10 sec	40KB	10KBps	8KBps	0.1 sec
URI-2	...	...	...	...	...	...
...						

(*PBTime*, *PBEnd*): original playback duration for the object

EstBW: estimated bandwidth for the object from the server to the client

PlayRate: only valid for continuous objects like audio or video

RTDelay: round-trip delay measured by the object-retrieving engine

Fig. 17. The object information table.

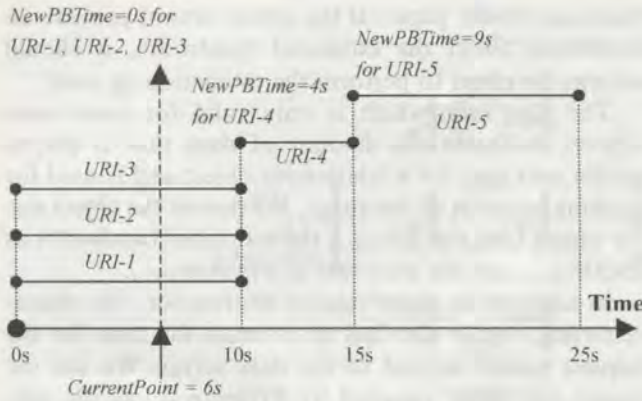


Fig. 18. An example for the play action.

Therefore, objects with original playback time later than *CurrentPoint* should be played for the play action, and the new playback time for the object is $PBTime_{URI-i} - CurrentPoint$, which is denoted by $NewPBTime_{URI-i}$. In other words, the object should be played $NewPBTime_{URI-i}$ seconds later after starting the playback for the new user action. An example for illustration of the new playback time for the play action is shown in Fig. 18. Finally, the object request time is computed as $NewPBTime_{URI-i} - (Size_{URI-i}/EstBW_{URI-i} + RTDelay_{URI-i})$.

Because of the random user actions, there are cases that *CurrentPoint* does not align to the $PBTime_{URI-i}$ of an object but within the original playback duration of the object. In such case, the new playback time for the object becomes 0 s (i.e. beginning of the new playback) and the retrieving pattern depends on the type of the object. For static objects like images and text, since they are not temporally divisible, the object-retrieving engine should still retrieve the whole object. For continuous objects like video and audio, only part of the object should be retrieved. From time point of view, the retrieved part of the continuous object, which is called *sub-object*, is related to the new playback duration for the object. The new playback duration is actually from *CurrentPoint* to $PBEnd_{URI-i}$. For instance, the new playback duration for URI-1 (audio) and URI-2 (video) in Fig. 18 is (6 s, 10 s). The size for the sub-object denoted by $SubSize_{URI-i}$ is computed as $(PBEnd_{URI-i} - CurrentPoint) * PlayRate_{URI-i}$. Therefore, the retrieving time for the sub-object becomes $(SubSize_{URI-i}/EstBW_{URI-i} + RTDelay_{URI-i})$. An illustration for the calculation of a sub-object is shown in Fig. 19. The object request time for the sub-object is then computed as $NewPBTime_{URI-i} - (SubSize_{URI-i}/EstBW_{URI-i} + RTDelay_{URI-i})$.

The calculation of the object request time is based on the $NewPBTime$ for the object. Since the value of $NewPBTime$ is relative to the starting time of the new playback for the user action, the object request time is also relative to the starting time of the playback. A negative value of the object request time implies that the request for the object should be issued before the play-

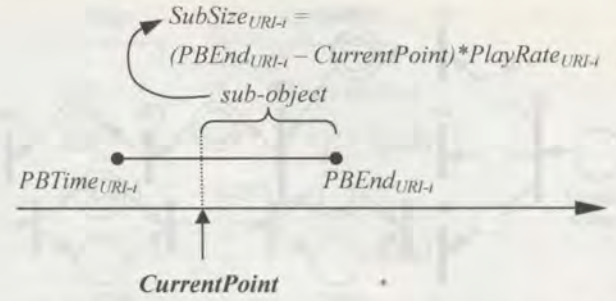


Fig. 19. Illustration for locating a sub-object.

back of the presentation for the user action. Therefore, when the user action is made, the playback of the presentation should be delayed by the maximum negative value of all the object request times, which is the initial delay for the user action.

5.2.2. Pause/restart

When the user makes the pause action, the object-retrieving engine stops all the pre-fetching process and waits for the next user action. The restart action is assumed to follow the pause action to continue the presentation in play mode. Therefore, the *CurrentPoint* parameter associated with the restart action indicates the next playback point of the presentation. The operation of the object-retrieving engine is thus the same as that of the play action.

5.2.3. Fast forward

Two parameters, *JumpPeriod* and *PlaybackPeriod*, define the forwarding pattern and *CurrentPoint* indicates the starting point of the presentation as mentioned in Section 3. In order to identify the objects or sub-objects that should be retrieved under this action, we have to scan the original playback duration in the object information table from *CurrentPoint* to the end of the presentation. The summation of *JumpPeriod* and *PlaybackPeriod* is used as the cycle time to scan the original playback durations. The overlapping duration of an object with *PlaybackPeriod* is the sub-object to be retrieved and to be played.

We use the example in Fig. 20 to illustrate the iterative process. The playback duration for each object, which is derived from the sample SMIL document, is shown in the upper part of the figure. It is assumed that the user made the fast forward action while the playback of the presentation reaches the time point of 6th second, and *JumpPeriod* and *PlaybackPeriod* are 5 and 2 s respectively. Therefore, the duration from 6th to 8th second is the first part of the presentation to be played, 13th to 15th second is the next part to be played, and then 20th to 22nd second, etc., as shown in the figure. The above time periods are then used to locate the part of an object to be retrieved, and the pre-fetch timetable for the fast forward action is set up as shown in Fig. 21.

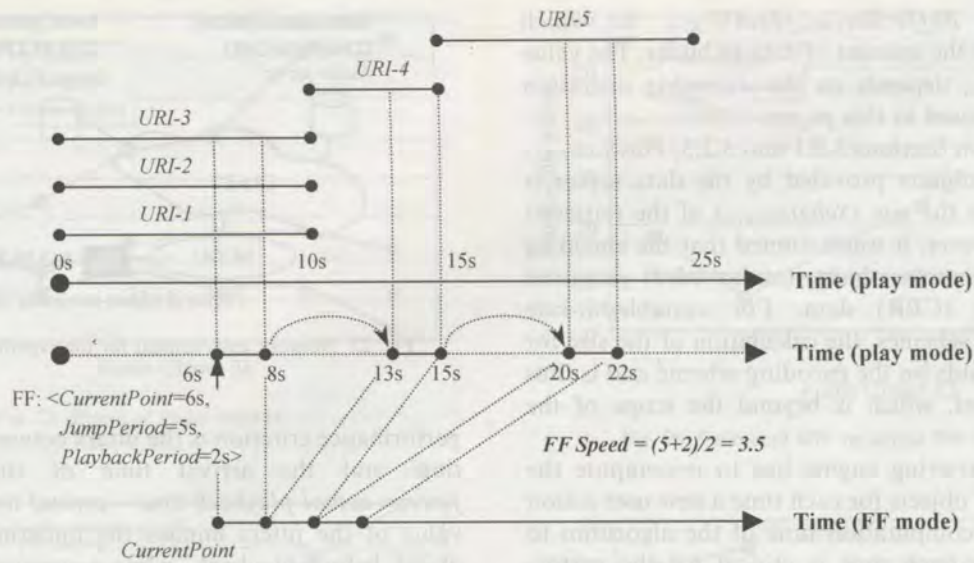


Fig. 20. An example of fast forward operation.

Note that in the pre-fetch table in Fig. 21, the sub-object fields for *URI-3 (text)* and *URI-4 (image)* are invalid since they are static objects, which means the whole object for *URI-3* and *URI-4* should be retrieved.

The retrieving time for sub-object *URI-i* with duration *PlaybackPeriod* is calculated as $(\text{PlaybackPeriod} * \text{PlayRate}_{\text{URI-}i}) / \text{EstBW}_{\text{URI-}i} + \text{RTDelay}_{\text{URI-}i}$. The new playback time for each sub-object depends on the count of iteration in which the object is scanned, and it is calculated as $\text{PlaybackPeriod} * \text{IterationCount}$. The pre-fetch time (object request time) is then computed as the new playback time minus the retrieving time of the sub-object. After setting up the pre-fetch timetable, the object-retrieving engine makes requests to retrieve objects (or sub-objects) according to the pre-fetch time for each

object. Note that when a new user action is made, the object-retrieving engine updates the pre-fetch timetable with the new computed pre-fetch time for each object.

5.2.4. Fast backward

The operation of the object-retrieving engine for the fast backward action is similar to that of the fast forward action, and the only difference is that the direction of the scanning process is reverse as shown in Fig. 4. Computation of the retrieving time and the pre-fetch time is the same as in the fast forward action. Note that the object-retrieving engine is only responsible for retrieving proper data for the player, so the ability of reversing the playback of continuous objects depends on the player. If the player cannot provide the reverse playback of the object data, it should just play the retrieved data in the normal (forward) direction.

5.2.5. Sliding

When the user uses the slider to change the playback point of the presentation, the player must determine the next playback point and passes the value (*NextPlaybackPoint*) to the object-retrieving engine. Thus the value of *NextPlaybackPoint* indicates the time point of the presentation to be played. It is assumed that the sliding action results in the normal playing mode from the new playback point, so the operation of the object-retrieving engine is the same as that of the play action.

5.2.6. Discussion

If the data server supports the streaming mechanism for continuous objects, it is not necessary to retrieve the whole content of the object before its playback time. Only the amount of data to support the streaming operation is required. Thus, the transmission time of

CurrentPoint: 6s

Action: fast forward, *JumpPeriod*=5s, *PlaybackPeriod*=2s

Relative to CurrentPoint

Obj ID	sub-object	NewPBTime	end time	pre-fetch time
URI-1	6s ~ 8s	0s	2s	$\text{NewPBTime} - \text{retrieval time}$
URI-2	6s ~ 8s	0s	2s	$\text{NewPBTime} - \text{retrieval time}$
URI-3	N/A	0s	2s	$\text{NewPBTime} - \text{retrieval time}$
URI-4	N/A	2s	4s	$\text{NewPBTime} - \text{retrieval time}$
URI-5	5s ~ 7s	2s + 2s	6s	$\text{NewPBTime} - \text{retrieval time}$

Fig. 21. Pre-fetch timetable.

the object is $BufferSize_{URI-i}/EstBW_{URI-i}$, in which $BufferSize_{URI-i}$ is the amount of data to buffer. The value of $BufferSize_{URI-i}$ depends on the streaming operation and is not addressed in this paper.

As presented in Sections 5.2.1 and 5.2.3, $PlayRate_{URI-i}$ for continuous objects provided by the data server is used to calculate the size ($SubSize_{URI-i}$) of the retrieved sub-object. However, it was assumed that the encoding scheme for continuous objects (audio/video) generates constant-bit-rate (CBR) data. For variable-bit-rate (VBR) encoding schemes, the calculation of the size for sub-objects depends on the encoding scheme and is thus more complicated, which is beyond the scope of the paper.

The object-retrieving engine has to re-compute the pre-fetch time of objects for each time a new user action is made, so the computation time of the algorithm to calculate the pre-fetch time is critical for the performance of the object-retrieving engine. The scanning process for determining the objects to be retrieved and for computing the pre-fetch time is only one pass for all objects in the presentation, so the algorithm only takes linear computation time.

The accuracy of end-to-end bandwidth estimation affects the performance of the object-retrieving engine as well as the quality of the presentation. Since the network behavior is very dynamic, it is impossible to exactly estimate the time required to finish the retrieving process for a media object. Thus, we discuss the impact of the accuracy of estimated time to finish the retrieving process for a media object on the performance of the object-retrieving engine.

If the estimated time is more pessimistic (bandwidth is underestimated) than the actual status, the object will be buffered for some time before its playback time. On the other hand, if the estimated time is more optimistic (bandwidth is overestimated) than the actual status (e.g. network is congested), the presentation will probably be paused to wait for the object. Furthermore, if the network bandwidth could be reserved in advance by some booking method, the estimated object request time will be more precise. Hence, the quality of the presentation and the buffer utilization will also be improved.

6. Implementation and performance measurement

We have implemented an experimental system for the feasibility and performance evaluation of the proposed object-retrieving engine. The network environment for the experimental system is shown in Fig. 22. There are two data servers (free web sites) in the system: one is for providing the audio data, and the other is for providing Image/HTML data. All the three object-retrieving policies, *pre-loading*, *passive-loading*, and *just-in-time* are included in the system for performance comparison. The

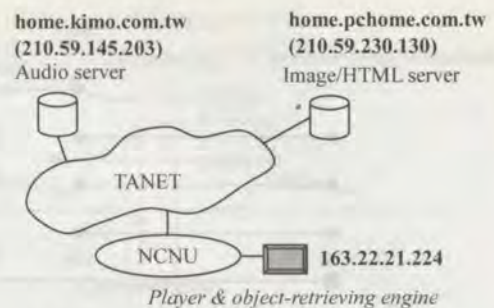


Fig. 22. Network environment for the experimental system.

performance criterion is the jitters between the playback time and the arrival time of the object (i.e. $jitter = actual\ playback\ time - arrival\ time$). A positive value of the jitters implies the buffering time for the object before playback, while a negative value of the jitters indicates the pause time of the playback to wait for the object to arrive. Thus, the value of the jitters closer to zero implies a better performance.

The test SMIL document for performance measurement includes six child elements in the root (*seq*) element and each child element is composed of three media elements (audio, image, and text) with duration 10 s. That is, there are six audio objects, six image objects, and six text objects in the 60-s presentation. The size of the audio objects is 80 K bytes, the size of the image objects is within the range of 20–40 K bytes, and the size of the text objects is within the range of 0.5–13 K bytes.

Since the data servers are free web sites that cannot provide the advanced service like bandwidth estimation, the object-retrieving engine in the system has to estimate the bandwidth by itself. For the just-in-time retrieving policy, the engine measures the average bandwidth from the data server to the client by requesting some test files from the server. The $EstBW$ obtained is then used in the calculation of the object request time as presented in Section 5. Some of the performance measurements are displayed in Figs. 23–25 in which the object-retrieving engine assumed that the *play* action is enabled after loading the test SMIL document ($CurrentPoint = 0\ s$). Figs. 26–28 show the relationship between the estimated bandwidth and the actual end-to-end bandwidth experienced by each object under the just-in-time policy.

The pre-loading policy retrieves all the objects before starting the playback of the presentation, so the later the playback time of an object (which has a larger ID in the test SMIL file), the larger jitters (more buffering time) the object will experience. Therefore, the jitters for the pre-loading policy form a monotonic ascending curve in the figures. On the other hand, the jitters for the passive-loading policy are always negative as shown in the figures, and the value of the jitters depends on the traffic condition and the size of the requested object.

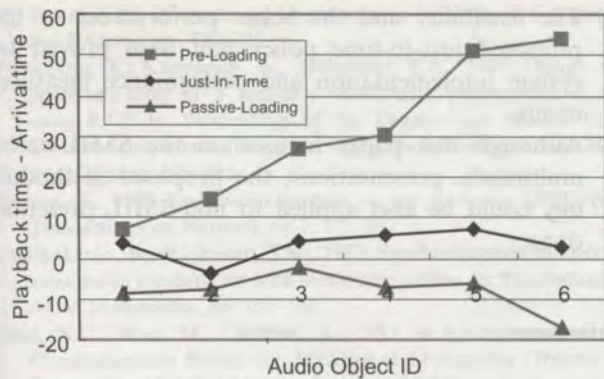


Fig. 23. Jitters of audio objects.

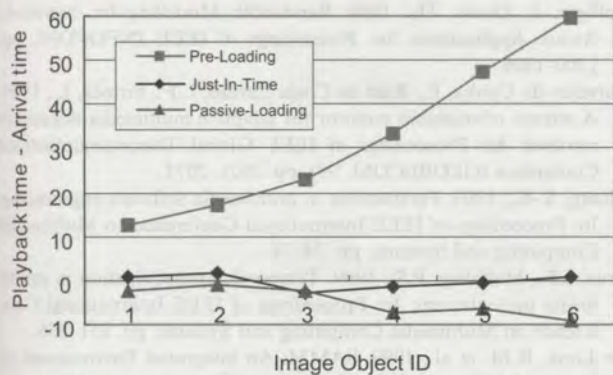


Fig. 24. Jitters of image objects.

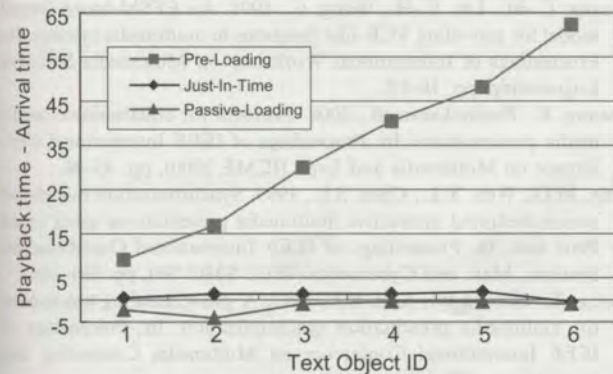


Fig. 25. Jitters of text objects.

Figs. 26–28 show that the actual end-to-end bandwidth fluctuates when the object-retrieving engine retrieves media objects from the servers, so the measured average bandwidth for computing the object request time is imprecise. However, the performance of the just-in-time policy is still better than that of the other two policies, which justifies the idea of the just-in-time policy. Actually, under the same network traffic condition, the jitters of the just-in-time policy should always be smaller than those of the other two extreme policies,

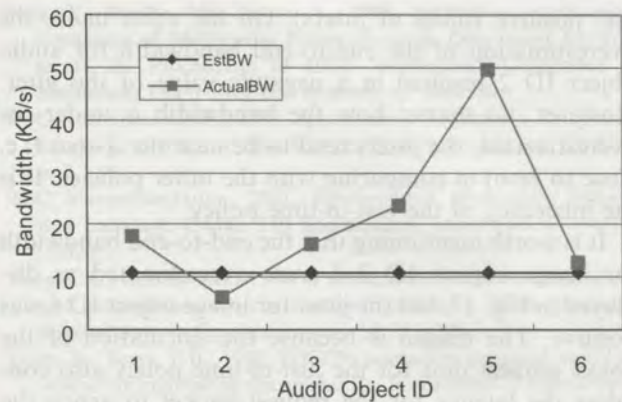


Fig. 26. Estimated BW vs. actual BW for audio.

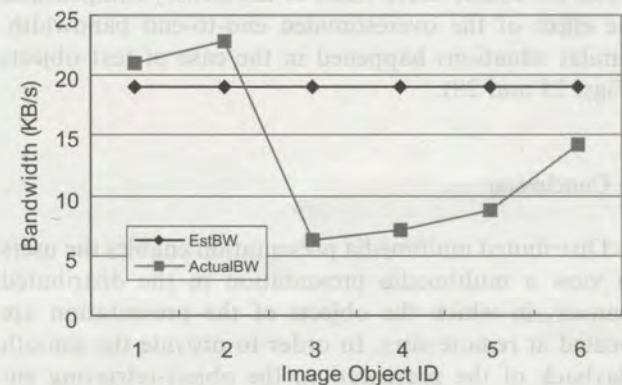


Fig. 27. Estimated BW vs. actual BW for image.

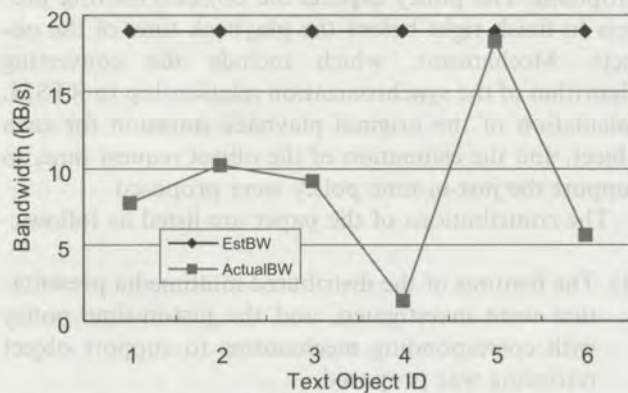


Fig. 28. Estimated BW vs. actual BW for text.

which means the better performance for the just-in-time policy could always be achieved. Some observations for the impact of the bandwidth estimation on the performance of the just-in-time policy are presented in the following.

The end-to-end bandwidth for audio objects ID 1 and 3–6 in Fig. 26 was underestimated, i.e. the estimated bandwidth was less than the actual bandwidth, so all the jitters for these objects in Fig. 23 were above the X -axis

(i.e. positive values of jitters). On the other hand, the overestimation of the end-to-end bandwidth for audio object ID 2 resulted in a negative value of the jitter. However, no matter how the bandwidth is under- or overestimated, the jitters tend to be near the *X-axis* (i.e. close to zero) in comparing with the other policies. It is the inherency of the just-in-time policy.

It is worth mentioning that the end-to-end bandwidth for image objects ID 3–6 were overestimated as displayed in Fig. 27, but the jitter for image object ID 6 was positive. The reason is because the calculation of the object request time for the just-in-time policy also considers the latency for the request packet to arrive the server as presented in Section 5.2. The amount for this latency is estimated as the measured round-trip delay. Thus, the conservative value of the latency compensates the effect of the overestimated end-to-end bandwidth. Similar situations happened in the case of text objects (Figs. 25 and 28).

7. Conclusion

Distributed multimedia presentation enables the users to view a multimedia presentation in the distributed manner, in which the objects of the presentation are located at remote sites. In order to provide the smooth playback of the presentation, the object-retrieving engine for the player must fetch each object before its playback time. In this paper, the just-in-time retrieving policy for distributed multimedia presentations was proposed. The policy expects the object-retrieving process to finish right before the playback time of the objects. Mechanisms, which include the converting algorithm of the synchronization relationship to RTSM, calculation of the original playback duration for each object, and the estimation of the object request time, to support the just-in-time policy were proposed.

The contributions of the paper are listed as follows:

- (1) The features of the distributed multimedia presentation were investigated, and the just-in-time policy with corresponding mechanisms to support object retrieving was proposed.
- (2) The converting algorithm of the synchronization relationship for the SMIL1.0-based multimedia presentation to RTSM was proposed. The conversion provides an easier and systematic way to deal with the temporal relationship of the objects in the presentation.
- (3) Modeling of the user interactions such as fast forward, fast backward, and sliding, etc., for distributed multimedia presentations was proposed. Procedures of the object retrieving for handling the random user actions during the playback of the presentation were also presented in the paper.
- (4) The feasibility and the better performance of the proposed just-in-time policy had been proved by system implementation and performance measurements.
- (5) Although this paper focuses on the SMIL-based multimedia presentations, the proposed methodology could be also applied to non-SMIL presentations.

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ATTACHMENT 7

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 B.A., Rockford University, Rockford, Illinois, 1971

PROFESSIONAL EXPERIENCE

- 1981- Consultant for higher education, non-profit organizations, and corporations.**
- 2002- Adjunct Professor, School of Information, San José State University, San José, California.** Serve as part-time faculty member teaching graduate students in technical services (cataloging, bibliographic control, classification), “core courses,” and special topics.
- 2014-2016 Director, Grants and Resource Development, Colorado Community College System.** Provided leadership and vision to foster the continued growth of rigorous scholarship, innovative projects, and creative work for statewide system, 13 campuses, and 50 teaching sites serving 155,000 students. Responsible for leadership and ensured efficient functioning of contract and grants in compliance with state & federal requirements and successful implementation and management. Served as a subject matter expert and liaison for college Grant Directors for all issues relating to grants and subcontracts.
- 2010-2014 Senior Grant Administrator, Morgridge College of Education, University of Denver (Colorado).** Provided leadership and vision to foster continued growth of rigorous scholarship, innovative research, and creative work in the Morgridge College of Education. Ensure that contract and grants processes function effectively and efficiently for 60 faculty and researchers with a focus on the successful progression and efficient management of grants totaling \$13M. Worked effectively and collegially with Department Chairs and Program Coordinators on operational grant-related management activities and with a broad range of internal and external constituencies. Supported the dissemination and promotion of faculty research and scholarship to outside constituents at conferences and through publications. Assisted Principal Investigators and grant project teams by coaching, mentoring, and financial management.
- 2011-2013 Interim Director & Assistant Dean, Westminster Law Library, Sturm College of Law, University of Denver.** Planned, organized, and directed all administrative activities for the library serving students, faculty, and alumni; oversaw the employment, retention, promotion, transfer and termination of library personnel; represented the library at professional conferences and public meetings; created and promoted a climate and culture of acceptance for new programs and services, a positive high-quality image of the law library, and that reflect the organization’s values, encourage excellent performance, and reward high productivity and innovation; provided leadership and set strategic direction of the organization; ensured that the library provided excellent customer service through solution-oriented staff response to patron needs and by responsiveness and continuous improvement of the organization; promoted, developed, and maintained positive working relationships with colleagues and customers including key stakeholders and groups, higher education institutions, the legal community, other regional libraries and districts statewide, and national library organizations.

- 2007-2014** **Associate Professor, Library & Information Science, Morgridge College of Education, University of Denver (Colorado).** Served in leadership role and worked collaboratively in program, college, campus and community environments. Advised and supervised students, taught core and specialized courses at the graduate level in an integrative, student-centered learning environment. Served on LIS, College, and University committees, and maintained working relationships with colleagues in other academic units and information professionals in the Rocky Mountain region and beyond. Served on and chair doctoral student dissertation committees. Oversaw and facilitated the College and LIS graduate student association.
- 2002-2007** **Assistant Professor, Library & Information Science, College of Education, University of Denver (Colorado).** Served as tenure-track faculty member teaching graduate students in “core courses,” resource description and access, service learning, and independent studies. Advised graduate students, participate on LIS and College committees, and serve on doctoral student dissertation committees. Oversaw and facilitated the LIS graduate student association and alumni association.
- 2000-2002** **Affiliate Faculty, Library & Information Science, College of Education, University of Denver (Colorado).** Served as part-time faculty member teaching graduate students in technical services (cataloging, bibliographic control, classification), “core courses,” and special topics. Oversaw and facilitated the LIS graduate student association and alumni association.
- 2000-2001** **Special Assistant to the Secretary’s Regional Representative, U.S. Department of Education, Region VIII, Denver, Colorado.** Served as the principal advisor and representative of the U. S. Secretary of Education’s Regional Representative (SRR). Ensured the implementation of major goals of the SRR and the Secretary. Provided leadership on behalf of the SRR in contacts with high-level officials in Region VIII requiring sensitive policy interpretation in communication with senior Department officials to solve problems and resolve issues raised by State and local education officials. Served as the primary contact for School-to-Work/Career, Children’s Health Insurance Program, and Safe and Drug-Free Schools. Delivered technical assistance to local education agencies and institutions of higher education in technology, professional development, and school construction.
- 1999-2000** **Catalog Librarian, Jefferson County Public Library, Lakewood, Colorado.** Performed original, copy cataloging and classification of library materials (English and Spanish) using standard library protocols; completed original descriptive cataloging and subject analysis; enhanced brief catalog and authority records in III.
- 1997-1999** **Development Officer, McREL International, Aurora, Colorado.** Served as senior member of corporate management team in strategic planning, development of proposals and contracts, implementation, and evaluation of new services, products, and programs for educational agencies. Provided creative leadership to corporate committees to solicit ideas, identify goals and objectives, plan, develop, present, and evaluate professional development opportunities.
- 1995-1997** **Education Specialist, Education Service Center, Region One, Edinburg, Texas.** Served as member of Administrative Cabinet team in strategic planning, development of proposals and contracts, implementation, and evaluation of telecommunications capabilities, services, products, and programs for 40 school districts serving 283,000 students in 7 counties. Provided creative leadership to regional and state committees to solicit ideas, identify strategic goals and objectives, plan, develop, present, and evaluate funding opportunities and professional development for 400 librarians.

- 1993-1996** **Assistant Professor of Library Science, Sam Houston State University, Huntsville, Texas.** Served as a faculty member teaching 400 graduate students in technical services (cataloging, bibliographic control, classification), automation, and networking. Participated in distance education program and coordinated annual conference. Conducted university and Texas Library Association-funded field research focused on library collection development and academic achievement.
- 1992-1993** **Head Librarian, Rocky Mountain College of Art & Design, Denver, Colorado.** Responsible for the daily operation, selection and acquisition of materials, formulation of policies for library operations, media center, and photography/slides archives. Designed and implemented library automation and delivery of electronic resources to college community.
- 1981-1985** **Development Officer, PRLC, Inc., Pittsburgh, Pennsylvania.** Served as senior member of corporate management team in strategic planning, development of proposals and contracts, implementation, and evaluation of new services, products, and programs for 100 institutional member organizations. Coordinated the development of proposals and contracts totaling \$4,000,000 annually. Provided creative leadership to corporate committees to solicit ideas, identify goals and objectives, plan, develop, present, and evaluate professional development opportunities.
- 1981** **Director of Library Development, Pennsylvania Department of Education, Harrisburg, Pennsylvania.** Responsible for statewide development, technical assistance, professional development, resource sharing, children's services, institutional library services, networking, and state aid program for all libraries throughout the Commonwealth. Functioned as liaison to Governor's Advisory Council, LSCA Advisory Council, District Administrators, private colleges, universities, consortia managers, and network directors. Supervised \$14,000,000 formula-based state aid program and \$3,000,000 grant awards to individual libraries, consortia, and networks.
- 1978-1981** **Assistant Director, Southern Tier Library System, Corning, New York.** Coordinated operation of system-wide programs (technical assistance, professional development, resource sharing, technical services, outreach) to 40 public libraries in 5 counties serving 500,000 residents. Solicited ideas, identified goals, sponsored, and evaluated professional development opportunities and technical assistance sessions.
- 1976-1978** **Division Librarian for Technical Services, Corpus Christi Public Libraries, Corpus Christi, Texas.** Provided leadership in acquisitions, cataloging, serials control, and processing for main library and 4 branches serving 250,000 residents. Participated as senior member of library management team. Compiled and prepared technical evaluations, reports, and statistical analyses of Division operations to measure the achievement and cost of annual goals, objectives, and staff performance.
- 1975-1976** **System Coordinator, San Antonio Major Resource Center, San Antonio, Texas.** Served as senior member of the management team for District X Office, charged to provide technical assistance, resource sharing, media services, and professional development to librarians and staff representing 30 public library jurisdictions in 21 counties serving 1,500,000 residents. Functioned as liaison to System Director, staff, and members of governing bodies with the System Board of Directors and the Texas State Library and Historical Commission. Prepared LSCA grant applications and monitored awards totaling \$1,100,000 annually.

- 1973-1975** **Bilingual Branch Librarian, San Antonio Public Library, San Antonio, Texas.** Worked as librarian providing reference, information, and readers' advisory services in branch serving 50,000 Spanish-speaking residents in southwest San Antonio. Participated in collection development and resource acquisition activities, specializing in children's work, Spanish language resources, and multicultural studies.
- 1972-1973** **Librarian, Holding Institute, Laredo, Texas.** Worked as high school librarian serving 500 boarding students in Spanish-speaking environment of private school. Provided reference, research assistance, and library instruction to students and 35 faculty members.
- 1966-1971** **Rockford Public Library, Rockford, Illinois.** Worked in branches as part-time as a Library Assistant, Clerk, and Page in city library serving 150,000 residents.

PUBLICATIONS

Editor-reviewed Monographs (Completed and in Progress)

Hall-Ellis, Sylvia D., and Mary Bolin. *Contemporary Cataloging in an RDA Environment: A Handbook for Students and Practitioners*. Chicago, IL: American Library Association. Under contract & In development.

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Hall-Ellis-Sylvia D. "Job Design for Cataloging and Metadata Librarians." Submitted to *Journal of Library Administration*. In progress.

Hall-Ellis, Sylvia D. "The Relationship of Situational Leadership and the Dreyfus Model of Skill Acquisition for Supervisors in Cataloging and Metadata Services." To be submitted to *Library Resources and Technical Services*. In progress.

Hall-Ellis, Sylvia D. *The Relationship of Core Competencies on Learning Outcomes and Employers' Expectations for Catalog Librarians and Metadata Specialists*. To be submitted to the *Journal of Education for Library and Information Science*. In progress.

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- Hall-Ellis, Sylvia D. "Competencies for Metadata and Cataloging Leaders: What Employers Expect as Reflected in Position Descriptions, 2000-2016." *Cataloging & Classification Quarterly*. In progress.
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- Hall-Ellis, Sylvia D. "Reward Systems Promote High-Performance Work Teams Achieving Library Mission." *The Bottom Line* 27, no. 2 (April 2014): 66-69.
- Hall-Ellis, Sylvia D. "Investment in Staff Development for Seeking External Grant Funds." *The Bottom Line* 27, no. 1 (January 2014): 22-25.
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- Hall-Ellis, Sylvia D. and Deborah S. Greal. "Service Learning in LIS Education: A Case for Holistic Assessment." *Catholic Library World* 82, no. 3 (March 2012): 178-187.
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Hall-Ellis, Sylvia D. "Visual Arts as Foundation for Successful Library Automation: The Rocky Mountain College of Art & Design Experience." *Art Reference Serials Quarterly* 4 (1994): 43-54.

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Lewis, Melanie, Jamie M. Van Leeuwen, and Sylvia D. Hall-Ellis. *Project Homeless Connect 7 Event Evaluation*. Denver, Colo.: University of Colorado Denver, 2009.

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- Hall-Ellis, Sylvia D. *Denver Public Library: Opportunities for Change*. Denver, Colo.: University of Denver, Colorado Community-Based Research Network & Metropolitan Organization of People, 2005.
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- Hall-Ellis, Sylvia D. *Lewis & Clark Fellows Concept Paper for the Bicentennial Commemoration*. Vancouver, Wash.: Lewis and Clark Bicentennial Council, 1998.
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- Hall-Ellis, Sylvia D., Angela J. Kinney and Martha Ann Bace, editors. *Best Practices in Cataloging Education Identified at the 2007 ALCTS Pre-conference: A Special Issue of the Journal for Library and Information Science Education* 49, no. 2 (Spring 2008).

- Hall-Ellis, Sylvia D. *Cataloging Education: A New Emphasis for the Library and Information Science Curriculum*. Presentation delivered to the ALCTS Pre-conference, 132nd Annual Conference, American Library Association, Washington, D.C., June 22, 2007. <http://www.loc.gov/aba/professional/>
- Hall-Ellis, Sylvia D. “*Cataloger Competencies: Do the Employers Require What the Professors Teach?*” Presentation delivered to the ALCTS CCS Heads of Cataloging Discussion Group, 131st Annual Conference, American Library Association, New Orleans, Louisiana, June 26, 2006. <http://dlist.sir.arizona.edu/>
- Hall-Ellis, Sylvia D., guest editor, with Deborah S. Grealy, Clara L. Sitter, and Tassos Petrou. *Library Students’ Voices in Colorado: An Issue of Colorado Libraries* 31:1 (Spring 2005).
- Hall-Ellis, Sylvia D., ed. *Library and Information Science Program Self-Study Document for Accreditation by the American Library Association*. Denver, Colo.: University of Denver, College of Education, 2003. 125 p. with CD-ROM.
- Hall-Ellis, Sylvia D. and Deborah S. Grealy, guest editors. *Library Education in Colorado: An Issue of Colorado Libraries* 29, no. 2 (Summer 2003).
- Hall-Ellis, Sylvia D., ed. *Library and Information Science Program Self-Study Document for Accreditation by the American Library Association*. Denver, Colo.: University of Denver, College of Education, 2003.
- Hall-Ellis, Sylvia D. “Adaptive Furniture for the ADA-Qualified: An Investigative Study.” 2001. Unpublished manuscript.
- Hall-Ellis, Sylvia D. “Cataloging Electronic Serials: A Study in User Access and Article Delivery.” 2001. Unpublished manuscript.
- Hall-Ellis, Sylvia D. “E-books: Acquisition and Circulation Issues in Public Libraries.” 2001. Unpublished manuscript.
- Hall-Ellis, Sylvia D. “Authority Control and Its Importance in School Library Media Online Catalogs.” 1999. Unpublished manuscript.
- Hall, Sylvia D. “Cooperation Improving Service in San Antonio System.” *Texas Libraries* XXXVII (Spring 1976): 27-29.
- Hall, Sylvia D. “Summer is Sea Monstrously Fun!” *Texas Library Journal* L (December 1974): 224-226.
- Hall, Sylvia D. “A Brief Annotated Bibliography of Non-book Materials on the Mexican American.” *Texas Library Journal* XLVIII (October 1972): 213-232.

Book Reviews

- ALA Book of Library Grant Money*. Ann Kepler, ed. 8th ed. Chicago, IL: American Library Association, 2011. 978-0-8389-1058-0, \$175.00 [*Colorado Libraries*, June 2012]
- Developing a Compensation Plan for Your Library*. Paula M. Singer and Laura L. Francisco, comps. 2nd ed. Chicago, IL: American Library Association, 2009. 978-0-8389-0985-0, \$57.00 [*Colorado Libraries*, March 2012]
- Frugal Librarian*. Carol Smallwood, ed. Chicago, IL: American Library Association, 2011. 978-0-83891-075-7, \$42.00 [*Colorado Libraries*, February 2012]

- Dowlin, Ken. *Getting the Money: How to Succeed in Fundraising for Public and Nonprofit Libraries*. Westport, Conn.: Libraries Unlimited, 2008. 978-1-59158-597-X, \$50.00 [*Colorado Libraries*, February 2009]
- Lundahl, Mats. *Bebo de Cuba; Bebo Valdés y Su Mundo*, by Mats Lundahl. Traducción de Linda Oakeshott Dragó. Barcelona: RBA Libros, 2008. 978-849-86-7259-6, \$33.99 [*Críticas*, November 2008]
- Bonelli, Florencia. *Marlene*, by Florencia Bonelli. Buenos Aires: Aguilar, Altea, Taurus, Alfaguara, 2008. 978-987-04-0995-3, \$24.95 [*Críticas*, October 2008]
- Keret, Etgar. Traducción de Ana María Bejarano. *Pizzería Kamikaze y Otras Relatos*. México, D.F.: Editorial Sexto Piso, 2008. 968-5679-29-0, no price given [*Críticas*, September 2008]
- Littauer, Marita, and Florence Littauer. *Enriquece tu Comunicación. Miami, Fla.: Editorial Unilit, 2008. 978-0-7899-1521-4, \$11.99 [*Críticas*, August 2008]*
- Martínez, Guillermo. *La Muerte Lenta de Luciana B.* New York: Rayo Planeta, 2008. 978-0-06-156551-9, \$14.95 [*Críticas*, May 2008]
- Matthews, Joseph R. *The Evaluation and Measurement of Library Services*. Westport, Conn.: Libraries Unlimited, 2007. 978-1-59158-532-9, \$50.00 [*Colorado Libraries*, April 2008]
- Gómez-Jurado, Juan. *A Masacre de Virginia Tech: Anatomía de una Mente Torturada*. Barcelona: Ediciones El Andén, 2007. 978-84-935789-4-7, €16.50 [*Críticas*, February, 2008]
- Matthews, Joseph R. *Library Assessment in Higher Education*. Westport, Conn.: Libraries Unlimited, 2007. 978-1-59158-531-2, \$45.00 [*Colorado Libraries*, February 2008]
- Chacón, Inma. *La Princesa India: Cuando el Viento Azul*. México: Alfaguara, 2006. 970-770398-9, \$19.95 [*Críticas*, June 2006]
- Vargas Llosa, Mario. *Israel/Palestina: Paz o Guerra Santa*. fotogs. by Morgana Vargas Llosa. Spain/U.S.: Aguilar: Santillana, 2006. 84-03-09691-7, paper, \$19.95 [*Críticas*, May 2006]
- Findlay, Diane. *Digging into Dewey*. Fort Atkinson, Wisc.: Upstart Books, 2005. 978-1-932146-18-9, \$16.95 [*Colorado Libraries*, May 2006]
- Pequeñas Resistencias 4: Antología del Nuevo Cuento Norteamericano y Caribeño*. Menéndez, Ronaldo, Ignacio Padilla & Enrique del Risco, eds. Madrid: Páginas de Espuma, 2005. 84-95642-59-X, paper, \$36.95 [*Críticas*, April 2006]
- Rueda, André. *Vengo a Salvar a España: Biografía de Un Franco Desconocido*. Madrid: Nowtilus (Investigación Abierta), 2005. photogs., bibliog. 84-9763-202-8, paper, \$23.95 [*Críticas*, March 2006]
- Becerra, Ángela. *El Penúltimo Sueño*. 1st ed. Barcelona: Planeta, 2005. 84-08-05795-2, \$25.95. [*Críticas*, January 2006]
- Aguilar Camín, Héctor. *La Conspiración de la Fortuna*. 1st ed. México: Planeta, 2005. 970-37-0368-2, \$19.95 [*Críticas*, October 2005]
- México en Sus Libros*. Enrique Florescano with Pablo Mijangos, editors & compilers. 1st ed. México, D.F.: Taurus Aguilar, 2004. 968-19-0783-3, \$16.95 [*Críticas*, September 2005]

- Historia Económica de México*. Coordinator, Enrique Semo. México: Universidad Nacional Autónoma de México, Editorial Oceano de México, 2004. 13 vols. 970-32-0805+3 (obra completa), \$9.25 each [*Críticas*, August 2005]
- Czarnowsky, Christyne A. and Michael H. Williams. *Managing Your Wired Workforce: A Practical Guide*. Denver, Colo.: Bradford Pub., 2003. 1-883726-79-4, \$24.95 [*Colorado Libraries*, 2004]
- Abraham Lincoln*. Colección Grandes Biografías. Madrid: Edimat Libros, 2003. 84-8403-858-0, €4.95 [*Críticas*, 2004]
- Alponte, Juan María. *Colón: el Hombre, el Navegante, la Leyenda*. México, D.F.: Aguilar, 2003. 968-19-1260-8, \$16.95 [*Críticas*, 2004]
- Olcese Salvatecci, Alfieri. *Cómo Estudiar con Éxito: Técnicas y Hábitos Para Aprender Mejor*. México, D.F.: Alfaomega Grupo Editor, 2002. 970-15-0764-9 [*Críticas*, 2003]
- Mujeres Como Islas: Antología de Narradoras Cubanas, Dominicanas, Puertorriqueñas*. Edición: Olga Marta Pérez, Thelma Jiménez, Andrés Blanco D., eds. Santo Domingo, República Dominicana: Ediciones Ferilibro, 2002. 959-209-419-5 [*Críticas*, 2003]
- Tibol, Raquel. *Los Murales de Diego Rivera: Universidad Autónoma Chapingo*. México, D.F.: Editorial RM, Universidad Autónoma Chapingo, 2002. 968-5208-08-5 [*Críticas*, 2003]
- Lindsay-Poland, John. *Emperors in the Jungle: the Hidden History of the U.S. in Panama*. Durham, N.C.: Duke University Press, 2003. 0-8223-3098-9, \$18.95 [*Críticas*, 2003]
- Kaplan, Allison G. and Ann Marlowe Riedling. *Catalog It! A Guide to Cataloging School Library Materials*. Worthington, Ohio: Linworth Pub., 2002. 1-58683-014-7, \$44.95 [*Colorado Libraries*, 2002]
- Bardach, Ann Louise. *Cuba Confidential: Love and Vengeance in Miami and Havana*. New York: Random, 2002. 0-375-50489-3, \$25.95 [*Library Journal*, 2002]
- Swan, James. *Fundraising for Libraries: 25 Proven Ways to Get More Money for Your Library*. New York: Neal Schuman, 2002. 1-55570-433-6, \$69.95 [*Colorado Libraries*, 2002]
- Puig de Lange, Victoria. *Sol Con Agua*. Nashville, Tenn.: Editorial Vistazo/Ediciones Reio Negro, 2002. 0-9724506-0-2, \$17.75 [*Críticas*, 2002]
- The Encyclopedia of Latin American Politics*. Edited by Diana Kapiszewski; assistant editor, Alexander Kazan. Westport, Conn.: Oryx Press, 2002. 1-57356-306-4, \$74.95 [*Library Journal*, 2002]
- Vargas Lizano, Isabel. *Y Si Quieres Saber de Mi Pasado*. Con la colaboración de J.C. Vales. Madrid: Santillana Ediciones Generales, S.L., 2002. 84-03-09278-4, \$18.95 [*Críticas*, 2002]
- Ruy Sánchez, Alberto. *Los Jardines Secretos de Mogador: Voces de Tierra*. México, D.F.: Alfaguara, S.A., 2001. 968-19-0879-1, \$16.95 [*Críticas*, 2002]
- Chávez, Ricardo and Celso Santajuliana. *El Final de las Nubes*. Barcelona: RBA Libros, S.A., 2001. 84-7901-760-0, \$11.95 [*Críticas*, 2002]

The Power of Language / El Poder de la Palabra: Selected Papers from the Second REFORMA National Conference. Edited by Lillian Castillo-Speed and the REFORMA National Conference Publications Committee. Englewood, Colo.: Libraries Unlimited, 2001. 1-563089459, \$35.00 [*Colorado Libraries*, 2001]

Martínez, Rubén. *Crossing Over: A Mexican Family on the Migrant Trail.* Metropolitan: Holt, 2001. 0-8050-4908-8, \$26.00 [*Library Journal*, 2001]

Guevara, Ernesto "Che." *The African Dream: the Diaries of the Revolutionary War in the Congo.* Translated from the Spanish by Patrick Camiller. With an introduction by Richard Gott and a foreword by Aleida Guevara March. New York: Grove Press, 2001. 0-8021-3834-9, \$13.00 [*Library Journal*, 2001]

Cooper, Gail and Garry Cooper. *New Virtual Field Trips.* Englewood, Colo.: Libraries Unlimited, 2001. 1-56308-887-8, \$27.50 [*Colorado Libraries*, 2001]

NATIONAL SERVICE & PROFESSIONAL AFFILIATIONS

American Library Association, Life Member

Association for Library Collections & Technical Services (now CORE)

Cataloging, Classification, and Metadata Section

Margaret Mann Citation Committee, 2023-

ALCTS Editorial Board, Member, 2015-2019

Committee on Cataloging: Description and Access, Member, 2008-2012

Test Site for RDA, Manager, 2009-2011

Nominating Committee, Member, 2007-2008

Committee for Education and Training of Catalogers, Chair, 2006-2007, Member, 2003-2007

Competencies & Education for a Career in Cataloging Interest Group, Chair, 2010-2012; Member, 2010-

President's Program Committee, 2015-2016

Education Committee, Member, 2005-2007

Task Force on Competencies and Education for a Career in Cataloging, Chair, 2007-2009

2007 Annual Meeting Pre-conference, "What They Don't Teach in Library School: Competencies,

Education and Employer Expectations for a Career in Cataloging," Steering Committee Chair

Fundraising Committee, Member, 2004-2006

Office of Diversity

Committee on Diversity, Chair, 2010-2011

Diversity Research Advisory Committee, Member, 2009-2010

Spectrum Scholar Mentor, 2009

Diversity Grants Review Committee, Member, 2007, 2010, 2012

Office of Statistics and Research

Research and Statistics Committee, Member, 2005-2007; Intern, 2003-2005

Library Research Round Table

Nominating Committee, 2022-2023

Membership Committee, 2019-2021

Board of Directors, Member At-Large, 2009-2012

Office of Accreditation

Accreditation Panel Member (training completed 2004)

Accreditation Review Panel Member (training completed 2004)

REFORMA, Life Member

National Board of Directors, 2005-2013

National Fundraising Chair, 2005-2013

National Recruiting and Mentoring Committee, 2008-2010

Colorado Chapter, Secretary, 2004-2005

Colorado Chapter Liaison to National Board of Directors, 2004-2013

American Association of Law Libraries (AALL), Life Member Online Audiovisual Catalogers Association (OLAC) Colorado Association of Law Librarians (CoALL)

American Association of University Women Association for Library and Information Science Education (ALISE)

University of Denver ALISE Representative, 2003-2008; 2010-2011

Membership Advisory Committee, 2007-2010

Technical Services Education Special Interest Group, 2003-

Garfield Doctoral Dissertation Award Reviewer, 2012

Garfield Doctoral Dissertation Scholarship Reviewer, 2014

American Association of University Professors (AAUP), 2006-

American Grant Writers Association, 2014- Grant Professionals Institute, 2016- National Grants Management Association, 2014-

Grant Reviewer (National and Regional Team Leader), U.S. Department of Education, 1998- Grant Reviewer, Broadband Technologies Opportunity Program, U.S. Department of Commerce, 2009
Grant Reviewer, Institute of Museum and Library Services, 1998-2000
Grant Reviewer, Colorado Department of Education, 2014-
Grant Reviewer, Colorado State Library, 1998-
Grant Reviewer, American Association of Community Colleges *Working Connections* program, 1999
Peer Reviewer, *Journal for Library and Information Science Education*, 2005-
Peer Reviewer, *Journal of Library Metadata*, 2009
Peer Reviewer, *International Journal of Library and Information Science*, 2011
Regular Columnist, *The Bottom Line*, 2013-2016
Book Reviewer, *Library Journal*, 2001
Book Reviewer, *Criticas*, 2002-2009
Book Reviewer, *Colorado Libraries*, 2000-2012

REGIONAL SERVICE & PROFESSIONAL AFFILIATIONS

Mountain Plains Library Association

Professional Development Grants Committee, Member, 2005-2006
Professional Development Policy and Guidelines Sub-committee Chair, 2006

Colorado Association of Libraries

“Student Voices” Column Editor, *Colorado Libraries*, 2005-2006
Conference Planning Committee, Member, 2002
Technical Services and Automation Division, Chair, 2002-2003; Member, 2000-
Academic Libraries Division, Peer Review Conference Papers Committee, Member, 2007-2009
Education Committee, Member, 1988-1993
Diverse Populations Committee, Member, 2009-2013

SERVICE TO THE UNIVERSITY OF DENVER

Center for Teaching and Learning Faculty Advisory Board, 2007-2008; 2010-2012
Center for Community Engagement and Service Learning Advisory Board, 2007-2012
Faculty Senate
Executive Committee, 2008-2013
Nominations, Rules & Credentials Committee, Chair, 2008-2013; Member 2007-2013
Appointment, Promotion, and Tenure Revision Committee, 2010-2012
Grievance Policy Committee Member, 2007-2010
Law Library Director Search Committee Chair, 2012-2013
PROF Grant Review, College Representative to the University Review Team, 2006, 2008
Project Homeless Connect Evaluations, Principal Investigator, 2006-2009
University Technology Council, 2007-2009
University of Denver Hyde Interviews for Incoming Freshmen, 2003-2012

SERVICE TO THE MORGRIDGE COLLEGE OF EDUCATION

Appointment, Tenure & Review Committee
Member, voting, 2003-2005; 2007- 2009
Chair, Clinical Faculty Promotion & Tenure Policy Subcommittee, 2008-2009
Member, Community Engagement Subcommittee, 2007-2009
Member, Tenure Review Panel, 2003
Advancement and Alumni Relations Committee, Chair, 2003-2007; Member, 2002-2007
College Building Committee Member, 2004-2010

College of Education Student Association, Faculty Advisor, 2004-2007; 2009-2010
Faculty Senator, 2007-2013
Research and Scholarship Committee, Chair, 2008-2009; Member, 2002-2003, 2008-2009
Research and Grant Mentoring Committee, Chair, 2009-2010
Research Task Force Member, 2010-2012
Search Committee Member, Assistant Professor for Curriculum & Instruction, 2010-2011
Workload Task Force Member, 2010-2011

SERVICE TO THE LIBRARY & INFORMATION SCIENCE PROGRAM

Library and Information Science Student and Alumni Association, Faculty Advisor, 2002-2008
ALA Student Chapter, Faculty Advisor, 2005-2008
Beta Phi Mu Phi Chapter, Faculty Advisor, 2004-2014
Steering Committee Member, Accreditation by the American Library Association, 2001-2004
Search Committee Member, Associate Professor for LIS, 2006
Search Committee Chair, Assistant Professors for LIS, 2003, 2005, 2006, 2007
Search Committee Ex-Officio Member, Director for LIS, 2004

SERVICE TO SAM HOUSTON STATE UNIVERSITY

Rio Roundup: South Texas Literature Conference, Conference Coordinator, 1993
External Relations, Fund Raising, Grants Committee, Chair, 1993-1995
Advisory Council Committee, Chair, 1993-1995
Students, Admissions, and Advisement Committee, Chair, 1994
Institutional Effectiveness Committee, Member, 1993-1995

SERVICE TO THE COLLEGE OF EDUCATION AND APPLIED SCIENCE

Faculty Affairs Committee, Member, 1993-1995
Curriculum Committee, Member, 1993-1995
Continuing Education Committee, Member, 1993-1995

SERVICE TO THE COMMUNITY

French Teacher & Student Exchange with Laon, France, Monarch High School, Boulder Valley School District (Boulder, Colorado), 2017-
Denver/Boulder Games 2022, Board of Directors, Secretary-Treasurer, 2015-2018
United Way Campaign Committee, College of Education, 2006
Arapahoe County, Election Judge for the County Clerk and Recorder, 2000-2005
Arthritis Foundation, Rocky Mountain Chapter, Certified Educator & Trainer, 1999-2008
Bonfils Blood Center, Silver Level Donor, 2000-2016
Denver Museum of Natural History, Docent, 1992
Tech Prep of the Lower Rio Grande Valley, Inc. (Harlingen, Texas) Board of Directors, 1995-1997
Executive Committee, 1996-1997; Chair, Development Committee, 1995-1997; Chair, Fiscal Agency Committee, 1995-1996; Chair, Colleges and Universities Committee, 1996-1997
Gilpin County (Colorado) Public Library Board of Trustees, 1986-1989; Vice President, 1987-1989
City of Central (Colorado) Economic Development Committee, 1987-1989
Columbine Family Health Centers, Inc. (Nederland and Black Hawk, Colorado) Board of Directors, 1988-1989

CERTIFICATION

Permanent Public Librarian Certificate - Pennsylvania, New York, Texas
Westlaw Expert Witness, 2008-
Certified Grant Writer®, 2016-

AWARDS AND HONORS

Advanced Practitioner for Service Learning and Community Engagement, University of Denver, 2011
Platinum Star Alumnae, College of Information, Library Science & Technologies, University of North Texas, 2009
Commendation for Integration of Technologies in Teaching & Learning Environment, University of Denver, 2006
Outstanding Adjunct Faculty Member Award, College of Education, University of Denver, 2002
Beta Phi Mu, Pi, University of Pittsburgh, 1985
Alpha Lambda Sigma, University of North Texas, 1972
Albert Nelson Marquis Lifetime Achievement Award, Who's Who in America
Who's Who in American Women
Who's Who of Women Executives
Dictionary of International Biography
Who's Who in the East
Who's Who in the South and Southwest
Who's Who in the World
Who's Who of Online Professionals
Who's Who in Library and Information Science
2,000 Notable Women
Who's Who of Emerging Leaders
Who's Who in Professional and Executive Women
Who's Who in American Education
International Who's Who of Professional and Business Women
International Leaders in Achievement
International Educator of the Year
Who's Who in Finance and Industry
Who's Who in Finance and Business

Invited International and National Conference Presentations

Hall-Ellis, Sylvia D. *Presentation of the Robert O. Ellett Endowed Scholarship*. Presentation delivered to the School of Information at San Jose State University Alumni & Student Program, American Library Annal Conference, San Diego, Calif., June 29, 2024.

Driscoll, Margaret, Christy Confetti Higgins, Scott Brown, and Sylvia D. Hall-Ellis. *A View from Within: Open House Tour of Three Canvas Core Courses*. Presentation to be delivered at the School of Information, San José State University Professional Development Seminar, San José, California, October 17, 2019.

Hall-Ellis, Sylvia D. *Invest in Me -- I'm Your Future: Succession Planning for Libraries*. Keynote presentation delivered at the ALCTS President's Symposium, Boston, Mass., January 8, 2016.

Seidel, Kent E. and Sylvia D. Hall-Ellis. *Making Grants Work for You: Strategies for Doctoral Students and Early Career Scholars*. Presentation delivered at the University Council for Educational Administration, Early Career Scholars Session, Indianapolis, Ind., November 9, 2013.

Hall-Ellis, Sylvia D. *So You Want to be a Manager; Leadership Skills and Competencies for Technical Services Managers and Administrators*. Presentation delivered at the 138th Annual Conference, American Library Association, Chicago, Ill., June 29, 2013.

Seidel, Kent E., Karen S. Riley, Lyndsay Agans, Susan Korach, and Sylvia D. Hall-Ellis. *Making Grants Work for You (Instead of Just Working for Grants)*. A panel discussion delivered at the University Council for Educational Administration, Early Career Scholars Session, Denver, Colo., November 17, 2012.

Hall-Ellis, Sylvia D. *After the Great TS Reorganization: The Westminster Law Library*. Presentation delivered at the 137th Annual Conference, American Library Association, Anaheim, Calif., June 23, 2012.

Hall-Ellis, Sylvia D. *Conversations with Catalogers in the 21st Century*. A panel discussion sponsored by the ALCTS Competencies for a Career in Cataloging Interest Group, delivered at the 137th Annual Conference, American Library Association, Anaheim, Calif., June 22, 2012.

Hall-Ellis, Sylvia D., moderator. *Mid-Career Leaders Program*. A panel discussion sponsored by the ALA Committee on Diversity delivered at the 136th Annual Conference, American Library Association, New Orleans, La., June 26, 2011.

Hall-Ellis, Sylvia D., moderator. *Diversity Town Hall*. A community conversation sponsored by the ALA Committee on Diversity delivered at the 136th Annual Conference, American Library Association, New Orleans, La., June 24, 2011.

LaBarre, Kathryn, Sylvia D. Hall-Ellis, Karen Anderson, Rick Hasenyager, Christopher Cronin, and Penny Baker. *Briefings from RDA Test Participants*. A panel discussion delivered at the Midwinter Conference, American Library Association, San Diego, Calif., January 7, 2011.

Miksa, Shawne, Marjorie Bloss, and Sylvia D. Hall-Ellis. *Educating the Next Generation of Catalogers: Teaching RDA*. A panel discussion delivered at the 97th Annual Conference, Association for Library and Information Science Education, San Diego, Calif., January 7, 2011.

Hall-Ellis, Sylvia D., Robert Maxwell, John Hostage, and George Prager. *RDA Panel: What Cataloging Managers Need to Know*. Presentation delivered at the 103rd Annual Conference, American Association of Law Librarians, Denver, Colo., July 12, 2010.

Hall-Ellis, Sylvia D. and Stacey L. Bowers. *Catalogers in the RDA Environment: Skill Sets, Expectations and Challenges*. Presentation delivered at the 103rd Annual Conference, American Association of Law Librarians, Denver, Colo., July 11, 2010.

Hall-Ellis, Sylvia D. *Comfortable in Your Cataloging and Metadata Specialist Skin? Or, So You Want to Hire a Cataloger*. Presentation delivered to the ALCTS Research Group at the 134th Annual Conference, American Library Association, Chicago, Ill., July 11, 2009.

Perez, Megan, Sylvia D. Hall-Ellis, and Denise Anthony. *From Novice to Expert: Collaboration for Succession Planning*. A "hot topic" presentation delivered at the 14th ACRL Conference, Seattle, Wash., March 13, 2009.

Hall-Ellis, Sylvia D. *Cataloging in the RDA Environment: Skill Sets, Expectations and Challenges*. Presentation delivered to the ALCTS Research and Publications Committee at the Midwinter Conference, American Library Association, Denver, Colo., January 24, 2009.

Hall-Ellis, Sylvia D. *LIS Cataloging Education for the 21st Century: Expectations and Challenges*. A panel discussion held at the 95th Annual Conference, Association for Library and Information Science Education, Denver, Colo., January 23, 2009.

Chu, Clara, Sylvia D. Hall-Ellis, and Mark Winston. *The Doctoral Degree & Building a Career*. A panel discussion delivered at the ALA Office of Diversity Spectrum Doctoral Fellows E.J. Josey Leadership Institute, Midwinter Conference, American Library Association, Denver, Colo., January 20, 2009.

Hall-Ellis, Sylvia D. and Robert O. Ellett, Jr. *Fundamentals of Cataloging Course: An Overview of the ALCTS Online Course*. Presentation delivered to the ALCTS Big Heads Group, 133rd Annual Conference, American Library Association, Anaheim, Calif., June 30, 2008.

Hall-Ellis, Sylvia D. *Employers' Expectations for Technical Services Librarians: What We Don't Know*. Presentation delivered to the ALCTS Research and Publications Committee Program, 133rd Annual Conference, American Library Association, Anaheim, Calif., June 28, 2008.

Hall-Ellis, Sylvia D., Virginia R. Maloney, and Mary Stansbury. *Institutional Responses to Engaged Scholarship: The Carnegie Foundation Engaged University Classification at Two Universities*. Presentation delivered to the 94th Annual Conference, Association for Library and Information Science Education, Philadelphia, Pa., January 11, 2008.

Hall-Ellis, Sylvia D. *Puzzles, Problems, and Predicaments*. Presentation delivered to the ALCTS Research Discussion Group, 132nd Annual Conference, American Library Association, Washington, D.C., June 23, 2007.

Hall-Ellis, Sylvia D. *Cataloging Education: A New Emphasis for the Library and Information Science Curriculum*. Presentation delivered to the ALCTS Pre-conference, 132nd Annual Conference, American Library Association, Washington, D.C., June 22, 2007. <http://www.loc.gov/catdir/cpsocareercat.html>

Ellett, Jr., Robert O. and Sylvia D. Hall-Ellis. *Copy Cataloging Done Smarter*. Presentation delivered to the International Conference on Interdisciplinary Information Sciences and Technologies (InSciT2006), October 25-28, 2006.

Hall-Ellis, Sylvia D. and Robert O. Ellett, Jr. *Cooperative Cataloging: Challenges and Opportunities for Defense Libraries*. Presentation delivered to the 1st Annual Conference of Defense Libraries, Spanish Ministry of Defense, Madrid, Spain, July 7, 2006.

Hall-Ellis, Sylvia D. *Cataloger Competencies: Do the Employers Require What the Professors Teach?* Presentation delivered to the ALCTS CCS Heads of Cataloging Discussion Group, 131st Annual Conference, American Library Association, New Orleans, La., June 26, 2006.

Grealy, Deborah S. and Sylvia D. Hall-Ellis. *From Research to Practice: The Scholarship of Teaching and Learning in LIS Education*. Presentation delivered to the at the 92nd Annual Conference, Association for Library and Information Science Education, San Antonio, Tex., January 18, 2006.

Hall-Ellis, Sylvia D. *Employers' Expectations for Entry-Level Catalogers: What Position Announcement Data Indicate*. Research paper delivered to the Technical Services Special Interests Group, 91st Annual Conference, Association for Library and Information Science Education, Boston, Mass., January 12, 2005.
<http://dlist.sir.arizona.edu/>

Hall-Ellis, Sylvia D. *Common Errors in MARC Records Prepared by LIS Students: What Does It Mean?* Research paper delivered to the ALCTS CCS Cataloging Norms Discussion Group, Mid-Winter Conference, 90th American Library Association, San Diego, Calif., January 10, 2004.

Hall-Ellis, Sylvia D. *Visual Arts as Foundation for Successful Library Automation: The Rocky Mountain College of Art & Design Experience*. Paper delivered at the 6th Annual Conference of Higher Education, Charleston, S. C., 1993.

Hall, Sylvia D. *Design Elements for Bibliographic Databases: An Overview*. Paper delivered at the 14th Online National Conference, New York, 1983.

Invited Regional Conference Presentations

- Hall-Ellis, Sylvia D., Hudson, Christopher D., Brittany Cronin, and Kathryn Michaels. "The Colorado Law Project: Meeting the Public's Need for Legal Information." Panel discussion delivered at the Mountain Plains Library Association Conference, Billings, Mont., April 9, 2011.
- Grealy, Deborah S. and Sylvia D. Hall-Ellis. *Education for Information Professionals in New Mexico: Library & Information Science Graduate Education at the University of Denver*. Presentation delivered at the New Mexico Library Education Summit, Las Vegas, N.M., September 26, 2005.
- Hall-Ellis, Sylvia D. *Public Library-School Library Partnerships*. Presentation delivered at the 3rd Annual Colorado Association of Libraries Conference with the Mountain Plains Library Association, Denver, Colo., October 22, 2004.
- Hall-Ellis, Sylvia D. *Learn All You Can – Educational Partnership Opportunities for the Lewis and Clark Bicentennial Commemoration*. Paper delivered at the 3rd Annual Lewis and Clark Bicentennial Council National Planning Conference, Bismarck, N.D., April 26, 1998.

Invited State Conference Presentations

- Grealy, Deborah S. and Sylvia D. Hall-Ellis. *Academic Library Leadership Changes: Using Succession Planning and Mentoring*. Presentation delivered at the Minnesota Library Education Conference, St. Cloud, Minn., October 10, 2013.
- Hall-Ellis, Sylvia D., Merrie Valliant, and Melissa Powell. *RDA: What Is It and What Do You Need To Do With It At Your Library?* Presentation delivered at the Colorado Library Consortium Spring Conference, Ft. Morgan, Colo., April 26, 2013.
- Hall-Ellis, Sylvia D. *Service Learning and the Library & Information Science Graduate Education at the University of Denver*. Presentation delivered at the 4th LEADS Scholars Orientation, Denver, Colo., August 5, 2009.
- Hall-Ellis, Sylvia D. *Service Learning: Enhancement to Library & Information Science Graduate Education at the University of Denver*. Presentation delivered at the 3rd LEADS Scholars Orientation, Denver, Colo., June 2008.
- Hall-Ellis, Sylvia D. *Law Librarianship: A Community Conversation*. Sponsored by the Colorado Association of Law Libraries. Paper delivered at the Colorado Supreme Court Library, Denver, Colo., May 14, 2008.
- Hall-Ellis, Sylvia D. *Opportunities and Challenges in Law Librarianship: A Community Conversation*. Presentation delivered at the Sturm College of Law, Denver, Colo., November 7, 2007.
- Ellis, Sylvia D. *Grant Writing Resources for Nursing Professionals*. Presentation delivered at the Presbyterian / St. Luke's Health One Medical Center 1st Annual Research Symposium, Denver, Colo., October 17, 2007.
- Hall-Ellis, Sylvia D. *Project Homeless Connect 4 Event Evaluation – Insights and Lessons Learned*. Presentation delivered at the Homelessness Research Symposium: What is DU Doing about Homelessness in Denver, Denver, Colo., September 14, 2007.

Hall-Ellis, Sylvia D. *Service Learning and the Library & Information Science Graduate Education at the University of Denver*. Presentation delivered at the 2nd LEADS Scholars Orientation, Denver, Colo., August 10, 2007.

Hall-Ellis, Sylvia D. *Education for Information Professionals in a Digital Environment: Library & Information Science Graduate Education at the University of Denver*. Presentation delivered at the 15th Spring Mountains and Plains Parapros Conference, Denver, Colo., February 24, 2007.

Hall-Ellis, Sylvia D. *Public Library Service to Spanish-Speaking and Latino Residents in Denver: A Case Study*. Presentation delivered at the 4th Annual Colorado Association of Libraries Conference, Denver, Colo., November 10, 2005.

Hall-Ellis, Sylvia D. *Education for Information Professionals in a Digital Environment: Library & Information Science Graduate Education at the University of Denver*. Presentation delivered at the 14th Annual Mountains and Plains Parapros Conference, Aurora, Colo., July 29, 2005.

Hall-Ellis, Sylvia D. *Educational Opportunities: Library & Information Science Graduate Education at the University of Denver*. Presentation delivered at the 13th Annual Mountains and Plains Parapros Conference, Centennial, Colo., August 6, 2004.

Hall-Ellis, Sylvia D. *Library Education & Training: Focus on the West: An LIS Faculty Member's Personal Response*. Presentation delivered at the 1st Annual Colorado Association of Libraries Conference, Keystone, Colo., October 18, 2002.

Hall-Ellis, Sylvia D. *Grant Writing for School Librarians*. Presentation delivered at the 2002 Annual Colorado Education Media Association Conference, Colorado Springs, Colo., February 15, 2002.

Hall-Ellis, Sylvia D. *Grants – Opportunities for the Future*. Paper delivered at the Southeast Regional Accountability Annual Conference, Lamar, Colo., November 12, 1998.

Hall-Ellis, Sylvia D. *The Texas Library Connection and Interlibrary Loan: An Experiment in Resource Sharing*. Paper delivered at the Texas Computer Educators' Association Annual Conference, Austin, Tex., February 6, 1997.

Hall-Ellis, Sylvia D. *Finding Grant Sources on the Internet: A Guide for Librarians*. Paper delivered at the 2nd Annual Institute for School Library Personnel, Pharr-San Juan-Alamo North High School, Pharr, Tex., July 29, 1996.

Hall-Ellis, Sylvia D. *Mathematical and Logical Thinking: A Critical Intelligence*. Paper delivered at the 3rd Annual Paraprofessional Conference at the University of Texas - Pan American, Edinburg, Tex., March 8, 1996.

Hall-Ellis, Sylvia D. *Cataloging Trends and Issues: Update Session*. Paper delivered at the 1st Annual Institute for School Library Personnel, South Texas Community College, McAllen, Tex., July 19, 1995.

Hall-Ellis, Sylvia D. *Grant Writing: Tips and Encouragement for School Librarians*. Paper delivered at the 1st Annual Institute for School Library Personnel, South Texas Community College, McAllen, Tex., July 18 and 19, 1995.

Hall-Ellis, Sylvia D. *How to Become an Expert Grant Writer*. Paper delivered at the 3rd Annual High School Principals' Academy, South Padre Island, Port Isabel, Tex., June 19, 1995.

Texas Library Study: Results from Regions I and II. Paper delivered at the 3rd Annual Technology Conference, Texas A&M University, College Station, Tex., November 18, 1994.

Hall-Ellis, Sylvia D. *Academic Achievement and Middle School Students*. Paper delivered at the 8th Annual Young Adult Conference, Sam Houston State University, Huntsville, Tex., November 5, 1994.

Hall-Ellis, Sylvia D. *Multimedia Resources for Library Leaders*. Paper delivered at the Institute for Librarians in A Multicultural Environment, Sam Houston State University, Huntsville, Tex., June 10, 1994.

Hall-Ellis, Sylvia D. *Finding the Resource: Empowering the User, or, the Case for Curriculum Based Subject Access to Learning Resource Center Collections*. Paper delivered at the 81st Annual Texas Library Association Conference, Corpus Christi, Tex., April 12-16, 1994.

Hall-Ellis, Sylvia D. and William H. Pichette. *Sam Houston State University Makes Use of OCLC/AMIGOS Collection Analysis CD*. Paper delivered at the 81st Annual Texas Library Association Conference, Corpus Christi, Tex., April 12-16, 1994.

Hall, Sylvia D. *Funding and Library Development in Pennsylvania: A Symbiotic Relationship*. Paper delivered at the Annual Graduate Student Colloquia, University of Pittsburgh, School of Library and Information Science, 1982.

Hall, Sylvia D. *Leadership for Public Library Trustees*. Paper delivered for the Trustees Division, Pennsylvania Library Association Annual Conference, Lancaster, Penn., 1981.

Seminar and Professional Development Presentations

Taylor, Meredith, and Sylvia D. Hall-Ellis. *Talent Management and Succession Planning*. ALCTS eForum, held March 22, 2017.

Hirsh, Sandra, Heather O'Brien, Michelle Holschuh Simmons, Michael Krasulski, and Sylvia D. Hall-Ellis. *Information Services Today: An Introduction. Part 3: Information Services: Roles in the Digital Age*. Rowan and Littlefield in partnership with Library Journal webinar, recorded February 5, 2015.

Hall-Ellis, Sylvia D. and Jennifer Sweda. *Copy Cataloging in an RDA Environment*. ALCTS eForum, held May 14 and 15, 2013.

Hall-Ellis, Sylvia D. *Law Librarianship: A Community Conversation*. Sponsored by the Colorado Association of Law Libraries, presented at the Colorado Supreme Court Library, Denver, Colo., May 14, 2008.

Hall-Ellis, Sylvia D. and Beatrice Z. Gerrish. *Reading and Libraries: Recent Research in Reading*. Presentation at the Ricks Center for Gifted Education, Denver, Colo., March 4, 2008.

Hall-Ellis, Sylvia D. *Cataloger Competencies: Do the Employers Require What the Professors Teach?* Presentation for the School of Library and Information Science, San José State University, February 12, 2008.

Hall-Ellis, Sylvia D. and Robert O. Ellett, Jr. *Cooperative Cataloging: Rules, Tools, and Conventions for Building a Multi-institutional Catalog*. Sponsored for the Spanish Ministry of Defense, Madrid, Spain, July 10, 2006.

Hall-Ellis, Sylvia D. *Cash for Kids: Grant Writing Opportunities for Youth Services Librarians*. Sponsored by the Colorado Young Adult Librarians; presented at Bemis Memorial Library, Littleton, Colo., November 13, 2002.

Hall-Ellis, Sylvia D. *MARC Records and Authority Control: Planning for Bibliographic Database Migration*. Sponsored and held at the Douglas County Public Library, Castle Rock, Colo., May 28, 2002.

Grant Writing: A Refresher for Librarians. Sponsored by Library and Information Science Program, College of Education, University of Denver; presented at University Center at Chaparral, August 12, 2000.

Hall-Ellis, Sylvia D. *Shaking the Money Tree – Basic Grant Writing for Colorado Educators*. Sponsored by the Office of Educational Telecommunications of the Colorado Department of Education. Pikes Peak Community College, Colorado Springs, Colo., November 16, 1998.

Pueblo School District 60, Pueblo, Colo., November 12, 1998.
University of Northern Colorado, Greeley, Colo., November 10, 1998.
United Technology Educational Partnership, Grand Junction, Colo., November 9, 1998.

Hall-Ellis, Sylvia D. *Cataloging Multimedia, Kits, Globes and Map Materials in USMARC*. Sponsored and hosted by Region One Education Service Center, Edinburg, Tex., April 24, 1997 and December 12, 1996.

Hall-Ellis, Sylvia D. *New Standards for School Library Media Centers*. Sponsored and hosted by Region One Education Service Center, Edinburg, Tex., April 15, 1997.

Hall-Ellis, Sylvia D. *The School Library Media Specialist in the 21st Century: Visions for the Future*. Sponsored and hosted by Pharr-San Juan-Alamo Independent School District, Pharr, Tex., April 4, 1997.

Hall-Ellis, Sylvia D. *Cataloging Sound Recordings and Audio Materials in USMARC*. Sponsored and hosted by Region One Education Service Center, Edinburg, Tex., March 20, 1997 and November 21, 1996.

Hall-Ellis, Sylvia D. *Evaluating and Selecting CD-ROMs for School Library Media Collections*. Sponsored and hosted by Region One Education Service Center, Edinburg, Tex., March 18, 1997.

Hall-Ellis, Sylvia D. *Cataloging Audiovisual Materials in USMARC*. Sponsored and hosted by Region One Education Service Center, Edinburg, Tex., February 27, 1997, November 7, 1996 and October 24, 1996.

Hall-Ellis, Sylvia D. *Introduction to Dialog: Basic Searching Strategies*. Sponsored and hosted by Region One Education Service Center, Edinburg, Tex., February 14, 1997.

Hall-Ellis, Sylvia D. *Cataloging Books in USMARC*. Sponsored and hosted by Region One Education Service Center, Edinburg, Tex., January 30, 1997, October 10, 1996, September 26, 1996 and August 8, 1996.

Hall-Ellis, Sylvia D. *Advanced Internet Searching Techniques for Librarians*. Sponsored and hosted by Region One Education Service Center, Edinburg, Tex., January 21, 1997.

Hall-Ellis, Sylvia D. *Texas Library Connection Full-Text Searching*. Sponsored and hosted by Region One Education Service Center, Edinburg, Tex., December 13, 1996 and October 25, 1996.

Hall-Ellis, Sylvia D. *Developing Evaluation Strategies for Grants and Proposals*. Sponsored and hosted by Region One Education Service Center, Edinburg, Tex., December 10, 1996.

Hall-Ellis, Sylvia D. *Developing Needs Assessment for Grants and Proposals*. Sponsored and hosted by Region One Education Service Center, Edinburg, Tex., November 12, 1996.

Hall-Ellis, Sylvia D. *Texas Library Connection Union Catalog Searching*. Sponsored and hosted by Region One Education Service Center, Edinburg, Tex., November 8, 1996 and September 6, 1996.

Hall-Ellis, Sylvia D. *Grant Resources on the Internet*. Sponsored and hosted by Region One Education Service Center, Edinburg, Tex., October 23, 1996.

Hall-Ellis, Sylvia D. *Preparing a Response to the Telecommunications Infrastructure Fund Board: Needs Assessment, Professional Development Framework, and Evaluation Strategies*. Sponsored and hosted by Region One Education Service Center, Edinburg, Tex., October 16, 1996.

Hall-Ellis, Sylvia D. *Texas Library Connection: Building the Districtwide Bibliographic Database*. Sponsored and hosted by Mercedes Independent School District, Mercedes, Tex., September 13, 1996 and August 8, 1996. Sponsored and hosted by Los Fresnos Consolidated Independent School District, Los Fresnos, Tex., August 12, 1996.

Hall-Ellis, Sylvia D. *School-to-Work and Special Education: An Inclusive Partnership for Success*. Sponsored and hosted by the Office of Special Education, Region One Education Service Center, Edinburg, Tex., September 11, 1996.

Hall-Ellis, Sylvia D. *Telecommunications Infrastructure Fund Board: An Overview of Funding for Secondary Schools*. Sponsored and hosted by Region One Education Service Center, Edinburg, Tex., August 31, 1996.

Hall-Ellis, Sylvia D. *Cataloging Books, Multimedia, and Realia in USMARC*. Sponsored and hosted by Edinburg Consolidated Independent School District, Edinburg, Tex., August 6, 1996.

Hall-Ellis, Sylvia D. *Internet Resources for Grant Writers*. Sponsored and hosted by Region One Education Service Center, Edinburg, Tex., April 20, 1996.

Hall-Ellis, Sylvia D. *Enhanced Grant Writing Skills for Mathematics Educators: Writing Skills for Campus Teams*. Sponsored and hosted by the Office of General Education, Region One Education Service Center, Edinburg, Tex., March 22, 1996.

Hall-Ellis, Sylvia D. *Internet Resources for Grant Writers*. Sponsored and hosted by the College of Education and Applied Science, Sam Houston State University, Huntsville, Tex., March 9, 1996.

Hall-Ellis, Sylvia D. *Grant Writing for Mathematics Educators: A Development Process for Campus Teams*. Sponsored and hosted by the Office of General Education, Region One Education Service Center, Edinburg, Tex., March 4, 1996.

Hall-Ellis, Sylvia D. *Shaking the Money Tree: Preparing Successful Technology Grant Applications*. Sponsored and hosted by the Office of Technology and Media Services, Region One Education Service Center, Edinburg, Tex., February 29, 1996 and April 29, 1996.

Hall-Ellis, Sylvia D. *District-wide Technology Planning: Technical Assistance for the Texas Education Agency Initiative*. Sponsored and hosted by the Office of Technology and Media, Region One Education Service Center, Edinburg, Tex., February 2, 1996.

Hall-Ellis, Sylvia D. *Enhanced Grant Writing Skills*. Sponsored and hosted by Pharr-San Juan-Alamo Independent School District, Pharr, Tex., January 27, 1996.

Hall-Ellis, Sylvia D. *United States Copyright Act of 1976, Video Transmissions, Computer Software and the Internet*. Sponsored and hosted by the Office of Technology and Media, Region One Education Service Center, Edinburg, Tex., January 24, 1996.

Hall-Ellis, Sylvia D. *The Grant Writing Development Process*. Sponsored and hosted by Pharr-San Juan-Alamo Independent School District, Pharr, Tex., January 20, 1996.

Hall-Ellis, Sylvia D. *MARC Cataloging of Materials for Library Media Centers*. Sponsored and hosted by the Office of Media Services, Region One Education Service Center for the Donna Independent School District, Donna, Tex., August 17, 1995.

Hall-Ellis, Sylvia D. *Classification*. Sponsored by AJ Seminars, Rockville, Maryland; presented at University Hilton Hotel, Houston, Tex., May 10, 1995.

Hall-Ellis, Sylvia D. *Library Technical Services*. Sponsored by AJ Seminars, Rockville, Maryland; presented at University Hilton Hotel, Houston, Tex., April 26, 1995.

Hall-Ellis, Sylvia D. *Grant Writing: An Introduction for Public School Administrators*. Sponsored and hosted by the Office of Administrative Services, Region One Education Service Center, Edinburg, Tex., April 19, 1995.

Hall-Ellis, Sylvia D. *The School Library Media Specialist in the 21st Century: Visions for the Future*. Sponsored and hosted by the United Independent School District, Laredo, Tex., March 31, 1995.

Hall-Ellis, Sylvia D. *Using USMARC*. Sponsored by AJ Seminars, Rockville, Maryland; presented at University Hilton Hotel, Houston, Tex., March 29, 1995.

Hall-Ellis, Sylvia D. *Library Media Center Policies and Guidelines: How to Prepare for School Board Adoption*. Sponsored and hosted by the Office of Technology and Media Services, La Joya Independent School District, La Joya, Tex., March 10, 1995.

Hall-Ellis, Sylvia D. *Developing District-wide Policies and Guidelines for Library Media Centers*. Sponsored and hosted by the Office of Technology and Media Services, La Joya Independent School District, La Joya, Tex., January 10, 1995.

Hall-Ellis, Sylvia D. *MARC Cataloging of Audiovisual Materials for Library Media Centers*. Sponsored and hosted by the Office of Library Media and Technology Services, Cypress-Fairbanks Independent School District, Houston, Tex., December 1, 1994.

Hall-Ellis, Sylvia D. *The School Library Media Specialist in the 21st Century: Visions for the Future*. Sponsored and hosted by United Independent School District, Laredo, Tex., October 14, 1994.

Hall-Ellis, Sylvia D. *The School Library Media Specialist in the 21st Century: Visions for the Future*. Sponsored and hosted by the Laredo Independent School District, Laredo, Tex., October 7, 1994.

Hall-Ellis, Sylvia D. *MARC Cataloging for Library Media Centers*. Sponsored by the Office of Library Media and Technology Services, Cypress-Fairbanks Independent School District, Houston, Tex., October 5, 1994.

Hall-Ellis, Sylvia D. *Jump to the Head of the Class: Undergraduate Library Resources Available at Sam Houston State University*. Sponsored by the Office of the Associate Vice President for Student Services, Sam Houston State University, Huntsville, Tex., October 4, 1994.

Hall-Ellis, Sylvia D. *CD-ROMs - 1994's Newest and the Best for Secondary Level Media Centers*. Sponsored and hosted by Clear Lake Independent School District, Houston, Tex., June 3, 1994.

Hall-Ellis, Sylvia D. *Introduction to Classification*. Sponsored by AJ Seminars, Rockville, Maryland; presented at Holiday Inn, Market Center, Dallas, Tex., May 18, 1994.

Hall-Ellis, Sylvia D. *Basic Descriptive Cataloging*. Sponsored by AJ Seminars, Rockville, Maryland; presented at University Hilton Hotel, Houston, Tex., May 4, 1994.

Hall-Ellis, Sylvia D. *Shaking the Money Tree - Part II: Writing Successful Grant Applications*. Sponsored by Donna Independent School District, Donna, Texas, and Region One Education Service Center Edinburg, Texas; presented at South Texas Community College Library, McAllen, Tex., April 29, 1994.

Hall-Ellis, Sylvia D. *Using MARC*. Sponsored by AJ Seminars, Rockville, Maryland; presented at Holiday Inn, Market Center, Dallas, Tex., April 6, 1994.

Hall-Ellis, Sylvia D. *Automated Authority Control*. Sponsored by AJ Seminars, Rockville, Maryland; presented at University Hilton Hotel, Houston, Tex., March 23, 1994.

Hall-Ellis, Sylvia D. *Automating the District School Library Media Centers: Choices and Opportunities*. Sponsored and hosted by the Office of Technology and Library Media Services, Fort Bend Independent School District, Sugar Land, Tex., March 4, 1994.

Hall-Ellis, Sylvia D. *Shaking the Money Tree - Part I: Preparing Successful Grant Applications*. Sponsored and hosted by the Office of Library Media Services, Donna Independent School District, Donna, Tex., February 4, 1994.

GRADUATE COURSES TAUGHT

San José State University, School of Library and Information Science

INFO 249 – Advanced Cataloging and Classification (Fall 2015, 2016; Summer 2016)
INFO 287 – Special Topics in Cataloging and Classification (Spring 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024; Fall 2020, 2021, 2022, 2023, 2024)
LIBR 248 – Beginning Cataloging and Classification (Summer 2002, 2003, 2004, 2005, 2006)
LIBR 249 – Advanced Cataloging and Classification (Summer 2003; Fall 2014; Summer 2015)

University of Denver, University College

Grant Writing Certificate Seminar for Non-Profit Organizations (Fall 2020, 2021; Spring 2021)

University of Denver, Morgridge College of Education HED

5991 – Grant Writing in Higher Education (Spring 2011)
LIS 4010 – Organization of Information (Fall 2002-2009; Winter 2005; Spring 2004-2006)
LIS 4020 – Professional Principles and Ethics (Summer 2000)
LIS 4040 – Management of Libraries and Information Centers (Fall 2010; Spring 2003, 2009 (DS); Winter 2005)
LIS 4070 – Cataloging and Classification (Winter 2008, 2009, 2010, 2011, 2012; Fall 2009 (DS)) LIS
4321 – Collection Management (Spring 2005)
LIS 4326 – LIS Research (Winter 2009 (DS); Spring 2009 (DS))
LIS 4350 – Adult Materials and Services (Summer 2006, 2009)
LIS 4379 – Social Sciences Resources (Spring 2009)
LIS 4400 – Cataloging and Classification (Spring 2000, 2001; Winter 2002-2009; Summer 2005, 2006 – course renumbered LIS 4070, September 2007)
LIS 4401 – Descriptive Cataloging (Winter 2001; Spring 2002, 2003, 2006-2009; Summer 2005)
LIS 4402 – Subject Cataloging (Spring 2001, 2009; Summer 2005, 2006, 2007, 2008)
LIS 4403 – Classification Schemes (Fall 2007, 2008, 2009 (DS)) LIS
LIS 4405 – Authority Control (Winter 2009)
LIS 4510 – Materials and Services for Children (Winter 2004; Summer 2005)
LIS 4620 – Grant Writing and Fundraising (Summer 2000, 2002, 2004, 2010; Winter 2006; Fall 2006-2009)
LIS 4700 – Seminar in Technical Services (Fall 2001)
LIS 4700 – Seminar in Public Libraries (Summer 2002)
LIS 4804 – Management of Electronic Records (Spring 2004; Fall 2005)
LIS 4902 – Capstone Projects (Winter 2003, Spring 2008, 2009, 2011)
LIS 4910 – Independent Study (every quarter Winter 2000 through Spring 2011)
LIS 4920 – Service Learning (every quarter Summer 2004 through Spring 2011)
RMS 4954 – Grant Writing (Summer 2013, 2014)
RMS 4959 – Content Analysis Methodology (Spring 2015)
QRM 4978 – Grant Writing (Summer 2011, 2012)

Rutgers University, School of Communication and Information

SC&I 522 – Cataloging and Classification (Summer 2013)

University of Arizona, College of Behavioral and Social Sciences

LIS 602 – Cataloging and Classification (Summer 1995)
LIS 612 – Advanced Online Search and Retrieval (Summer 1995)

Sam Houston State University, College of Education & Applied Science

LIS 532 - Cataloging and Classification (Fall 1993, 1994, 1995)
LIS 563 - Advanced Cataloging and Classification (Summer 1994)
LIS 567 - Research Methods (Spring 1994, Spring 1995)
LIS 591 - Educational Technology (Spring 1994, 1995)
LIS 596 - Networking and Computer Technologies in Education (Fall 1993, Summer 1994, Fall 1995)

Dissertations at the University of Denver

Bowers, Stacey L. *Library Anxiety of Law School Students: A Study Utilizing the Multidimensional Library Anxiety Scale*. Chair, May 5, 2010.

Fattor, Melissa M. *Student Engagement Differences by Ethnicity and Scale for Ninth Grade Students*. Chair, November 1, 2010.

Fulton, Roseanne. *A Case Study of Culturally Responsive Teaching in Middle School Mathematics*. Kent Seidel, Chair, June 18, 2009, Outside Chair.

Greal, Deborah S. *Tribes and Territories in Library and Information Studies Education*. Bruce Uhrmacher, Chair, June 10, 2008, Committee Member.

McCord, J. Michael. *Developing a Standard of Care for Educational Malpractice*. Chair, April 15, 2011.

Priebe, Sarah J. *Distinguishing Effects of Domain and General Knowledge on Passage Fluency and Comprehension*. Jan Keenan, Chair. July 21, 2011, Outside Chair.

Snyder-Mondragon, Sandra M. *Institutional Factors that Impact the Retention of Graduate Students of Color in Schools of Library and Information Science: A Metaregression of Accredited Library School Statistics on Student Retention and Graduation Rates*. Kathy Green, Chair, July 24, 2009, Committee Member.

Taylor, Karen Pickles. *Effective Teaching*. Elinor Katz, Chair, July 15, 2009, Outside Chair.

Thompson, Jennifer. *Distinguishing a Western Women's College: A History of the Curriculum and Student Experience at Colorado Women's College*. Edith W. King, Chair, July 16, 2010, Committee Member.

Walker, Emelda. *Influence of Organizational Factors on Job Satisfaction of Disability Service Providers at Postsecondary Institutions*. Chair, April 29, 2010.

Dissertation Proposals at the University of Denver

Bowers, Stacey L. *Library Anxiety of Law School Students: A Study Utilizing the Multidimensional Library Anxiety Scale*. Chair, November 5, 2009.

McCord, J. Michael. *Developing a Standard of Care for Educational Malpractice*. Edith W. King, Chair. April 23, 2010.

Thompson, Jennifer. *History of Colorado Women's College*. Edith W. King, Chair, October 30, 2008. Committee Member.

Walker, Emelda. *Influence of Organizational Factors on Job Satisfaction of Disability Service Providers at Postsecondary Institutions*. Chair, July 21, 2009.

Dissertations at Other Institutions

Rodríguez-Mori, Howard. *The Information Behavior of Puerto Rican Immigrants to Central Florida, 2003-2009: Grounded Analysis of Six Case Studies Use of Social Networks during the Migration Process*. Kathleen Burnett, Chair, April 10, 2009, Florida State University, Committee Member.

Schwartz, Brian *More than a Look-up Skill: Medical Information Literacy Education in Osteopathic Medical Schools*. D. Mirah Dow, Chair, July 18, 2017. Emporia State University, Committee Member.

Snow, Karen. *A Study of the Perception of Cataloging Quality among Catalogers*. Shawne D. Miksa, Chair, August 1, 2011. University of North Texas, Committee Member.

Dissertation Proposals at Other Institutions

Schwartz, Brian *More than a Look-up Skill: Medical Information Literacy Education in Osteopathic Medical Schools*. D. Mirah Dow, Chair, December 4, 2015. Emporia State University, Committee Member.

Snow, Karen. *A Study of the Perception of Cataloging Quality among Catalogers*. Shawne D. Miksa, Chair, May 11, 2010. University of North Texas, Committee Member.

Master's Thesis at the University of Denver

Hemingson, Jeff. *Recital Paper*. Lamont School of Music, February 2010, Outside Chair.

Capstones at the University of Denver

Anthony, Alisa. *Correlation of Library and Information Science Program outcomes and Vacant Position Qualifications Listed on the Colorado State Library Jobline by Employers During the Period September 1, 2000 through August 31, 2002*. Chair, Winter Quarter, 2003.

Borden, Donna M. *Improving Emergency Communications Systems: Is a Radio Communications Network the Answer?* Fall Quarter, 2014.

Bowden, Heather L.M. *Exploring Biological Models for Long-term Data Preservation*. Chair, Spring Quarter, 2008.

Casenada, Cassandra Y. *Challenges to the Recruitment, Education, and Retention of Librarians of Color*. Chair, Spring Quarter, 2008.

Chang, Jennifer C. *Legal Research Practice and Preference: A Law Firm Perspective*. Chair, Spring Quarter 2011.

Ellis, Megan S. Fitzgerald. *Design of a Public Library Adult Volunteer Recruitment Program and Training Curriculum*. Chair, Winter Quarter, 2003.

Kircher, Kathy. *Development of a Library Pathfinder for Exobiology and Posting it on the Internet*. Chair, Winter Quarter, 2003.

Melhado, Loretta. *Design of St. John's Episcopal Church Library*. Chair, Spring Quarter, 2008.

Radcliff, Kathy. *Original Cataloging of Archival materials in the HERS Collection in Penrose Library*. Chair, Winter Quarter, 2003.

Sass, Carol Ann. *ACT Periodical Index: Access to Catholic Thinking Periodical Index: Web Index to Select Catholic Periodicals*. Spring Quarter 2000.

Stone, Sergio D. *Conducting Community Analysis for the Bemis Public Library (Littleton, Colorado) Using 2002 U.S. Census Data and the Online Outcome-Based Evaluation Toolkit*. Chair, Winter Quarter, 2003.

Tureson, Tamara. *Design and Use of an Information Audit Tool for Use in a Law Library*. Chair, Winter Quarter, 2003.

Tweed, Beth. *Evaluation of Email Reference Service in a Consumer Health Library Environment*. Chair, Winter Quarter, 2003.

GRANTS AND CONTRACTS

Student Learning in Agriculture STEM through Teacher Professional Development. Research team: Stanton Gartin (PI) and Cyndi Hofmeister, Northeast Junior College; Jeff Cash, Cheryl Sánchez, Anne-Marie Crampton, Lamar Community College; Suzanna Spears, Morgan Community College; Jack Wiley, Kerry Gabrielson, Trinidad State Junior College; Michael J. Miller, Colorado State University; Michael Womochil (Co-PI), Casey Sacks, and Sylvia D. Hall-Ellis, Colorado Community College System. U.S. Department of Agriculture, Agriculture and Food Research Initiative, Food, Agriculture, Natural Resources and Human Sciences Education and Literacy Initiative, \$404,460 (2017-2020)

Leading and Achieving: the Colorado Agriculture Regional Consortium. Research team: Jack Wiley (PI), Kerry Gabrielson, Trinidad State Junior College; Jeff Cash (PI), Cheryl Sánchez, Anne-Marie Crampton, Lamar Community College; Suzanna Spears, Morgan Community College; Cyndi Hofmeister, Northeast Junior College; Michael Womochil (Co-PI), Casey Sacks, and Sylvia D. Hall-Ellis, Colorado Community College System. U.S. Department of Agriculture, Hispanic Serving Institutions Education Grants Program, \$504,414 (2017-2020)

Cyber Prep Program Planning Grant. Research team: Debbie Sagen (PI), Brenda Lauer, Pikes Peak Community College; Gretchen Martin, Koiosa Insights; and, Sylvia D. Hall-Ellis, Colorado Community College System. U.S. Department of Commerce, Regional Alliances and Multi-stakeholder Partnerships to Stimulate (RAMPS) Cybersecurity Education and Workforce Development, \$199,681 (2016-2018)

Career and Technical Education in Colorado: Pathways to Education and Employment. Research team: Heather McKay (PI), Rutgers University; Sarah Heath, Casey Sacks, Sylvia D. Hall-Ellis, Colorado Community College System. U.S. Department of Education, Institute of Education Sciences, \$1,400,000 (2017-2021)

Pre-Alliance Planning Grant Colorado Community College Alliance. Research team: Victor Vialpondo (PI) and Janel Highfill, Community College of Aurora; Heidi Loshbaugh (Co-PI), Community College of Denver; Rick Reeves, Bill McGreevy, Liz Cox, and Kristin Aslin, Red Rocks Community College; Cathy Pellish, Front Range Community College; Samuel DeVries, Arapahoe Community College; Sylvia D. Hall-Ellis, Colorado Community College System. National Science Foundation, Louis Stokes Alliance for Minority Participation (LSAMP), \$86,817 (2016-2017)

Towards Scalable Differentiated Instruction Using Technology-enabled, Competency-based, Dynamic Scaffolding. Research team: Karen Wilcox (PI) and Vijay Kumar, Center for Computational Engineering, Massachusetts Institute of Technology; Flora McMartin, Broad-based Knowledge; Quinsigamond Community College; and, Casey Sacks, and Sylvia D. Hall-Ellis, Colorado Community College System. U.S. Department of Education, First in the World Developmental Grant, \$2,891,882 (2015-2019)

Colorado Strategic Partnerships Emergency Grant. Research team: Elise Lowe-Vaughn (PI), Amy Hodson, Celia Hardin, Barbara McBride, James Newby, Christopher Dewhurst, Nina Holland, Kate Anderson, MaryAnn Roe, Chrystalynn Chrystalynn, Elaine Edon, Mona Barnes, Tom Morgan, Rob Hanni, and Marie Valenzuela, Colorado Department of Labor and Employment; Steve Anton, Joelle Brouner, and, Katie Griego, Colorado Department of Human Services; Rebecca Holmes, Judith Martinez, and Jennifer Jirous, Colorado Department of Education; Emily Templin Lesh, Colorado Workforce Development Council; Cory Everett, Colorado Department of Regulatory Agencies; and, Casey Sacks and Sylvia D. Hall-Ellis, Colorado Community College System. U.S. Department of Labor, Strategic Partnerships Emergency Grant, \$5,000,000 (2015-2017)

CAEL Jump Start Program: Competency-Based Education. Research team: Jerry Migler (PI), Casey Sacks, Debra Cohn, Thomas Hartman, and Sylvia D. Hall-Ellis, Colorado Community College System; Matt Jamison, Front Range Community College; Mike Coste, Red Rocks Community College; Amanda Corum, Pueblo Community College; Janet Colvin, Pikes Peak Community College; and, MaryAnn Matheny, Community College of Denver. Council for Adult and Experiential Learning, \$15,000 (2015)

Summit on the Redesign of Developmental Education. Research team: Jerry Migler (PI), Casey Sacks, and Sylvia D. Hall-Ellis, Colorado Community College System; Chip Nava, Pueblo Community College; Kim Moultny, Arapahoe Community College; Debbie Ulibarri, Trinidad State Junior College; and, Kris Bernard, Front Range Community College. American Association of Community Colleges, \$15,000 (2015-2016)

Equity in Excellence at Colorado Community Colleges. Research team: Keith Howard (PI) and Sylvia D. Hall-Ellis, Colorado Community College System; Estela Mata Bensimon, Center for Urban Education, University of Southern California; and Kerry Gabrielson, Trinidad State Junior College. Colorado Department of Higher Education, Colorado Opportunity Scholarship Program, \$150,000 (2015-2016)

MBA High School of Business in Colorado. Research team: Laurie Urich (PI) and Sylvia D. Hall-Ellis, Colorado Community College System; Rudolph Sumpter and Beatrice Gerrish, Boulder Valley Schools; Keith Curry Lance, RSL Research Group. Colorado Department of Higher Education, Colorado Opportunity Scholarship Program, \$501,295 (2015-2016)

Fullbridge Program in Colorado. Research team: Keith Howard (PI) and Sylvia D. Hall-Ellis, Colorado Community College System; Suzanna Spears, Fort Morgan Community College; and, Cheryl Sánchez and Anne-Marie Compton, Lamar Community College. Colorado Department of Higher Education, Colorado Opportunity Scholarship Program, \$300,000 (2015-2017)

Colorado Community College System Alternative Credit Program. Research team: Jerry Migler (PI), Keith Howard, and Sylvia D. Hall-Ellis, Colorado Community College System. American Council on Education, \$13,000 (2015)

Internationalization in Higher Education. Researcher: Samuel D. Museus. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Office of Internationalization, \$8,000 (2014-2015)

International Perspectives on Bilingual Education. Researcher: Sharolyn Pollard-Durodola. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Office of Internationalization, \$3,700 (2014-2015)

Cultivating Culturally Relevant and Responsive Curriculum and Pedagogy in College. Researcher: Samuel Museus. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, iRise Grant, \$5,000 (2014-2015)

Project EMERGE (Educational Model for Evaluation and Replicability in Gifted Environments). Research team: Norma Hafenstein (PI) and Bruce Uhrmacher. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Lynde and Harry Bradley Foundation, \$235,000 (2014-2015)

Collecting Asian American Refugee Stories. Researcher: Samuel Museus. Technical reviewer for MCE: Sylvia D. Hall-Ellis. American Educational Research Association, Research Grant, \$5,000 (2014-2015)

Developing Expertise in Teaching K-5 Mathematics. Research team: Julie Sarama (PI) and Douglas H. Clements (Co-PI), in partnership with the School of Education at the University of Michigan. Technical reviewer for MCE: Sylvia D. Hall-Ellis. National Science Foundation, \$130,344 (2013-2015)

Investigation of the Long-Term Outcomes for Special Education Students. Researcher: Antonio Olmos-Gallos. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Jefferson County School District, Office of Assessment, \$40,000 (2014)

Refugee Community Collaboration. Researcher: Vicki Tomlin (PI) in partnership with the African Community Center and Jewish Family Service. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Center for Community Engagement and Service Learning, \$14,854 (2014-2015)

Access to Mathematics for All. Research team: Richard S. Kitchen (PI), Nicole M. Russell (Co-PI), and Terrence Blackman (Co-PI), Curriculum Studies and Teaching Program, Morgridge College of Education; Álvaro Árias (Co-PI, Department of Mathematics); and, James Gray (Co-PI), Department of Mathematics, Community College of Aurora. Technical reviewer for MCE: Sylvia D. Hall-Ellis. National Science Foundation, The Robert Noyce Scholarship Program, Capacity Building Project, \$349,926 (2014-2016)

Cognitive Test Battery for Intellectual Disabilities. Research team: Karen Riley (PI), Lyndsay Agans, Jessica Lerner, and Karin Dittrick-Nathan in partnership with David Hessel (PI), The MIND Institute at the University of California – Davis, and Elizabeth Berry-Kravis, Rush University Medical Center. Technical reviewer for MCE: Sylvia D. Hall-Ellis. National Institutes of Health, Outcome Measures for Use in Treatment Trials for Individuals with Intellectual and Developmental Disabilities (R01), \$2,499,996 (\$588,672 at DU) (2014- 2019)

Broadening Participation in Engineering among Women and Latino/as: A Longitudinal, Multi-Site Study. Researcher: Patton Garriott (PI) in partnership with the University of North Dakota and the University of Missouri. Technical reviewer for MCE: Sylvia D. Hall-Ellis. National Science Foundation, HER Core Research, \$677,390 (\$69,992 at DU) (2014-2019)

Designing a Teacher Evaluation System to Improve Teacher Effectiveness for Culturally and Linguistically Diverse Learners. Research team: María del Carmen Salazar (PI), Jessica Lerner, and Kathy Green. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Professional Research Opportunities for Faculty, \$29,988 (2014-2016)

Developing a College-Going Culture in Latina/O Families: Exploring the Influence of Funds of Knowledge on Family Outreach Programs. Researcher: Judy Marquez Kiyama. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Professional Research Opportunities for Faculty, \$18,720 (2014-2016)

Assessment of Quality of Life in Neural Implantation Surgery for the Treatment of Parkinson's Disease. Researcher: Cynthia McRae. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Office of Internationalization, \$3,967 (2014-2015)

Pura Vida: Cloud Forest, Curriculum and Cross-Cultural Study. Research team: Norma Hafenstein (PI) and Bruce Uhrmacher (Co-PI). Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Office of Internationalization, \$8,000 (2014-2015)

Online Course Development for Curriculum and Instruction. Researcher: Ruth Chao. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Office of Teaching and Learning, \$3,000 (2014)

Online Course Development for Curriculum and Instruction. Researcher: María del Carmen Salazar. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Office of Teaching and Learning, \$3,000 (2014)

Online Course Development for Curriculum and Instruction. Researcher: Jessica Lerner. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Office of Teaching and Learning, \$3,000 (2014)

Online Course Development for Curriculum and Instruction. Researcher: Duan Zhang. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Office of Teaching and Learning, \$3,000 (2014)

The Mathematics Education of African Americans, 1866 – 1954. Researcher: Nicole M. Russell. Technical reviewer for MCE: Sylvia D. Hall-Ellis. National Academy of Education, Spencer Foundation Postdoctoral Fellowship, \$55,000 (2014-2016)

Early Childhood Care and Education Study. Research team: Carrie Germeroth (PI), Melissa Mincic, and Douglas H. Clements. Technical reviewer for MCE: Sylvia D. Hall-Ellis. State of North Dakota, Department of Public Instruction, \$73,500 (2013-2014)

Graduate Level Specialty in Addiction Counselor Training with Emphasis on Integration of Native American Specific Content. Research team: Ruth Chao (PI) and Michael J. Faragher (Co-PI). Technical reviewer for MCE: Sylvia D. Hall-Ellis. The Galena Foundation, \$289,732 (2013-2016)

The Collecting Asian American and Pacific Islander Refugee Stories (CARS) Project. Researcher: Samuel Museus. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Center for Community Engagement and Service Learning, \$15,000 (2014)

Parents in Transition: A Multiple Case Study of Parent and Family Orientation Programs. Researcher: Judy Marquéz Kiyama. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Faculty Research Fund, \$1,500 (2014-2015)

The Sistah Network: Black Women Graduate Students Supporting and Retaining Each Other. Researcher: Nicole M. Russell. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Faculty Research Fund, \$2,708 (2014-2015)

Evaluation of the Northeast Denver Babies Ready for College Program. Research team: Carrie Germeroth (PI), Melissa Mincic, and Douglas H. Clements. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Mile High Montessori, \$9,922 (2013-2014)

Developing Teaching Expertise in K-5 Mathematics. Research team: Julie Sarama (PI) and Douglas Clements (University of Denver), in partnership with Timothy Boerst (PI), Meghan Shaughnessy, Deborah Ball, Hyman Bass (School of Education at the University of Michigan). Technical reviewer for MCE: Sylvia D. Hall-Ellis. National Science Foundation, \$449,827 (\$130,344 at the University of Denver) (2013-2015)

Early Learning Care and Education Study Program Grant for the State of North Dakota. Research team: Carrie Germeroth (PI), Melissa Mincic, and Sheridan Green. Technical reviewer for MCE: Sylvia D. Hall-Ellis. State of North Dakota Department of Public Instruction, \$73,500 (2013-2014)

Local Professional Learning Community for School Leaders. Research team: Susan Korach (PI), Kristina Hesbol, and Rebecca McClure. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Education Development Center, \$10,950 (2013)

Healthy Eaters, Lifelong Movers 2: Implementing Evidence-Based School Environment, Policy, and Curricular Changes to Increase Opportunities for Healthy Eating and Physical Activity in Low Income, Rural Colorado. Research team: Elaine Berlansky, University of Colorado at Denver (PI), Nicholas Cutforth, University of Denver (Co-PI), and Allison Reeds. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Colorado Health Foundation, \$3,103,108 (2013-2017)

Hughes Rare Books Library Room Renovation in the Sturm College of Law. Project team: Patti H. Marks, Sylvia D. Hall-Ellis, and Leigh Elliott. Mabel T. Hughes Charitable Trust, \$34,000 (2013-2014)

The Promise Center Partnership with the Marsico Institute for Early Learning and Literacy and the City and County of Denver. Research team: Karen Riley (PI), Douglas H. Clements (Co-PI), and Sheridan Green. Technical reviewer for MCE: Sylvia D. Hall-Ellis. The Piton Foundation, \$223,468 (2013-2014)

Center of Excellence for Problem Gambling. Research team: Ruth Chao (PI) and J. Mike Faragher. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Colorado Department of Behavioral Health, \$68,021 (2012-2013)

United Way Implementation and Validation Review. Research team: Douglas H. Clements (PI), Amanda Moreno, and Sheridan Green. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Mile High United Way, \$19,737 (2013)

Math/Science Partnership in Rural Districts. Research team: Kristen Bunn (PI, Eagle County Schools), Paul Michalec (Co-PI), and Alegra Reiber. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Colorado Department of Education, Colorado's Mathematics and Science Partnership Program, \$750,000 (2013-2014)

Mathematics and Science Education of African Americans. Research team: Nicole Russell (PI), Sylvia D. Hall-Ellis, Steve Fisher (Penrose Library). Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Professional Research Opportunities for Faculty, \$29,994 (2013-2015)

Online Course Development for Curriculum and Instruction. Researcher: Nicole Russell. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Office of Teaching and Learning, \$3,000 (2013)

Discourse and Opportunity: Undocumented Students and Higher Education Policy. Researcher: Ryan Gildersleeve. Technical reviewer for MCE: Sylvia D. Hall-Ellis. National Academy of Education, Spencer Foundation Postdoctoral Fellowship, \$55,000 (2012-2014)

An Anthropological Study of the Latino Graduation Ceremony. Researcher: Ryan Gildersleeve. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Spencer Foundation, \$39,900 (2012-2013)

Fragile-X and Pharmaceutical Company: Clinical Trial of AFQ056. University of California – Davis Children's Hospital MIND Institute (Sacramento), Children's Hospital Denver, and Rush Children's Hospital at Rush University Medical Center (Chicago). Karen Riley, PI. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Novartis Pharmaceuticals Corporation, \$394,206 (2012-2014)

Project Engage, Phase 2, a DAPRA Grant in partnership with Total Immersion Systems, Inc., and Texas A&M University. Research team: Karen Riley (PI) and Lyndsay Agans (Co-PI). Technical reviewer for MCE: Sylvia D. Hall-Ellis. U.S. Department of Defense, \$60,000 (2011-2013)

International School Psychology Practicum Exchange. Researcher: Gloria L. Miller. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Center for Community Engagement and Service Learning, \$14,951 (2012-2013)

Online Course Development for Curriculum and Instruction. Research team: Bruce Uhrmacher (PI) and Norma Hafenstein (Co-PI). Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Office of Teaching and Learning, \$18,193 (2012-2014)

Writers in the Schools. Research team: Karen Riley (PI) and Amanda Moreno (Co-PI). Technical reviewer for MCE: Sylvia D. Hall-Ellis. Colorado Humanities, \$4,965 (2012-2013)

Learning Ecosystem Validation Grant. Research team: Karen Riley (PI), Lyndsay Agans, Kent Seidel, and Shimelis Assefa. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Bill & Melinda Gates Foundation, \$315,000 (2012-2013)

Project Words of Oral Reading and Language Development (WORLD). Research team: Jorge E. Gonzalez (PI), Texas A&M University; Laura Saenz (Co-PI), University of Texas – Pan American; and, Sharolyn Pollard-Durodola (Co-PI), University of Denver. Technical reviewer for MCE: Sylvia D. Hall-Ellis. U.S. Department of Education, Institute of Education Sciences, \$53,354 (2012-2015); award \$640,718, transfer from Texas A&M University

Increasing the Efficacy of an Early Mathematics Curriculum with Scaffolding Designed to Promote Self-Regulation. Research team: Douglas H. Clements (PI) and Julie Sarama (Co-PI). Technical reviewer for MCE: Sylvia D. Hall-Ellis. U.S. Department of Education, Institute of Education Sciences, \$1,445,315 (2008-2014); award \$4,541,975, transfer from University at Buffalo, The State University of New York

Using Rule Space and Poset-based Adaptive Testing Methodologies to Identify Ability Patterns in Early Mathematics and Create a Comprehensive Mathematics Ability Test. Research team: Douglas H. Clements (PI) and Julie Sarama (Co-PI). Technical reviewer for MCE: Sylvia D. Hall-Ellis. National Science Foundation, \$323,791 (2010-2014); award \$1,194,944, transfer from University at Buffalo, The State University of New York

Comprehensive Postdoctoral Training in Scientific Education Research. Researcher: Julie Sarama (PI). Technical reviewer for MCE: Sylvia D. Hall-Ellis. U.S. Department of Education, Institute of Education Sciences, \$133,458 (2010-2014); award \$613,353, transfer from University at Buffalo, The State University of New York

Longitudinal Study of a Successful Scaling Up Project: Extending TRIAD. Research team: Douglas H. Clements (PI), Julie Sarama (Co-PI), and Abt Associates (Carolyn Layzer, Fatih Unlu, Laurie Bozzi, Lily Fesler, Alina Martinez, Cristofer Price, James van Orden). Technical reviewer for MCE: Sylvia D. Hall-Ellis. Institute of Education Sciences, \$384,940 (2011-2015; award \$1,250,286, transfer from University at Buffalo, The State University of New York

Early Childhood Education in the Context of Mathematics, Science, and Literacy. Research team: Julie Sarama (PI), Douglas H. Clements (Co-PI). Technical reviewer for MCE: Sylvia D. Hall-Ellis. National Science Foundation, \$990,020 (2010-2014; award \$2,285,228, transfer from University at Buffalo, The State University of New York

Early Childhood Clearinghouse Information Center Redesign. Research team: Karen Riley (PI) and Amanda Moreno (Co-PI). Technical reviewer for MCE: Sylvia D. Hall-Ellis. Office of the Lt. Governor of Colorado, \$12,000 (2012-2013)

Morgridge Rural Educational Leadership Initiative. Research team: Lyndsay Agans (PI), Linda Brookhart (Co-PI), Susan Korach, and Rebecca McClure. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Morgridge Family Foundation, \$100,000 (2012-2014)

Center of Excellence for Problem Gambling. Research team: Patrick Sherry (PI) and J. Mike Faragher. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Colorado Department of Behavioral Health, \$55,000 (2012-2013)

Intermodal Transportation Institute Research Initiatives. Researcher: Patrick Sherry. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University Transportation Centers Program, Research and Innovative Technology Administration, U.S. Department of Transportation. \$600,000 (2012-2014)

Mile High United Way Social Innovation Fund Early Literacy Initiative. Gloria L. Miller, PI, Amanda Moreano, Kim Hartnett-Edwards, and Sheridan Green. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Mile High United Way, \$89,992 (2012-2013)

International School Psychology Practicum Exchange. Researcher: Gloria L. Miller. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Center for Community Engagement and Service Learning, \$1,000 (2012-2013)

Refugee Student Art Outreach. Researcher: Karin Ditttrick-Nathan. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Faculty Research Fund, \$3,000 (2012-2013)

Resistance, Resilience, and Reciprocity: Centering the Voices of Black Doctoral Women with Faculty Aspirations. Researcher: Nicole M. Russell. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Faculty Research Fund, \$2,965 (2012-2013)

Assessing Learning through Student Notebooks. Research team: Keith Miller, Nancy Sasaki, and Kathy Green.

Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Professional Research Opportunities for Faculty, \$30,000 (2012-2014)

International School Psychology Practicum Exchange. Researcher: Gloria L. Miller. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Office of Internationalization, \$2,000 (2012-2013)

ELO in Colorado. Research team: Cynthia Hazel and Duan Zhang. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Colorado Legacy Foundation, \$150,000 (2012-2013)

Creating Online LIS Courses. Research team: Mary C. Stansbury (PI), Shimelis Assefa, Denise Anthony, Xiao Hu, and Krystyna Matusiak. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Center for Teaching and Learning, \$15,000 (2011-2013)

Maritime Piracy Seminar. Researcher: Ved Nanda, The Nanda Center, Sturm College of Law. Technical reviewer for Sturm College of Law: Sylvia D. Hall-Ellis. Arsenault Family Foundation, \$15,000 (2012-2013).

Early Childhood Librarianship: An Interdisciplinary, Experiential Learning MLIS. Researcher: Mary C. Stansbury (PI). Technical reviewer for MCE: Sylvia D. Hall-Ellis. Laura Bush's 21st Century Librarians Program, Institute for Museums and Library Services, \$249,066 (2012-2014)

Learning Ecosystem Planning Grant. Research team: Karen Riley (PI), Lyndsay Agans, Kent Seidel, and Shimelis Assefa. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Bill & Melinda Gates Foundation, \$281,217 (2011-2012)

Advanced Service Learning Practitioner Faculty Grant, Sylvia D. Hall-Ellis, University of Denver, Center for Community Engagement and Service Learning, \$400 (2011)

Evaluating and Enhancing the EspeciallyMe Program. Research team: Lori D. Patton and Nicole Russell. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Center for Community Engagement and Service Learning, Public Good Fellowship Grant, \$24,780 (2012)

Choosing Excellence: Let Every Child Bloom. Research team: Shimelis Assefa (PI) and Mary C. Stansbury (Co-PI). Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Center for Community Engagement and Service Learning, Public Good Grant, \$7,657 (2012)

K-8 STEM Content Specific Professional Development to Improve Elementary Student Achievement. Research team: Kent Seidel (PI), Nicole Russell (Co-PI), Kimberly Hartnett-Edwards, Paul Michalec, Jeff Farmer, Keith Miller, Alegra Reiber, and Nancy Sasaki. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Colorado Department of Education, Improving Teacher Quality Grant, (Title II ESEA), \$307,299 (2011-2012)

Building a Better Principal Pipeline to Boost Student Achievement. Researcher: Susan Korach. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Denver Public Schools; a subcontract from the Wallace Foundation Grant, \$170,000 (2011-2017)

Center of Excellence for Problem Gambling. Research team: J. Mike Faragher (Co-PI) and Bobbie Vollmer (PI). Technical reviewer for MCE: Sylvia D. Hall-Ellis. Colorado Department of Behavioral Health, \$79,999 (2011-2012)

An Exploration of Novice Teachers' Core Competencies: Impacts on Student Achievement, and Effectiveness of Preparation. Research team: Kent Seidel (PI), Kathy Green (Co-PI), Kimberly Hartnett-Edwards, and Duan Zhang. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Institute of Education Sciences, Effective Teachers and Effective Teaching, \$990,987 (2012-2015)

Project Engage, a DAPRA Grant in partnership with Total Immersion Systems, Inc., and Texas A&M University.

Research team: Karen Riley (PI) and Lyndsay Agans (Co-PI). Technical reviewer for MCE: Sylvia D. Hall-Ellis. U.S. Department of Defense, \$49,964 (2011-2014)

User-centered Evaluation of Music Search Engines. Researcher: Xiao Hu. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Faculty Research Fund, \$2,931 (2011-2012)

Educational Practicum in Vietnam and China to Promote the Inclusion of Young Children with Disabilities.

Researcher: Gloria L. Miller. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Office of Internationalization, \$5,000 (2011-2012)

Evaluation of Colorado's Enhancing Quality in Infant-Toddler (EQIT) Initiative. Research team: Virginia R.

Maloney and Amanda Moreno. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Buell Foundation, \$395,884 (2011-2013)

Creating Engaging Environments to Teach Pre-Algebra Mathematics to Elementary Students. Research team:

Álvaro Arias, Mario López, María del Carmen Salazar, and Lyndsay Agans. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver Interdisciplinary Grant, \$60,000 (2011-2012)

Morgridge Education Technology Accessible (META) Resource Project. Research team: Lyndsay Agans (PI) and

Shimelis Assefa (Co-PI). Technical reviewer for MCE: Sylvia D. Hall-Ellis. Morgridge Family Foundation, \$36,000 (2011)

MCE Connect: A 21st Century Framework for Faculty Development. Research team: Bruce Uhrmacher (PI),

Shimelis Assefa (Co-PI), Lyndsay Agans (Co-PI), Kimberly Hartnett-Edwards, Norma Hafenstein, Xiao Hu, Paul Michalec (Co-PI), María del Carmen Salazar (Co-PI), and Sandra Snyder-Mondragon. Technical reviewer for MCE: Sylvia D. Hall-Ellis. University of Denver, Center for Teaching and Learning, \$22,355 (2011-2012)

Parent Education and Parent Leadership and Advocacy. Research team: Virginia Maloney (PI) and Amanda

Moreno, Marsico Institute for Early Learning and Literacy. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Colorado Health Foundation, \$27,358 (2010-2011)

Intentional School Culture. Researcher: Cynthia Hazel. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Denver Public Schools, \$38,040 (2010-2011)

Healthy Eaters, Lifelong Movers: Implementing Evidence-Based School Environment, Policy, and Curricular Changes to Increase Opportunities for Healthy Eating and Physical Activity in Low Income, Rural Colorado.

Research team: Elaine Berlansky, University of Colorado at Denver (PI), Nicholas Cutforth, University of Denver (Co-PI), and Allison Reeds. Technical reviewer for MCE: Sylvia D. Hall-Ellis. Colorado Health Foundation, \$1,683,277 (2011-2014)

Second Life Learning Community. Research team: Don McCubbrey (PI), Sylvia D. Hall-Ellis (Co-PI), Walter

LaMendola, and Paul Novak. University of Denver, Center for Teaching and Learning, \$13,000 (2010-2011)

Reintroducing the Value of Law Librarians to Academic and Public Librarians in Colorado through the

Identification and Use of Emerging Technologies. Research team: Sylvia D. Hall-Ellis (Co-PI), Stacey L.

Bowers (PI), and Christopher Hudson, in partnership with Denver Public Library, Arapahoe Library District, and the Colorado State Supreme Court Library. University of Denver, Center for Community Engagement and Service Learning, \$5,773 (2010-11)

Reintroducing the Value of Law Librarians to Public Librarians through the Identification and Use of Emerging

Technologies and Resources. Research team: Stacey Bowers (PI) and Sylvia D. Hall-Ellis (Co-PI). American Association of Libraries, Wolters Kluwer Law & Business Grant Program, \$2,725 (2010-2011)

Faculty Service Learning Pod. Research team: María del Carmen Salazar and Nicholas Cutforth (Curriculum and Instruction Program), Frank Tuitt (Higher Education Program), Cynthia Hazel and Gloria Miller (Child, Family, and School Psychology Program), and Sylvia D. Hall-Ellis (Library and Information Science Program). University of Denver, Center for Community Engagement and Service Learning, \$8,000 (2010-2011)

Lincoln Collaborative. Research team: Antonio Esquibel (Principal, Lincoln High School), María del Carmen Salazar (Curriculum and Instruction Program), and Sylvia D. Hall-Ellis. School Improvement Grant, Denver Public Schools, \$375,000 (2010-2012)

Future LEADers of America: Leaders III. Research team: Denver Public Library (Kristen Svendsen, PI), the University of Denver (Sylvia D. Hall-Ellis), the Colorado Chapter of REFORMA (Orlando Archibeque), and the Colorado Association of Libraries (Martin Garner). Laura Bush's Recruiting Librarians for the 21st Century Program, Institute for Museums and Library Services, \$988,366 (2009-2012)

Teaching for Success in the Library Environment: LIS 4030 in Library 2.0. Research team: Deborah S. Greal (PI) and Sylvia D. Hall-Ellis (Co-PI). University of Denver, Center for Teaching and Learning, \$ 9,350 (2009-10)

Writing Group Faculty Grant, Sylvia D. Hall-Ellis, University of Denver, Center for Community Engagement and Service Learning, \$750 (2008-2009)

Collaborative Learning Faculty Grant, Sylvia D. Hall-Ellis, University of Denver, Center for Teaching and Learning, \$1,500 (2008)

Connecting Information Literacy to Learning. Research team: Lori Micho, Merrie Valliant, Amanda Samland, and Sylvia D. Hall-Ellis. Colorado State Library, LSTA Discretionary Grant Program, \$19,548 (2008-2009)

Law Librarianship Fellows Program. Research team: Sylvia D. Hall-Ellis (PI), Stacey Bowers (Co-PI), and Christopher Hudson, Westminster Law Library. Laura Bush's 21st Century Librarians Program, Institute for Museums and Library Services, \$999,370 (2008-2012)

Grant Writing in a Cooperative Learning Environment. Sylvia D. Hall-Ellis. University of Denver, Center for Teaching and Learning, \$2,000 (2008-2009)

Project Homeless Connect 6 Event Evaluation. Research team: Sylvia D. Hall-Ellis and Duan Zhang. University of Denver Center for Community Engagement and Service Learning, \$9,785 (2008)

Project Ecuador: International Learning Service Libraries – A Faculty Development Experience in Ecuador. Sylvia D. Hall-Ellis, Office of Internationalization, University of Denver, \$600 (2007)

Project Ecuador: International Learning Service Libraries – A Faculty Development Experience in Ecuador. Sylvia D. Hall-Ellis, International Service Learning Office, University of Denver, \$400 (2007)

Project Homeless Connect 5 Event Evaluation. Research team: Sylvia D. Hall-Ellis and Duan Zhang. University of Denver Center for Community Engagement and Service Learning, \$1,000 (2007)

Project Homeless Connect 4 Event Evaluation. Research team: Sylvia D. Hall-Ellis and Duan Zhang. University of Denver Center for Community Engagement and Service Learning, \$4,595 (2007)

Future LEADers of America: Leaders II. Research team: Denver Public Library (Kristen Svendsen, PI), the University of Denver (Sylvia D. Hall-Ellis), and the Colorado Chapter of REFORMA (Orlando Archibeque). Laura Bush's Recruiting Librarians for the 21st Century Program, Institute for Museums and Library Services, \$988,518 (2007-2010)

Strategic Planning Assistance for the Denver Medical Library. Sylvia D. Hall-Ellis. Denver Medical Library, Inc., \$30,000 (2006-2007)

Destiny Software for JMAC Student Lab. Sylvia D. Hall-Ellis, gift from the Sagebrush Corporation, Minneapolis, Minnesota, \$10,000 (2006)

Libraries: Tools for Education and Development Worldwide: A Faculty Development Experience in France. Sylvia D. Hall-Ellis, Office of Internationalization, University of Denver, \$800 (2005)

Denver Public Library: Opportunities for Change. Sylvia D. Hall-Ellis, Colorado Community Based Research Network, \$2,000 (2005)

Future LEADers of America. Research team: Denver Public Library (Letty Icolari and Steve Taylor, PIs), Emporia State University (Jim Agee), and the University of Denver (Sylvia D. Hall-Ellis). Recruiting Librarians for the 21st Century Program, Institute for Museums and Library Services, \$670,315 (2005-2008)

American Association of University Professors Summer Institute Professional Development Grant. Sylvia D. Hall-Ellis, American Association of University Professors, \$300 (2005)

Beta Phi Mu Alumni Tea. Sylvia D. Hall-Ellis, gift from the Office of Alumni and Parent and Relations, University of Denver, \$2,000 (2005)

Spectrum Software for LIS Student Lab. Sylvia D. Hall-Ellis, gift from the Sagebrush Corporation, Minneapolis, Minnesota, \$5,000 (2005)

Developing Research Capacity in Community Organizations and Residents through Training and Technical Assistance. Nicholas J. Cutforth (PI) and Sylvia D. Hall-Ellis. Piton Foundation, \$25,000 (2005-2006)

Libraries: Tools for Education and Development Worldwide: A Faculty Development Experience in Argentina. Sylvia D. Hall-Ellis, Office of Internationalization, University of Denver, \$500 (2004)

Developing Research Capacity in Community Organizations and Residents through Training and Technical Assistance. Research team: Nicholas J. Cutforth (PI), Gary Lichtenstein and Sylvia D. Hall-Ellis, Piton Foundation, \$25,000 (2003-2004)

Increasing Spanish-Speaking and Hispanic Diversity among Library and Information Science Students at the University of Denver: Development of a Student Recruitment Model. Researcher: Sylvia D. Hall-Ellis (PI), Office of Multicultural Excellence, University of Denver, \$2,750 (2003-2004)

Collection Development Enrichment to Support the Cataloging & Classification Specialization and School Librarianship within the Library & Information Science Program at the University of Denver. Research team: Sylvia D. Hall-Ellis (PI) and Deborah S. Grealy. Women's Library Association, University of Denver, \$4,000 (2003)

Collection Development Enrichment to Support the Library & Information Science Program at the University of Denver. Research team: Deborah S. Grealy (PI) and Sylvia D. Hall-Ellis. Women's Library Association, University of Denver, \$4,000 (2001)

Wireless LAN for Library Education. Research team: Deborah S. Grealy (PI) and Sylvia Hall-Ellis. University of Denver, Center for Teaching and Learning, \$24,000 (2001-2002)

Upward Bound – A Program for South Texas Youth. Research team: Monte Churchill, Executive Director of Community Relations; Gary R. Saucedo, Outreach Coordinator; Raymond Hernandez, (PI) Associate Dean for Student Success; and Sylvia D. Hall-Ellis, South Texas Community College (McAllen, Texas). U.S. Department of Education, Office of Postsecondary Education, \$2,672,003 (1999-2003)

Write Now! Improving Elementary Students' Writing Skills. Research team: Caryl G. Thomason, Assistant Superintendent (PI); Karen Tankersley, Principal; and, Hal Anderson, Director of Technology, Cheyenne Mountain School District 12 (Colorado Springs, Colorado); and Sylvia D. Hall-Ellis. Colorado Department of Education, Educational Telecommunications Unit, \$189,453 (1999-2001)

Operation Quick Start -- Distance Learning in Rural Colorado. Research team: Randal Weigum, Technology Coordinator (PI); Bonnie Barns, Director of Federal Programs and Staff Development; and, Adam "Joe" Raskop, Executive Director, Southeastern Board of Cooperative Educational Services (Lamar, Colorado); and Sylvia D. Hall-Ellis. Colorado Department of Education, Educational Telecommunications Unit, \$400,000 (1999-2001)

Advanced Technological Training for Information Professionals for the 21st Century. Research team: Mario Reyna, Division of Business Director (PI) and Sylvia D. Hall-Ellis, South Texas Community College (McAllen, Texas). Phi Delta Kappa and the National Science Foundation, \$250,000 (1999-2001)

Working Connections – Training Information Technologies Professionals for the 21st Century. Research team: Mario Reyna, Division of Business Director (PI) and Sylvia D. Hall-Ellis, South Texas Community College (McAllen, Texas). Microsoft Corporation and the American Association of Community Colleges, \$1,147,775 (1999-2001)

The ROAD (Research Oriented Amplification of Development to Literacy) Program. Research team: Deborah J. Leong (PI), Metropolitan State University; Elena Bodrova, Metropolitan State University; Dmitri Semenov, Robert J. Marzano, and Sylvia D. Hall-Ellis, Mid-continent Regional Educational Laboratory (Aurora, Colorado). Hewlett-Packard Foundation, \$25,000 (1998-1999)

Press to Literacy. Research team: Deborah J. Leong (PI), Metropolitan State University; Elena Bodrova, Metropolitan State University; Dmitri Semenov, Robert J. Marzano, and Sylvia D. Hall-Ellis, Mid-continent Regional Educational Laboratory (Aurora, Colorado). The Denver Post and the Robert S. McCormick Foundation, \$49,818 (1998-1999)

International Telementor Center. Research team: David Neils, David B. Frost (PI), and Sylvia D. Hall-Ellis, Mid-continent Regional Educational Laboratory (Aurora, Colorado). Hewlett-Packard Philanthropy, \$100,000 (1998-1999)

America Reads: Providing Tutor Training for the America Reads Challenge. Research team: Louis F. Cicchinelli (PI) and Sylvia D. Hall-Ellis, Mid-continent Regional Educational Laboratory (Aurora, Colorado). U.S. Department of Education, Office of Educational Research and Improvement, \$306,000 (1998-1999)

Comprehensive School Reform. Research team: Louis F. Cicchinelli (PI), J. Timothy Waters, and Sylvia D. Hall-Ellis, Mid-continent Regional Educational Laboratory (Aurora, Colorado). U.S. Department of Education, Office of Educational Research and Improvement, \$285,000 (1998-1999)

Sustainable Energy Education (SEE) Program for Grades 4-8: Preparing Today's Youth for Lifelong Learning and Responsible Actions in Energy Conservation. Research team: Mary Gromko, Colorado Department of Education; Gene McCarthy, Rocky Flats Field Office, U.S. Department of Energy; Gina Kissell, National Renewable Energy Laboratory; and Barbara L. McCombs (PI), Janet L. Bishop, and Sylvia D. Hall-Ellis, Mid-continent Regional Educational Laboratory (Aurora, Colorado). State of Colorado Governor's Office for Energy Conservation, \$499,936 (1997-1999)

Review of Kansas Curriculum Standards in Mathematics and Language Arts. Research team: Robert J. Marzano (PI), John S. Kendall, David B. Frost, and Sylvia D. Hall-Ellis, Mid-continent Regional Educational Laboratory (Aurora, Colorado). Submitted to the Kansas State Department of Education, \$25,903 (1998)

International Telementor Center. Research team: David Neils, John Kuglin, Chris Rapp, David B. Frost (PI), and Sylvia D. Hall-Ellis, Mid-continent Regional Educational Laboratory (Aurora, Colorado). Hewlett-Packard Company, \$54,752 (1998)

Genesis Mission: Education Public Outreach. Developed in partnership by the Jet Propulsion Laboratory, California Institute of Technology, Los Alamos National Laboratory, Lockheed Martin Astronautics, and the Mid-continent Regional Educational Laboratory (Aurora, Colorado). Research team: John T. Sutton (PI), Alice Krueger, Martha Henry, Greg Rawls, Shae Isaacs, Jeff Johnson, Deb Jordan, Arlene Mitchell, David B. Frost, Jana Caldwell, J. Timothy Waters, and Sylvia D. Hall-Ellis. National Aeronautics and Space Administration, \$139,700,000; subcontract award, \$4,750,000 (1997-2007)

North Dakota Mathematics Assessment Project. Developed in partnership by the North Dakota Department of Education and Mid-continent Regional Educational Laboratory (Mid-continent Regional Educational Laboratory). Research team: Ann Clapper, Clarence Bina, Greg Gallagher, North Dakota Department of Education; Don Burger (PI), Hillary Michaels, and Sylvia D. Hall-Ellis, Mid-continent Regional Educational Laboratory (Aurora, Colorado). U.S. Office of Education, \$1,618,214; subcontract award, \$389,076 (1997-2001)

Pacific Resources for Education and Learning Distance Education: Project Evaluation. Developed in partnership by the Pacific Educational Community, the Pacific Resources for Education and Learning (PREL), and Mid-continent Regional Educational Laboratory (McREL). Research team: John W. Kofel (PI), Executive Director, PREL; J. Timothy Waters, Executive Director; Joan Buttram, Robert Keller, and Sylvia D. Hall-Ellis, Mid-continent Regional Educational Laboratory (Aurora, Colorado). U.S. Office of Education, Star Schools Program, \$10,000,000; subcontract award, \$500,000 (1997-2002)

Identification of Bilingual Gifted and Talented Children: A Comprehensive School Grants for Bilingual Education. Developed in partnership by Hidalgo (Texas) ISD, Los Fresnos (Texas) CISD, Progreso (Texas) ISD, University of Texas – Pan American (Edinburg, Texas), and Education Service Center, Region One (Edinburg, Texas). Research team: Hilda Medrano, Dean, College of Education, University of Texas – Pan American; Linda Phemister (PI), Janie Navarro, and Sylvia D. Hall-Ellis, Education Service Center, Region One. U.S. Department of Education, Office of Bilingual Education and Minority Languages Affairs, \$1,670,633 (1997-2002)

Academics 2000: First Things First -- The Texas Goals 2000. Developed for Jim Hogg (Hebbronville, Texas) County ISD, Mirando City (Texas) ISD, and San Isidro (Texas) ISD. Research team: Hilda Medrano, Dean, College of Education, University of Texas - Pan American (Edinburg, Texas); Angie Lehmann, Amy Mares, Ellen Gonzalez (PI), and Sylvia D. Hall-Ellis, Education Service Center, Region One (Edinburg, Texas). Texas Education Agency, \$339,987 (1997-2000)

Southwestern Bell's Learning Communities Initiative. Developed for Tech Prep of the Rio Grande Valley, Inc. (Harlingen, Texas); the Center for Professional Teacher Development, University of Texas – Brownsville; Teach for America – Rio Grande Valley (McAllen, Texas); and Education Service Center, Region One (Edinburg, Texas). Research team: Patricia G. Bubb, Executive Director (PI), Tech Prep of the Rio Grande Valley; Martin Winchester, Executive Director, Teach for America – Rio Grande Valley; Aileen Johnson, Director, School of Education, University of Texas – Brownsville; and Sylvia D. Hall-Ellis. Southwestern Bell Foundation, \$100,000 (1997-1998)

Texas School to Work: Regional Implementation. Developed for Tech Prep of the Rio Grande Valley, Inc. (Harlingen), South Texas Community College (McAllen), Texas State Technical College (Harlingen), Texas Southmost College (Brownsville), Empowerment Zone of the Rio Grande Valley (Mercedes), Project VIDA (Weslaco), Youth Fair Chance (McAllen), and Education Service Center, Region One (Edinburg). Research team: Patricia G. Bubb (PI), Tech Prep of the Rio Grande Valley; Stephen Vassberg, Texas State Technical College; Ellen Trevino, Youth Fair Chance; Wanda Garza, Project VIDA; Leonardo Olivares, University of Texas – Pan American; Michael Bell, South Texas Community College; and Sylvia D. Hall-Ellis. Texas Workforce Commission, \$4,250,000 (1997-2002).

Comprehensive Bilingual Education Grant for Hidalgo ISD and Roma ISD. Developed for Hidalgo (Texas) ISD, Roma (Texas) ISD, College of Education, University of Texas – Pan American (Edinburg, Texas), and Education Service Center, Region One (Edinburg, Texas). Research team: Tomas Thomas (PI), Director, Office of Bilingual Education and Sylvia D. Hall-Ellis. U.S. Department of Education, Office of Bilingual Education and Minority Languages Affairs, \$1,531,361 (1997-2002)

Lopez High School, Porter High School, Rivera High School, Central Middle School, and Perkins Middle School, Brownsville (Texas) Independent School District. Telecommunications Infrastructure Fund Board, \$1,473,611 (1997-1998)

Donna High School, Todd Middle School, and Solis Middle School, Donna (Texas) Independent School District. Telecommunications Infrastructure Fund Board, \$704,052 (1997-1998)

Memorial Middle School and Nellie Schunior Middle School, La Joya Independent School District (Texas). Telecommunications Infrastructure Fund Board, \$293,641 (1997-1998)

Martin High School, Christen Middle School, Cigarroa Middle School, Lamar Middle School, Laredo (Texas) Independent School District. Telecommunications Infrastructure Fund Board, \$1,200,000 (1997-1998).

Lasara Middle School, Lasara (Texas) Independent School District. Telecommunications Infrastructure Fund Board, \$246,210 (1997-1998)

Los Fresnos High School and Resaca Middle School, Los Fresnos (Texas) Consolidated Independent School District. Telecommunications Infrastructure Fund Board, \$500,000 (1997-1998)

Lyford Junior High School, Lyford (Texas) Independent School District. Telecommunications Infrastructure Fund Board, \$354,997 (1997-1998)

Travis Middle School, McAllen (Texas) Independent School District. Telecommunications Infrastructure Fund Board, \$269,139 (1997-1998)

Mission High School, Mission (Texas) Independent School District. Telecommunications Infrastructure Fund Board, \$297,010 (1997-1998)

Progreso High School, Progreso (Texas) Independent School District. Telecommunications Infrastructure Fund Board, \$300,000 (1997-1998)

San Perlita High School, San Perlita (Texas) Independent School District. Telecommunications Infrastructure Fund Board, \$293,490 (1997-1998)

Myra Green Junior High School, Raymondville (Texas) Independent School District. Telecommunications Infrastructure Fund Board, \$225,000 (1997-1998)

Rio Grande City High School, Ringgold Middle School, Gruella Middle School, Rio Grande City (Texas) Independent School District. Telecommunications Infrastructure Fund Board, \$809,934 (1997-1998)

Rio Hondo Junior High School, Rio Hondo (Texas) Independent School District. Telecommunications Infrastructure Fund Board, \$297,024 (1997-1998)

Roma High School, Roma (Texas) Independent School District. Telecommunications Infrastructure Fund Board, \$333,178 (1997-1998)

San Benito High School, Miller Jordan Junior High School, San Benito (Texas) Consolidated Independent School District. Telecommunications Infrastructure Fund Board, \$547,000 (1997-1998)

Santa Maria High School and Santa Maria Middle School, Santa Maria (Texas) Independent School District. Telecommunications Infrastructure Fund Board, \$400,000 (1997-1998)

Salvador High School, United Independent School District (Laredo, Texas). Telecommunications Infrastructure Fund Board, \$250,879 (1997-1998)

Weslaco High School, Cabaza Middle School, Cuellar Middle School, Weslaco (Texas) Independent School District. Telecommunications Infrastructure Fund Board, \$874,242 (1997-1998)

Principals' Assessment and Training Center. Developed for Education Service Center, Region One (Edinburg, Texas). Research team: Roberto Zamora, Leonel Barrera, William H. Parry, and Sylvia D. Hall-Ellis. Texas Principals' Leadership Initiative, Texas Association of Secondary School Principals, Texas Association of Elementary School Principals, and the Sid Richardson Foundation. \$461,439 (1996-1998)

The Texas Library Connection -- Integrating and Sharing Resources. Developed for Hidalgo County Library System (McAllen), Cameron County Library System (Brownsville), South Texas Community College (McAllen), the University of Texas - Pan American (Edinburg), University of Texas - Brownsville, and Education Service Center, Region One (Edinburg). Research team: William R. McGee, Coordinator, Hidalgo County Library System; Joe Garcia, Director, Cameron County Library System; Michael D. Bell, Library Director, South Texas Community College; Eleanor Folger Foster, University Library, University of Texas - Pan American; Jaime Vela (PI), Director of Instructional Technology and Media Services, Ron Pontius, Instructional Technology, and Fabiola Fuentes, Media Services, Education Service Center, Region One; and Sylvia D. Hall-Ellis. Office of Library Media Services, Technology Services, Texas Education Agency. \$8,000 (1996-1997)

Developing Leadership Communities for Improving Algebra I for All Students. Developed for a partnership of the Region One Statewide Systemic Initiative Team. Research team: Noel Villarreal (PI), Eduardo Cancino, and Sylvia D. Hall-Ellis, Education Service Center, Region One (Edinburg). Texas Statewide Systemic Initiative for Reform in Mathematics, Science and Technology Education to The Charles A. Dana Center for Mathematics and Science Education, The University of Texas at Austin. \$25,000 (1996-1997)

Academics 2000: First Things First -- The Texas Goals 2000. Developed for Edinburg (Texas) CISD. Research team: Hilda Medrano, Dean, College of Education, University of Texas - Pan American (Edinburg); Helen Jones, Director (PI), Gifted and Talented Education, Edinburg CISD; and Sylvia D. Hall-Ellis, Education Service Center, Region One (Edinburg). Texas Education Agency, \$750,000 (1996-2001)

Texas Teachers Empowered for Achievement in Mathematics (TEXTEAM) Institute for Algebra I. Developed for Hidalgo ISD, Jim Hogg (Hebbronville) County ISD, La Joya ISD, La Villa ISD, Lyford ISD, Mission CISD, Pharr-San Juan-Alamo ISD, Rio Hondo ISD, San Isidro ISD, San Perlita ISD, Santa Maria ISD, Santa Rosa, Sharyland ISD, Valley View ISD, Webb (Laredo) CISD, Weslaco ISD, and Zapata County (Zapata) ISD. Research team: Noel Villarreal (PI), Chuck McInteer, Ellen M. Gonzalez, Education Service Center, Region One (Edinburg); and Sylvia D. Hall-Ellis. Charles A. Dana Center for Mathematics and Science Education, University of Texas - Austin, \$15,975 (1996)

Community Learning Center for La Villa, Texas. Developed for Edcouch-Elsa Independent School District. Research team: Noe Gonzalez (PI), Assistant Superintendent, Edcouch-Elsa Independent School District, and Sylvia D. Hall-Ellis. Delta Region Subzone, Rio Grande Valley (Texas) Rural Empowerment Zone, \$325,000 (1996-1997)

Monte Alto (Texas) Community Learning Center. Developed for Monte Alto Independent School District. Research team: Homero A. Diaz (PI), Superintendent, Monte Alto Independent School District, and Sylvia D. Hall-Ellis. Delta Region Subzone, Rio Grande Valley (Texas) Rural Empowerment Zone, \$300,000 (1996-1997)

Community Learning Center for La Villa, Texas. Developed for La Villa Independent School District. Research team: Sam Gonzalez (PI), Assistant Superintendent, La Villa Independent School District; and Sylvia D. Hall-Ellis. Delta Region Subzone, Rio Grande Valley (Texas) Rural Empowerment Zone, \$325,000 (1996-1997)

Building Project for Taylor Elementary. Developed for Mercedes (Texas) Independent School District. Research team: Mrs. Denise Rivera, Librarian, and Eduardo Infante, Principal, Taylor Elementary School; Ismael S. Cantu (PI), Federal Programs Director, Mercedes Independent School District; and Sylvia D. Hall-Ellis. Delta Region Subzone, Rio Grande Valley (Texas) Rural Empowerment Zone, \$375,000 (1996-1997)

Border Education Network (BEN) - Distance Education through Cable Television. Developed for Edinburg (Texas) Consolidated Independent School District. Research team: Noe Torres (PI), Library Media Specialist, Magdalena Rosas, Library Media and Technology Coordinator, Edinburg Consolidated Independent School District; and Sylvia D. Hall-Ellis, Education Service Center, Region One (Edinburg). Edinburg (Texas) Consolidated School District, \$250,000 (1996-1997)

Multiservice One-Stop Open Enrollment Charter School. Developed for the Information Referral Resource Assistance, Inc. (McAllen, Texas). Research team: Pablo Perez and Aguié Pena (PI), Executive Director, Information Referral Resource Assistance, Inc.; Roberto Zamora and Sylvia D. Hall-Ellis, Education Service Center, Region One (Edinburg). Texas Education Agency, \$3,066,000 (1996-2001)

Project OK: A Community Youth Opportunities Grant for Summer, 1996. Developed for McAllen (Texas) Independent School District, St. Joseph the Worker Catholic Church, and the Office of Adult Education, Education Service Center, Region One. Research team: Father Bart Flatt, St. Joseph the Worker Catholic Church; Noe Calvillo (PI), Office of Adult Education; Maria Louisa Garcia, McAllen Independent School District; and Sylvia D. Hall-Ellis, Education Service Center, Region One (Edinburg). Texas Protective and Regulatory Agency through the Office of the Mayor, City of McAllen, \$350,000 (1996-2001).

Early Childhood: a Time of Discovery. Developed for a partnership of Lasara ISD, Rio Hondo ISD, San Perlita ISD, the School of Education, University of Texas - Brownsville, and Education Service Center, Region One (Edinburg). Research team: Hugo Rodriguez, Dean, School of Education, University of Texas - Pan American; Leonel Barrera and Jack Damron, Field Service Agents, Ellen M. Gonzalez (PI), Administrator for Student Instructional Services, Ruth Solis, Education Specialist in Special Education, and Sylvia D. Hall-Ellis, Education Service Center, Region One (Edinburg). Texas Education Agency, \$722,090 (1996-2001)

Innovative Gifted and Talented Programs for Early Childhood and Elementary Education Students. Developed for a partnership of Edinburg (Texas) CISD, the School of Education, University of Texas - Pan American (Edinburg), and Education Service Center, Region One (Edinburg). Research team: Hilda Medrano, Dean,

School of Education, University of Texas - Pan American; Helen de la Garza (PI), Director of Elementary Curriculum and Instruction, Edinburg CISD; and Sylvia D. Hall-Ellis. Texas Education Agency, \$750,000 (1996-2001)

Reading Recovery in Early Elementary Grades. Developed for a partnership of La Villa (Texas) ISD the School of Education, University of Texas - Pan American (Edinburg), and Education Service Center, Region One (Edinburg). Research team: Hilda Medrano, Dean, School of Education, University of Texas - Pan American; Marcario Salinas (PI), Supervisor of Elementary Curriculum and Instruction, La Villa ISD; and Sylvia D. Hall-Ellis, Education Service Center, Region One. Texas Education Agency, \$750,000 (1996-2001)

Connected Mathematics Project for Middle and Junior High Students. Developed for a partnership of Michigan State University, The Charles A. Dana Center for Mathematics and Science Education, The University of Texas at Austin and Region One Statewide Systemic Initiative Team. Research team: Jack Damron, Chuck McInteer, Noel Villarreal (PI), and Sylvia D. Hall-Ellis, Education Service Center, Region One (Edinburg). National Science Foundation through Michigan State University to the Charles A. Dana Center at the University of Texas - Austin, \$539,610 (1996-1999)

Sharing Resources: Testing the Interlibrary Loan Potential of the Texas Library Connection -- Integrating Media Resources. Developed under the sponsorship of the Hidalgo County Library System (McAllen) and Education Service Center, Region One (Edinburg). Research team: William H. McGee, Hidalgo County System Coordinator; Fabiola Fuentes, Library Media; Ronald Pontius (PI), Instructional Technology, Education Service Center, Region One; and Sylvia D. Hall-Ellis. Library Media Services Program, Office of Technology Services, Texas Education Agency, \$25,000 (1996-1997)

State and Federal Adult Education JOBS Program. Developed for Education Service Center, Region One (Edinburg). Research team: Noe Calvillo (PI), Director, Adult Education Program, and Sylvia D. Hall-Ellis. Adult Education Program, Texas Education Agency, \$532,846 (1995-1996)

Creating Safe and Drug-Free Schools and Communities. Developed for a partnership of the Region One Consortium for Safe and Drug-Free Education Environments. Research team: Clara Contreras (PI), Health Specialist, and Sylvia D. Hall-Ellis, Education Service Center, Region One (Edinburg). Texas Education Agency, \$150,000 (1995-1996)

Developing Leadership Communities for Improving Mathematics Performance for All Students on Title I Campuses. Developed for a partnership of the Region One Statewide Systemic Initiative Team. Research team: Jack Damron, Chuck McInteer, Noel Villarreal (PI), and Sylvia D. Hall-Ellis, Education Service Center, Region One (Edinburg). Texas Statewide Systemic Initiative for Reform in Mathematics, Science and Technology Education to The Charles A. Dana Center for Mathematics and Science Education, The University of Texas at Austin, \$50,669 (1995-1996)

The Impact of Library Resource Centers on Academic Achievement in Selected Public Schools in South Texas. Sylvia D. Hall-Ellis (PI). Developed under the sponsorship of the Department of Library Science, College of Education and Applied Science, Sam Houston State University (Huntsville). Texas Association of School Librarians, Children's Services Round Table, and Young Adults Round Table (Austin, Texas), \$2,500 (1995)

School Library Media Specialists Fellowship Program. Sylvia D. Hall-Ellis (PI). Developed under the sponsorship of the Department of Library Science, College of Education and Applied Science, Sam Houston State University (Huntsville, Texas). U.S. Department of Education, HEA Title II-B, Library Education and Human Resource Development Program, \$44,000 (1995-1996)

Planning for Educational Technology. Research team: Ruth Ann Riggins (PI), Director of Library Media and Technology Services, Donna (Texas) Independent School District; Noe Torres, Education Service Center,

Region One; Patricia G. Bubb, Tech Prep of the Rio Grande Valley, Inc; Michael D. Bell, South Texas Community College; and Sylvia D. Hall-Ellis, Sam Houston State University. Developed under the sponsorship of Donna (Texas) Independent School District, Education Service Center, Region One (Edinburg), Tech Prep of the Rio Grande Valley, Inc. (Harlingen), South Texas Community College (McAllen), and the Department of Library Science, Sam Houston State University (Huntsville). Funded through Infusion of Educational Technology Planning Grant Program (H.B. 18: Models). Texas Education Agency, \$18,000 (1993-1994)

The Impact of Library Resource Centers on Academic Achievement in Selected Public Schools in South Texas.

Sylvia D. Hall-Ellis (PI) and Mary Ann Berry. Developed under the sponsorship of the Department of Library Science, College of Education and Applied Science, Sam Houston State University (Huntsville). Sam Houston State University Research Enhancement Fund, \$7,500 (1993-1994)

Electronic Mail Resource Sharing System: Management and Operation of the Iowa Computer-Assisted Network. State Library of Iowa, \$294,000 (1986-1993)

The Iowa Locator: A CD-ROM Resource Sharing Tool. State Library of Iowa, \$567,000 (1986-1992)

Statewide Database Development: An OCLC Tape Analysis To Determine Feasibility. State Library of South Dakota, \$15,000 (1987)

The Iowa Locator: A Feasibility Study. State Library of Iowa, \$50,000 (1986)

Electronic Mail Resource Sharing System: A Feasibility Study for Libraries in the State of Iowa. State Library of Iowa, \$5,000 (1985)

Access Pennsylvania: A Feasibility Study. State Library of Pennsylvania, \$50,000 (1984)

Automating Library Administrative and Management Tasks: Procurement and Distribution of Microcomputer Systems for District Library Centers in the Commonwealth of Pennsylvania. State Library of Pennsylvania, \$495,000 (1982)

Sharing Serial Titles Resources: Procurement and Distribution of Microfiche Readers for 550 Libraries in the Commonwealth of Pennsylvania. State Library of Pennsylvania, \$500,000 (1982)

Electronic Mail System: A Pilot Project for Libraries throughout the Commonwealth of Pennsylvania. State Library of Pennsylvania, \$125,000 (1982)

Literacy Program for Adults in Rural Upstate New York State: Program Outreach and Evaluation - Phase 3. Appalachian Regional Commission, \$50,000 (1981)

Database Building: A Cooperative Project of the Finger Lakes Library System (Ithaca), Four County Library System (Binghamton), and the Southern Tier Library System (Corning). New York State Library, \$450,000 (1980-1985)

Faces of the Southern Tier: A Professional Photographer-in-Residence. New York State National Endowment for the Humanities, \$25,000 (1980)

Literacy Program for Adults in Rural Upstate New York State: Program Implementation - Phase 2. Appalachian Regional Commission, \$50,000 (1980)

Small Business Resources Center: A Pilot Project for Rural Public Libraries. New York State Library, \$50,000 (1980)

Media Programming: A Professional Development Program for Public Librarians in Upstate New York: A Program in Allegheny, Chemung, Schuyler, Steuben, and Yates Counties. New York State Library, \$35,000 (1979)

Information and Library Resources for Inmates and Prisoners in Selected Upstate New York Facilities: A Cooperative Program in Allegheny, Chemung, Schuyler, Steuben, and Yates Counties. New York State Library, \$25,000 (1979)

Library Resources for Homebound Adults in Upstate New York: An Outreach Program in Allegheny, Chemung, Schuyler, Steuben, and Yates Counties. New York State Library, \$40,000 (1979)

Literacy Program for Adults in Rural Upstate New York State: Program Initiation and Establishment - Phase 1. Funded by the Appalachian Regional Commission. Awarded to the Corning (New York) Public Library, \$50,000 (1979)

Information Reference Services to Homebound Adults. New York State Library, \$31,000 (1978)

Books-By-Mail Services to Homebound Adults. New York State Library, \$31,000 (1978)

System Headquarters Services and Programs for Public Libraries in District 10. Funded through Library Services and Construction Act Title I. Texas State Library and Historical Commission, \$880,000 (1976)

County Library Development Grant for Atascosita County. Funded through Library Services and Construction Act Title I. Texas State Library and Historical Commission, \$15,000 (1976)

Spanish Language Materials Collection Development Program. Texas State Library and Historical Commission, \$40,000 (1975)

Establishment of System Headquarters for Alamo Regional Library System (District 10) Headquartered at the San Antonio (Texas) Public Library. Texas State Library and Historical Commission, \$800,000 (1975)

SELECTED CONSULTANTSHIPS

Project Strategic Planning & Funding Proposal Development

Walden University, 2015.
Pikes Peak Library District, 2014.
Douglas County Public Libraries, 2011-2012.
Denver School for Science and Technology, 2008-2011.
Johnson & Wales University, Denver Campus, 2007-2009.
Challenges, Choices, and Images K-12 Charter School, Denver Public Schools, 2007.
Denver Medical Library, Inc., 2006-2010.
Bemis Public Library (Littleton), Ergonomic Design and Facilities Enhancement Consultant, 2003.
Curtis Park Community Center (Denver), Community Technology Center Evaluation and Proposal Development Consultant, 2003.
Colorado Community Based Research Network (Denver), Funding Research Associate, 2002.
Our Lady of the Rosary Academy (Edgewater), Learning Resource Center Development Project Consultant, 2001-2003
University of Southern Colorado (Pueblo). Technology Integration and Curriculum Enhancement into Higher Education Learning Environment. Proposal Development Consultant, 2000.
Jefferson County Library System (Lakewood), 1999-2000.
Southeastern BOCES (Lamar, CO). Distance Learning Curriculum Content Development Project. Proposal Development Consultant, 1998-2004.
Cheyenne Mountain School District 12 (Colorado Springs, CO). Technology Integration into Elementary Writing Curriculum Project. Proposal Development Consultant, 1998.
Telecommunications Infrastructure Fund Board Round #2 Application, 1997. Technical assistance to the following:
La Villa (Texas) Independent School District; Mirando City (Texas) Independent School District; Monte Alto (Texas) Independent School District; San Isidro (Texas) Independent School District.
Telecommunications Infrastructure Fund Board Round #1, 1996. Technical assistance to the following: Brownsville (Texas) Independent School District; Donna (Texas) Independent School District; Edinburg (Texas) Consolidated Independent School District; Harlingen (Texas) Consolidated Independent School District; Jim Hogg County Independent School District (Hebbronville, Texas); La Feria (Texas) Independent School District; La Joya (Texas) Independent School District; La Villa (Texas) Independent School District; Los Fresnos (Texas) Consolidated Independent School District; Progreso (Texas) Independent School District; Raymondville (Texas) Independent School District; Rio Hondo (Texas) Independent School District; San Benito (Texas) Independent School District; Sharyland Independent School District (Mission, Texas); Weslaco (Texas) Independent School District; Zapata (Texas) County Independent School District.
South Texas Community College (McAllen). Strategy Development to Meet the Technology Instructional Needs for Vocational, School-To-Work and Academic Programs, 1994-2000. Development Consultant.
Donna (Texas) Independent School District. Planning for the Infusion of Technology in Middle Schools Serving High At-Risk Students, 1994-1995. Research Associate.
Pettus (Texas) Independent School District. Planning for District-wide Automation in School Library Media Centers: Preparation of Data, and CD-ROM Hardware/Software Configuration Evaluation, 1994. Principal Investigator.
Fort Bend Independent School District (Sugar Land, TX). Planning for District-wide Automation in School Library Media Centers, Preparation of Data, and CD-ROM Hardware/Software Configuration Evaluation, 1994-1995. Principal Investigator.
Northern Waters Library Services (Ashland, WI). Professional Consulting Services to Make Recommendations on the Development of System-Wide Efforts of the Northern Waters Library Service, 1988-1989. Research Associate.
State Library of Iowa (Des Moines). The Iowa Locator Compact Disc to Support Multi-Type Libraries Resource Sharing including Database Design, Building, Production, and Distribution, 1986-1991. Project Director.
State Library of Iowa (Des Moines). Iowa Computer-Assisted Network Development, Enhancement, and Operation, 1985-1992. Technical Director.
State Library of South Dakota (Pierre). Statistical Sampling and Analysis of Multi-Institutional OCLC Archive Tape for Statewide Online Database Building, 1985-1986. Research Associate.
District of Columbia Public Library (Washington, DC). Planning Document for the Retrospective Conversion of Bibliographic Records and Automation Issues in the 1990's, 1984-1985. Research Associate.

State Library of Pennsylvania (Harrisburg). Database Development for High School Libraries, 1984-1985. Research Associate.

MINITEX (Minneapolis, MN). Workshops for Retrospective Conversion, Bar Coding, Library Statistics, and OCLC Serials Format, 1985. Presenter and Research Associate.

ABC Film Consortium (Altoona, Bellefonte, Johnstown, PA). Database Building, System Design, and Implementation of Online Film Booking System, 1983-1985. Database Manager.

Library Automation -- System Design & Implementation

Douglas County Library District (Castle Rock, CO). Library Automation Technical and System Performance Specifications, 2001.

Pharr-San Juan-Alamo Independent School District (Pharr, TX). Library Automation Technical and System Performance Specifications, 1997. Project Development Consultant.

Harlingen (Texas) Independent School District. Planning for District-wide Automation in Junior High School Library Media Centers: Preparation of Data, and CD-ROM Hardware/Software Configuration Evaluation, 1996. Principal Investigator.

Sharyland (Texas) Independent School District. Design and Construction of New Elementary School Library and Technology Resources Center, 1995-1996. Principal Investigator.

South Texas Independent School District (Mercedes, TX). Design and Construction of a New High School Library and Technology Resources Center, 1995-1996. Principal Investigator.

Citizens' Library (Washington, PA). Online Community Resources Files: Design and Implementation, 1984. Research Associate.

Altoona (Pennsylvania) Hospital. Integrated Online System Upgrade Study, 1984. Research Associate.

State Library of South Dakota (Pierre). Automation Plan and State Database Development, 1982-1983. Principal Investigator.

State Library of Pennsylvania (Harrisburg). COM Production and Preparation of the Technical Specifications Document, Procurement, and Distribution of Microcomputers in the Commonwealth of Pennsylvania, 1983-1984. Research Associate.

Altoona (Pennsylvania) Area Public Library. Integrated System (Circulation/Online Catalog) Study, 1982-1983. Principal Investigator.

COPSCAULD (Council of Pennsylvania State College and University Library Directors, Edinboro, PA). Design of Online Media Catalog, 1982. Principal Investigator.

Erie (Pennsylvania) County Library System. Operations Research and Design for Automated Circulation, Hardware Upgrade and Re-Retrospective Conversion, 1982. Research Associate.

Michigan Library Consortium (Lansing, MI). Tape Management System Design and Implementation, 1982-1984. Research Associate.

State Library of Pennsylvania (Harrisburg). Preparation of the Technical Specifications Document, Procurement and Distribution of Microfiche Readers in the Commonwealth of Pennsylvania, 1982. Research Associate.

Community College of Allegheny County, Allegheny Campus (Pittsburgh, PA). Integrated Systems Study, 1981. Principal Investigator.

Community College of Allegheny County, South Campus (West Mifflin, PA). Retrospective Conversion Training Program for Handicapped Students, 1981. Technical Director.

Southern Tier Library System (Corning, NY). OCLC Acquisitions Subsystem Evaluation, 1981. Principal Investigator.

South Central Reference and Research Council (Ithaca, NY). South Central Regional Delivery System, 1980. Principal Investigator.

Southern Tier Library System (Corning, NY). Newspapers on Microfilm in the Chemung-Southern Tier Library System, 1979-1981. Principal Investigator.

Cataloging & Bibliographic Database Building

Challenges, Choices, and Images K-12 Charter School, Denver Public Schools, 2007.

Denver Medical Library, Inc., 2006-2010.

Ricks Gifted and Talented School Library, 2005-

American Humane Society (Englewood), 2004-2006.

Fisher Early Learning Center Library, 2004-

Colorado Community Based Research Network (Denver), 2004-
Boulder Valley School District (Boulder), 2002-2003.
Douglas Public Library District (Castle Rock), 2001-2002.

Bibliographic Center for Research, Inc. (Denver). Original Cataloging, 2001-2003 & 1992-1993. Professional Cataloger. Libraries include Arapahoe Library District (Centennial); Clarke College (Clarke, IA); Kaiser Permanente Center for Health Research (Portland, KS); Douglas County Library System (Carson City, NV); Grinnell College (Grinnell, IA); Kansas State University (Manhattan, KS); Kansas State Library (Topeka, KS); McPherson College (McPherson, KS); Newman University (Wichita, KS); Montana Technical University (Helena, MT); Montana State Library (Helena, MT); University of Texas Southwest Medical Center Library (Dallas, TX); Community College of Southern Nevada (Las Vegas, NV); Pikes Peak Library District (Colorado Springs); Mesa Community College (Grand Junction); Coe College (Cedar Rapids, IA); Briar Cliff College (Sioux City, IA); Tri-Care Health Systems (Aurora); The Penrose-St. Francis Healthcare System (Colorado Springs); Westminster Public Library (Westminster); Lutheran Medical Center Medical Library (Wheat Ridge); American Heritage Center, University of Wyoming (Laramie, WY); National Wildlife Research Center Library (Lakewood); University of Colorado Health Sciences Center, Denison Memorial Library (Denver); Water Resources Library, Denver District Office, Bureau of Land Management (Lakewood); Mesa State Community College Learning Resources Center (Pueblo); Front Range Community College Learning Resources Center (Westminster).

Colorado Historical Society Library (Denver). Original Cataloging of Serials for Multi-Institutional Union Listing Project, 1993. Technical Services Associate. Institutional partners: Denver Art Museum, Denver Museum of Natural History Library, and Denver Botanical Gardens Library.

Arapahoe Library District (Centennial). Original Cataloging of Major Media, 1991.

Original Cataloging Projects: Davis and Elkins College (Elkins, WV), 1989-1990; Waldorf College (Forest City, IA), 1989-1990; Kennametal Corporation (Latrobe, PA), 1984-1985; Pennsylvania Public Libraries Film Center (Harrisburg), 1982-1985.

Retrospective Conversion Projects: North Central Regional Library Service (Mason City, IA), 1987-1988; Southeastern Library Services (Davenport, IA), 1986-1987; Virginia Theological Seminary (Alexandria), 1984-1985; California University of Pennsylvania (California, PA), 1984-1985; Kennametal Corporation (Latrobe, PA), 1984-1985; West Virginia University (Morgantown), 1983-1985; Altoona Area Public Library (Altoona, PA), 1983-1984; George Washington University (Washington, DC), 1983-1984; Indiana University of Pennsylvania (Indiana, PA), 1983-1985; Health Education Center (Pittsburgh), 1983-1984; Central Pennsylvania District Library Center (Bellefonte, PA), 1982-1985; Duquesne University Law School Library (Pittsburgh), 1982-1983; Allegheny County Law Library (Pittsburgh), 1982-1984; Calgon Technical Information Center (Pittsburgh), 1982; Dow Corning Corporation, Technical Information Center (Midland, MI), 1982-1983; Tri-System Public Library Retrospective Conversion Project (Binghamton, Corning, and Ithaca, NY), 1978-1981, Technical Project Director.

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