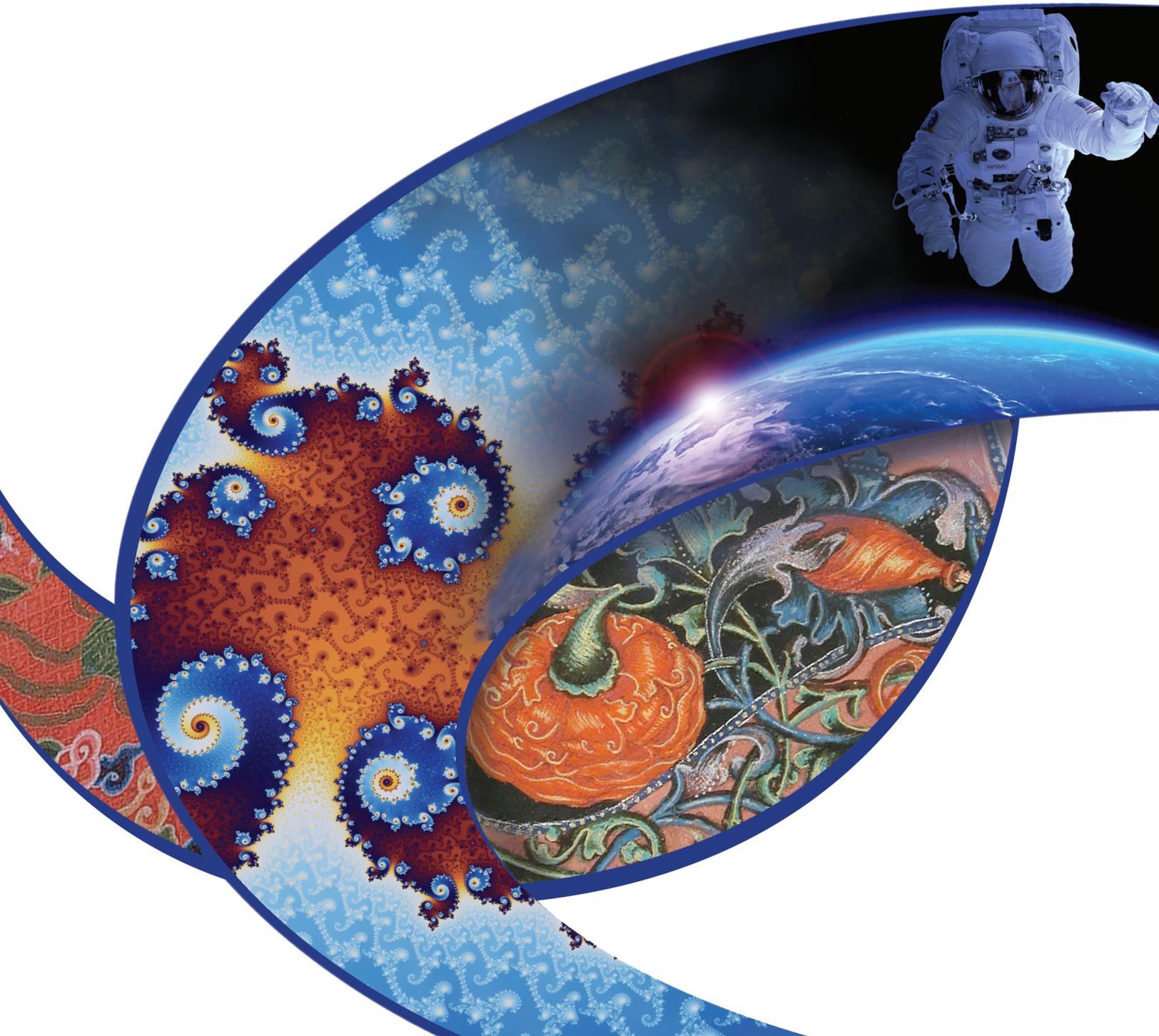




Coalition for Networked Information

Introduction &
Program Plan
2019-2020



CNI STEERING COMMITTEE, 2019-2020

Kristin Antelman, University of California, Santa Barbara, representing ARL, 2019-22

Daniel Cohen, Northeastern University, at-large member, 2019-20

P. Toby Graham, University of Georgia, representing ARL, 2017-20

Mary Lee Kennedy, ARL, *ex officio* member

Clifford A. Lynch, CNI, *ex officio* member

Beth Sandore Namachchivaya, University of Waterloo, representing ARL, 2018-21

John O'Brien, EDUCAUSE, *ex officio* member

Sharon P. Pitt, University of Delaware, representing EDUCAUSE, 2018-21

Gina M. Siesing, Bryn Mawr College, representing EDUCAUSE, 2019-22

Jenn Stringer, University of California, Berkeley, representing EDUCAUSE, 2017-20

Donald J. Waters, Independent Scholar, at-large member, 2019-20

CALENDAR OF KEY MEETINGS

ARL-CNI Fall Forum 2019: Research Libraries as Catalytic Leaders in a Society in Constant Flux–Sept. 26, 2019

Designing Libraries VIII, Atlanta, GA–Oct. 6-8, 2019

2019 Fall Membership Meeting, Washington, DC–December 9-10, 2019

15th International Digital Curation Conference, Dublin, Ireland–Feb. 17-20, 2020

2020 Spring Membership Meeting, San Diego, CA–March 30-31, 2020

Jisc/CNI Conference 2020, Bristol, England–July 14-15, 2020

Designing Libraries IX, Philadelphia, PA–Oct. 18-20, 2020

2020 Fall Membership Meeting, Washington, DC–Dec. 14-15, 2020

2021 Spring Membership Meeting, Denver, CO–March 22-23, 2021

2021 Fall Membership Meeting, Washington, DC–Dec. 13-14, 2021

2022 Fall Membership Meeting, Washington, DC–Dec. 12-13, 2022

CNI STAFF

Clifford A. Lynch, Executive Director (cliff@cni.org)

Sharon Adams, Administrative Assistant (sharon@cni.org)

Maurice-Angelo F. Cruz, Systems Coordinator (angelo@cni.org)

Jacqueline J. Eudell, Office Manager (jackie@cni.org)

Diane Goldenberg-Hart, Assistant Executive Director Designate (diane@cni.org)

Joan K. Lippincott, Associate Executive Director (*emerita* beginning Jan. 1, 2020) (joan@cni.org)

Coalition for Networked Information

21 Dupont Circle, Suite 800 • Washington, D.C. 20036

202-296-5098 • www.cni.org

Coalition for Networked Information

An Introduction & Program Plan 2019-2020

Mission

The Coalition for Networked Information (CNI) promotes the transformative promise of networked information technology for the advancement of scholarly communication and the enrichment of intellectual productivity.

ABOUT CNI

The Coalition for Networked Information (CNI), a joint initiative of the Association of Research Libraries (ARL) and EDUCAUSE, promotes the use of digital information technology to advance scholarship and education. In establishing the Coalition under the leadership of founding Executive Director Paul Evan Peters, our sponsor organizations recognized the need to broaden the community's thinking beyond issues of network connectivity and bandwidth to encompass digital content and advanced applications to create, share, disseminate, and analyze such content in the service of research and education. Reaping the benefits of the internet for scholarship, research, and education demanded, and continues to demand, new partnerships, new institutional roles, and new technologies and infrastructure. CNI seeks to advance these collaborations, to explore these new roles, and to catalyze the development and deployment of the necessary technology base.

Since its founding in 1990, CNI has addressed a broad and diverse array of issues related to the development and use of digital information in research and education environments. As the premier organization fostering connections and collaboration between library and information technology communities, we represent the interests of a wide range of member organizations from higher education, publishing, networking and telecommunications, information technology, government agencies, foundations, museums, libraries, and library organizations.

CNI is supported entirely from dues paid by its roughly 250 member institutions. We do not seek or accept grants, and all content produced by the Coalition is openly available. Membership in CNI is open to all organizations, both for-profit and not-for-profit, that share the commitment to furthering the development of digital information in the networked environment. We view our members as partners in advancing CNI's mission. Fall and spring membership meetings are flagship events, bringing together hundreds of representatives for a comprehensive update on critical issues; attendance at CNI's meetings is included in membership dues.

Governance and Leadership

CNI's program is guided by a Steering Committee to which sponsor organizations ARL and EDUCAUSE each appoint three representatives drawn from their member leadership; the current roster of Steering Committee members appears on the inside front cover of the printed *Program Plan* and on our website. A few "at large" representatives contribute additional perspectives. The chief executives of ARL, EDUCAUSE, and CNI serve as *ex officio* members.

CNI Executive Director Clifford Lynch has led the organization since 1997, following the untimely death of founding director Paul Evan Peters in 1996. Associate Executive Director Joan Lippincott has been a key part of CNI's leadership partnership since 1990. In January 2020, Lippincott will shift to *emerita* status (though she will continue to be engaged in some ongoing CNI programmatic work) and Diane Goldenberg-Hart, who has been CNI's communications coordinator since 2004, will assume the position of assistant executive director. We expect other staffing changes to take place in the coming months as a result of Joan's retirement.

For more information about the Coalition's history and contributions, see the CNI website, www.cni.org.

Program Themes

CNI's work is structured around three central themes that we believe are the essential foundations of the vision of advancing scholarship and intellectual productivity:

Developing and Managing Networked Information Content

The Coalition has played a central role in ensuring that the network richly engages the needs of scholarship, teaching and learning. We bring together many diverse groups that create and manage content, and work with these communities to advance the deployment and stewardship of digital information resources. Changes in scholarly practices (particularly those shorthanded by "e-science," "e-research" and digital scholarship) and the development of large-scale digitized collections require a close and continuing examination of information creation, aggregation, exchange, reuse, and preservation throughout the research and education community and society broadly; these developments, and the evolving roles of higher education institutions and cultural memory organizations in facilitating and supporting them, are a central part of the CNI

agenda. Working within these contexts and others, CNI furthers the development of economic, policy, social and legal frameworks to sustain the creation and management of digital information and to facilitate its access.

Transforming Organizations, Professions, and Individuals

The pervasiveness of ubiquitously accessible digital information is transforming institutions, professions, and the practices of learning and scholarship. CNI focuses on the unprecedented need for collaboration among libraries, information technology and instructional technology groups, research administration, faculty, museums, archives, university presses, and other units in order to achieve success in this environment. In addition, we promote new alliances and partnerships with publishers, information technology and network service providers, scholarly societies, government, and other sectors. Organizations must understand their constituencies and adapt their services and facilities to current needs; they must develop and share new strategies, policies, and best practices. Professions need to develop new competencies and enter into new dialogues that cross traditional disciplinary boundaries. CNI seeks to facilitate these collaborations and dialogues and to help professions and institutions work together in program strategy formulation.

Building Technology, Standards, and Infrastructure

The networked information environment relies on the development and deployment of standards and infrastructure components in order to enable the creation, discovery, use, and management of digital information on the internet. The ability to use collections of resources in a unified, consistent fashion is essential and requires a continuing focus on interoperability of services. At the same time, promising new technologies need to be explored, assessed and tested, and sometimes adapted to the needs of the CNI community. No one institution acting alone can build the needed infrastructure or explore the full range of new technologies as they become available; it requires a coordinated, community-wide effort that also reaches out to other communities, such as the world of e-research. CNI seeks to highlight links between technology and policies at all levels, to offer a context for collaborative experiments and test beds, and to serve as a focal point for sharing knowledge about new technologies.

The specific program initiatives that further CNI's themes evolve from year to year. The initiatives and strategies planned for 2019-2020 are described in the *Program Plan* portion of this publication; most build upon and continue efforts already underway. Many of the initiatives seek to make strategic progress relevant to more than one theme.

It is important to recognize that the digital information environment is still changing rapidly. CNI is continually adapting its activities in response to new developments and opportunities. Indeed, CNI believes agility is essential in the current environment and invites a continuous dialogue with its members on the need for additional program initiatives. Because of this, the *2019-2020 Program Plan* should be viewed as a snapshot of our thinking about priorities and opportunities as of late 2019 that will inevitably develop further during the coming program year.

CNI is strongly committed to addressing issues regarding values, ethics, diversity, and inclusion throughout its work. These are appearing in a variety of new, complex and sometimes surprising contexts ranging from the ways in which we choose to document the present (including traditionally undocumented or poorly documented communities); the ways in which we preserve, present, and contextualize the records of the past; the decisions about how we collect, use and preserve personal and community information, particularly involving students and research subjects; the balance between the integrity of the historical record and the right to be forgotten; the language and terminology that we use for description and discovery of information; the incorporation of accessibility in our content resources and information systems; and the use of new technologies such as machine learning for large-scale decision-making or information delivery. These issues continue to be highlighted at our meetings.

Policy & Consultative Activities

CNI acts as an important and respected voice on behalf of our community in a wide range of national and international policy venues. This is accomplished through our participation in the ongoing scholarly dialogue; through collaboration with key funding agencies, organizations,

and strategic partnerships; through work on advisory groups; through service on numerous visiting and advisory committees for our member institutions; by serving as signatory for relevant initiatives such as the National Digital Stewardship Alliance; and through contributions to standards efforts and organizations. CNI leadership regularly serves on study committees chartered by the US National Academies of Science, Engineering, and Medicine (currently the Committee for Forecasting Costs for Preserving, Archiving, and Promoting Access to Biomedical Data), on program, advisory, and nominating committees for related organizations and initiatives. We have been deeply involved with some of the programs of our sponsor organizations (including the *Horizon Report*, administered by EDUCAUSE), and we are affiliated with various organizations whose mandates align with our mission (the Library Publishing Coalition, for example).

The Coalition actively conducts an ongoing program of collaboration and advocacy to advance the development of digital information and its role in transforming organizations and scholarly activities. To this end, CNI works with scholarly societies, government agencies, publishers, and others. CNI is also committed to supporting leadership development and diversity, equity, and inclusion programs within the community through regular contributions to initiatives such as the CLIR Postdoctoral Fellows program and the ARL Leadership Fellows program, as well as future cohorts of ARL's Leadership and Career Development Program (LCDP), which focuses on people of color employed in academic and research libraries and archives. On an international level, we collaborate with other organizations concerned with networked information, including the Digital Curation Centre (DCC) and Jisc in the UK, the German Research Foundation (DFG), the Knowledge Exchange, and the Confederation of Open Access Repositories (COAR).

CNI works to provide our community with frameworks for understanding key networked information issues so that institutions can develop strategies to address these issues on the local, regional, or national level. We write white papers, reports, and articles, we present talks at conferences, and we make institutional visits that may involve meetings with campus leaders and presentations at public events and seminars.

CNI alerts its community to our organizational activities, significant new publications, and important developments in the field via the CNI website, the CNI-ANNOUNCE e-mail list, and the CNI News feed. Additional information about CNI's activities and interests is available through our Twitter and Facebook profiles. Videos of selected membership meeting presentations are publicly available on our YouTube and Vimeo channels. Part of our commitment to open access and inclusion is a policy of making all of our reports, videos, and other materials open access. Furthermore, we capture as much video and presentation materials as possible during our meetings and we make these openly available; meeting videos (which are closed-captioned) are used world-wide in both academic and institutional strategic settings.

Meetings

The Coalition's semiannual membership meetings, which this program year are scheduled for December 9-10, 2019, in Washington, DC, and March 30-31, 2020, in San Diego, CA, highlight activities related to CNI's program themes, focus attention on significant new thinking and technology developments, and provide opportunities for members to showcase and discuss a wide range of emerging issues and developments in networked information. Some participants have developed knowledge communities within CNI and use the meetings as an opportunity to share ideas on a particular aspect of networked information and to incubate new initiatives. Each member organization is invited to send two delegates, typically a senior information technologist and a senior librarian. Meeting participants are introduced to new developments that may reshape institutional plans in a forum that encourages collaborations and dialogues with others who share common interests.

CNI has a long history of being the first to offer discussion of major networked information developments, including the early web browser Mosaic, the National Science Foundation's (NSF) Digital Libraries Program, the Google Books Scanning program, and NSF's DataNet initiative. CNI regularly co-sponsors an event in partnership with Jisc as part of our ongoing collaboration with our UK colleagues; the next event will take place in Bristol, UK on July 14-15, 2020 and will focus on the roles of libraries on the frontiers of emerging research practices.

CNI occasionally convenes or co-hosts invitational or public workshops to advance specific elements of its program plan. Throughout 2018 and 2019, CNI held a series of meetings, *Refreshing the Collaboration*, to explore new priorities and opportunities for joint work engaging library and

IT leaders; themes included the research enterprise, teaching and learning, and data governance and privacy policies; we expect that the outcomes of these conversations will significantly influence our programmatic work in future years. The “Digital Scholarship Planning Workshop” was co-sponsored with ARL and held on March 25-26, 2019, at Northeastern University, and CNI hosted an invitational meeting on biographical reconciliation in Washington, DC, in November 2019.

We also serve as an active co-sponsor for other meetings relevant to the CNI agenda. This year these events include the ARL-CNI 2019 Fall Forum, “Research Libraries as Catalytic Leaders in a Society in Constant Flux” on September 26 in Washington, DC; the Georgia Institute of Technology, North Carolina State University Libraries, and CNI co-sponsored conference “Designing Libraries for the 21st Century VIII,” on October 6-8, 2019 in Atlanta, GA; and the 15th International Digital Curation Conference, to be held February 17-20, 2020, in Dublin, Ireland. Additionally, CNI is serving as a cooperating organization for several other conferences, including: Theory & Practice of Digital Libraries Conference (TPDL) 2019, in Oslo, Norway, September 9-12; Archiving 2020 in Washington, DC on May 18-21; the Joint Conference on Digital Libraries (JCDL) on June 19-23, 2020 in Wuhan, Hubei, P.R. China, and the Open Repositories meeting in Stellenbosch, South Africa, June 1-4, 2020. We are also a collaborating organization for the 2020 Personal Digital Archiving conference, tentatively scheduled for San Francisco, CA on May 4-5.

PROGRAM PLAN 2019-2020

Developing & Managing Networked Information Content

The Coalition has broad interests across all forms of digital content that can be used to support research and education. We provide a forum for information on leading projects in this arena, including a showcase at CNI membership meetings for innovative faculty-driven work. In addition, we track developments and promote strategies for the creation, management, and preservation of digital collections, digital libraries, and federated services in support of digital content. Further, because digital content cannot be divorced from the processes of teaching, learning, and scholarship that both create and rely upon that content, CNI is deeply involved in issues related to the changing practices of scholarship, the restructuring of scholarly publishing, the increasing focus on the value of data underlying research in all fields, and the broader transformation of scholarly communication, as well as innovation in teaching and learning. Through our membership meetings, specialized conferences and workshops, collaborative initiatives with other organizations, and publications, we provide leadership on digital content policy and new directions in scholarly communication.

Institutional and Disciplinary Implications of E-Research

The Coalition has long led programs to chart, understand, and facilitate the transformation of scholarly practice through the use of digital content and advanced information technology (IT). These endeavors have come to be shorthand as e-research (or, in the sciences, e-science, and in the humanities, digital humanities). In the sciences and engineering, CNI has been heavily involved in helping the higher education and library communities understand and frame emerging issues in cyberinfrastructure and e-science, with a primary focus on data sharing and data curation issues, and the interrelationships between data, software and more traditional publications. In the arts and humanities, CNI, working with a wide range of partners, has a long record of leadership in computing and the humanities, and in efforts to build collaborations that span the museum, archival and library communities. The need to continue to understand evolving scholarly practice in the sciences, social sciences, and humanities is vital in informing future planning by CNI’s members. We will continue to feature innovative and creative data and technology intensive scholarship across all disciplines, both within the US and internationally.

In the 2019-2020 program year, CNI will continue to engage data-related e-research developments in both the sciences and the humanities, but more selectively than in past years. A wide range of organizations now have aspects of data stewardship issues prominently on their agendas; there are immediate challenges for higher education institutions driven by funder mandates for data management plans, data sharing policies, and public access to research outcomes. It is our intention to support and collaborate with these efforts where we can be helpful but not

to duplicate or compete with them. We have also seen the launch of community-based efforts like the Digital Curation Network and the Research Data Alliance (RDA); we continue to track developments and try to facilitate coordination among disparate projects.

There are specific, challenging frontier areas in research data management where CNI expects to continue to provide direct leadership, including efforts to understand criteria for retention and re-assessment, re-use practices, issues related to data involving human subjects, aspects of large-scale infrastructure, reproducibility of results, long-term sustainability and the evaluation of the effectiveness of funder and institutional policies. We also hope to help clarify some of the tangled relationships among software sustainability and software preservation, data stewardship, and reproducibility of results.

We will continue to explore and document the ways in which data and computationally intensive scholarship are altering the nature of scholarly communication. These issues include the legal and technical barriers to large-scale text and data mining; appropriate organizational, policy and technical strategies for linking articles and underlying data; and ways to construct scholarly works that are amenable to various combinations of human and machine use. Critical issues include the need to better understand the complex architectural questions about the relationships among repositories, operational storage systems, e-research workflows, high performance network connectivity and powerful computational resources.

We will once again collaborate with the UK Digital Curation Centre (DCC) on the International Digital Curation Conference; IDCC 15 will take place in Dublin, Ireland in February 2020.

Connecting our work in e-research directly to our program focus on institutional content resources, CNI will continue to examine institutional policy and planning implications of campus cyberinfrastructure initiatives in both the sciences and humanities, and consider how these can complement national or international cyberinfrastructure investments and strategies at disciplinary and cross-disciplinary levels.

Digital Preservation

Closely related to, and supporting the programmatic focus on stewardship of institutional content resources, is the Coalition's ongoing work on preservation of a wide variety of digital content. This is a central issue not only in the shift to network-based scholarly communication, but also in ensuring the continuity of the broad cultural and intellectual record in the digital age and the continued availability of evidence to support future scholarly inquiry. CNI works closely with organizations such as the Association of Research Libraries (ARL), the Council on Library and Information Resources (CLIR), The Andrew W. Mellon Foundation, the Library of Congress, the National Science Foundation (NSF), ITHAKA, Jisc, and the DCC on the full range of technical, economic, and strategy issues surrounding digital preservation. Digital preservation progress will continue to receive extensive coverage at CNI membership meetings.

A particularly important development we are following closely is the emergence of genuinely viable virtual machine level emulation and containerization technology; this has implications not only for preservation but also for scholarly communication practices themselves.

The wide-scale adoption of networked information services and the shift to digital content raises a set of new questions about risk management and business continuity planning for libraries and higher education institutions. CNI continues to track these risk management issues, exploring developments and experiences with so-called "cloud" storage systems and their implications for robust storage and digital preservation, as well as some of the thinking emerging from the exascale computing and massive storage communities on the development of resilient systems, and the ways in which these ideas can be applied to very large-scale digital preservation. We explored aspects of this topic in our Executive Roundtable in April 2019.

Another area in which CNI has maintained a strong interest is in the changing nature of personal information storage and personal archiving, and the social and scholarly implications of these developments. A specific case in point is the institutional response to the acquisition of large, personal digital archives from scholars and researchers, as well as the personal archives of prominent intellectual, artistic, literary, political and similar figures. As part of our work in this area, we have been a sponsoring organization for the Personal Digital Archiving Conference since its inception.

The digital records of organizations are also poorly explored. A particular area of CNI interest is the changing nature of the academic record caused by the deployment of learning management

systems and next-generation digital learning environments, institutional repositories (IRs), large-scale lecture and event capture, digital educational resources, and long-lived, collaborative resources jointly developed by faculty and students. These emerging methods and systems will have lasting policy implications for special collections and institutional archives.

A new area of investigation is the character and structure of stewardship transitions, where responsibility for preserving and managing collections needs to migrate from one organization to another. Issues in this area are emerging in a wide range of contexts: escrow agreements for commercial digital content; the disposition of research data after some initial funder-underwritten retention period; organizational failures; and succession rights and strategies in the context of efforts like Portico or CLOCKSS.

Evidence to Support Present and Future Scholarship in a Digital World

Present and future scholarship depends on access to evidence. This includes a wide range of cultural materials, and also documentation of the past and the present. As these materials shift to digital form, there are enormous barriers in providing access to scholars and to ensuring their preservation. The situation is now reaching crisis proportions, and while this issue has long been of interest to CNI and its members, for the first time we are identifying it as an explicit and prominent programmatic theme. Key areas here include strategies for preserving the news, ensuring the preservation of digital books, music and video, and the challenges of documenting new personalized services and social media platforms. The issues here are not simply technical, but they represent a fundamental social and public policy challenge with wide-reaching implications. We are particularly interested in trying to define and characterize the ever growing range of materials that should constitute parts of our cultural and intellectual record in the broadest sense, including new areas such as social media, and to find ways to measure progress in preserving them. We are working closely with CLIR Presidential Fellow Carol Mandel to explore potential strategies for community collaboration to address some of these challenges.

A new area of concern is the ease with which highly persuasive audio and video fabrications can be manufactured, as are the implications of these developments for provenance documentation systems, content description, and related areas, particularly as these forms of content are weaponized for various purposes.

Managing Institutional Content Resources

A centerpiece of CNI's work on networked information is built around the broad theme of the stewardship of institutional content resources: materials created by members of the institutional community, or that document the work, processes, or intellectual and cultural life of an institution. Higher education and cultural memory organizations have a central role in such stewardship, which includes management, preservation, and access. Our work here has two major components. One is to advance and structure the wealth of new digital content. The program includes our continuing efforts to understand and highlight experiments in the creation of new types of scholarly works for the digital medium, such as successors to the scholarly print monograph or the development of electronic theses and dissertations; the disposition of materials collected through lecture capture systems; the implications of mass digitization of materials to support scholarship; and the availability of digital representations for existing collections of physical materials held in libraries, archives, museums, and audio/visual and public broadcasting groups. We are particularly interested in the ways in which IRs interact with virtual organizations, and their connections with individuals, including implications of faculty movement from one institution to another (explored in the recent Executive Roundtable "Supporting our Itinerant Scholars"), and with stewardship of scholarly work associated with faculty retirements.

The second major effort focuses on approaches to managing the wealth of new content through the development of strategies such as the deployment of IRs. Here CNI is addressing the full range of issues, from policy and strategic planning through system architecture and standards for the management of complex digital objects. Note that the specific case of research data management has already been discussed above; this is an area that has unusual complexities in relating institutional strategies to national and international disciplinary-related activities.

A continuing priority is a focused, ongoing re-examination and re-assessment of IR services. The concept of the IR is in its second decade; CNI was deeply involved in the initial conceptualization of IR services and in the development of implementation strategies for them. Platform alternatives, including commercial and nonprofit repository services, have multiplied and matured, and understandings about costs, as well as barriers to successful deployment, have become much

clearer. Indeed, we are seeing significantly different deployment trajectories in different nations, particularly in the context of subject repositories and other disciplinary or funder defined data management frameworks, and these are leading to new policy issues and requirements for various kinds of interoperability standards.

Transforming Organizations, Professions, & Individuals

The ubiquitous nature of digital content and networks has led to transformations in the way the research and education community does its work. In this program area, we focus on the impact of changing technologies, new modes of communication and content creation, and the pervasiveness of digital content on organizations, including the changing nature of teaching and learning, the need for new services and expertise in professions, the increasing demand for technical skills by undergraduate and graduate students, the importance of partnerships, and the pressure on physical facilities to accommodate the changing needs of user communities.

CNI has a longstanding commitment to highlighting and advancing organizational initiatives that facilitate cooperation across institutional units and professional cultures, with particular emphasis on collaboration between librarians and information technologists. We have also tried to extend the core library-IT collaboration to encompass instructional technologists, faculty, publishers, electronic records managers, archivists, museum professionals, data managers and data scientists, research managers and others. We will increase our focus on the career paths and professionalization of roles for those who support data-intensive research. Our work on organizational and institutional issues includes a focus on evaluation and assessment strategies, recognizing the continuing need to understand the effects and contributions of advanced IT and digital content.

There is a developing recognition that institutions need more coherent strategies for disseminating scholarship, and that this entails much more than just operating a university press. Just as research libraries and presses jointly enabled humanities monograph publishing to work in print, new partnerships will be needed to support digital humanities at scale. We continue to work with libraries and university presses as new initiatives emerge in this area. We are also monitoring a number of related developments in online learning innovations, open educational resources (OER), and ebook development, acquisition and dissemination.

Institutions are increasingly exploring how augmented reality (AR), virtual reality (VR), and machine learning can be used in research and in teaching and learning. More libraries are incorporating these technologies into their programs and facilities. Institutions are also developing innovation spaces as a way to encourage creativity and foster entrepreneurship among students, faculty, and community members. We are also interested in way that AR drives the need for the creation and maintenance of high-quality databases of geo-reference information.

Refreshing the Collaboration: New Priorities and Opportunities between Library and IT Leaders

A cornerstone of CNI's foundation in 1990 was the need for deep collaboration between library and IT leadership to address the challenges and opportunities of the networked information environment. In the intervening 30 years the world has changed greatly; the distribution of IT expertise and mission responsibilities on our campuses has been massively reconfigured, and a generational shift in leadership of these organizations is now largely complete. As a major CNI initiative, we convened four, small, invitational roundtables from September 2018 to September 2019 to discuss and re-assess the most promising and urgent areas for collaboration among these leaders, and also to consider how the collaborations need to be extended to additional partners, most notably research offices. The four roundtables focused on these themes: exploration of the broad landscape; teaching, learning, and student success; supporting the research enterprise; and institutional policy challenges in privacy and data governance. We are now completing the initiative with a dissemination and synthesis phase. We are producing summaries of these meetings, and conducting sessions on what we learned, including a featured session at the EDUCAUSE conference in October 2019, a session at the fall 2019 CNI membership meeting, and an ARL webinar in early 2020. Most importantly, we are also currently in the midst of exploring how the outcomes of these discussions will shape future CNI program initiatives and those of our collaborating organizations.

Acquisition and Creation of Instructional Materials

One of the most prominent outcomes of *the Refreshing the Collaboration* convenings was a sense that the current approach to acquiring instructional materials at most institutions is not serving students or institutions well. A fundamental redesign is needed as textbooks morph into constellations of digital learning materials. OER is a part of the solution, but there will be a continuing need for commercial materials as well; license terms and pricing models need careful examination, with full consideration of issues such as student privacy, needs for analytic data, long-term access to content, and supporting student success by ensuring that affordable content is available to all students. While there are numerous technical, legal, business and policy challenges, first and foremost this is a challenge for institutional organizational structures and collaborations. During this program year, we will seek to understand and document the current landscape, and try to highlight institutions that have made significant progress in overcoming these challenges.

Today's Learners and Digital Environments

Digital technologies and the global nature of higher education today are accelerating changes in colleges and universities in a variety of ways. There are increasing calls to make higher education more affordable and more accountable for student outcomes. One response has been the growing use of analytics software to track student behavior related to learning; this is used to improve student performance and outcomes, and to inform faculty members. We are serving on an advisory group of an IMLS-funded project to explore the relationship between institutional learning analytics and measures related to library use.

As both students and faculty increasingly produce new digital information, sometimes incorporating parts of others' work, and often in complex social software contexts, they have a pressing need to understand a wide range of issues including intellectual property, privacy, preservation, format standards, and metadata creation. A variety of digital literacies (information, technology, and visual) are converging as students, faculty, and others produce innovative digital content. Institutional scholarly communications programs and digital scholarship centers often provide expertise to their constituencies in these areas; our work on this is discussed below. We are also giving increasing attention to the needs of graduate students, and some undergraduates, to have opportunities to develop skills related to data-intensive research. Some institutions are implementing software carpentry programs, short courses, certificate programs, and other mechanisms for training students in research data management practices as well as research ethics and scholarly publishing practices and norms.

We note that data science, framed as a research support service similar to statistical consulting, geospatial information systems, or research data curation, as opposed to an academic program that is part of the curriculum, is emerging as a key strategic challenge. We will continue exploring this issue, and the challenges surrounding these distinctions, in future membership meetings and executive roundtables.

Spaces and Services that Support Technology-Enhanced Research and Learning

Campuses are building or renovating physical, technology-enabled spaces to support research and learning. CNI continues to have a strong focus on spaces that enhance new modes of teaching and learning; for example, spaces configured to support collaborative student projects employing technology and a range of information resources. Our interest stresses aligning new services and new technologies within the spaces that have been built to enhance the teaching and learning mission of the institution. Spaces that promote the integration of content and technologies into student-produced work in a way that engages students in the academic enterprise (whether media labs, studios, information/learning commons, or specialized classrooms) are a particular focus, highlighting the innovative ways that library spaces, technologies, and services are enabling pedagogical and curricular change. We are following developments in makerspaces, which often offer capabilities such as 3-D printing to support work in a wide variety of disciplines, visualization labs and installations, and the addition of VR stations in environments such as libraries that provide access to students and faculty from all disciplines in the university or college.

Our work also emphasizes how these spaces can provide mechanisms for various professional collaborations to offer student-centered services. Librarians, instructional technologists, multi-media specialists, information technologists, and writing center staff are some of the partners who may work together to offer joint services in these types of spaces. Often these initiatives are viewed as part of an institutional student success program.

CNI has co-sponsored a major conference, *Designing Libraries for the 21st Century*, since its inception, and the 8th conference was held at Georgia Tech in October 2019. The next conference will be held at Temple University in September 2020. We have taken some lessons learned to a broader community through webinars and sessions at conferences.

Many institutions are interested in understanding the learning spaces of other campuses when they are planning renovations or new buildings. They seek data, photos, floor plans, and service models for new learning spaces, including classrooms, media studios, learning or information commons, and small group collaborative spaces. We are working to highlight approaches such as the FLEXSpace project, the North Carolina State University (NCSU) Learning Space Toolkit's Space Browser, and the Learning Space Rating System, all of which provide useful information about campus spaces.

The assessment of learning spaces continues to garner attention. In December 2018 we co-hosted a workshop with the Learning Spaces Collaboratory that examined good practices for assessing the relationship between learning and library spaces, and we co-facilitated a workshop on this topic at the Library Assessment Conference in December 2018. We participated in and played a facilitation role in the Learning Spaces Collaboratory's Summit in November 2019.

Supporting Emerging Scholarly Research Practices at Scale

Changing research practices in all fields are closely connected to our programmatic emphasis on digital scholarship centers. These centers or labs typically provide high-end technologies, in-depth consultation for faculty, graduate students, and upper-level undergraduates working on capstone projects, and a suite of spaces. They represent an institutional response to the need for services to support new kinds of scholarship. CNI has produced articles and issued reports encouraging better understanding of the rationale and mission for a center, suggestions for good practice, and models of staffing, funding, and provision of services, and we supplemented the report with related materials on our website. We have held three well-attended workshops on this topic, co-sponsored by ARL, most recently at Northeastern University in March 2019, and have highlighted a number of centers in breakout sessions at CNI membership meetings. In addition, this has been a topic of great interest during CNI staff visits to campuses. We will have various roles at the "Critical Roles for Libraries in the Research Enterprise Symposium," an event in December 2019, funded as part of research conducted at the University of Calgary, "Academic Research and University Libraries: Creating a New Model for Collaboration," which is sponsored by The Andrew W. Mellon Foundation.

Innovation and partnerships are components of work in digital scholarship as well as other areas, and we co-sponsored the ARL-CNI Fall Forum "Research Libraries as Catalytic Leaders in a Society in Constant Flux" in September 2019.

Executive Roundtable

CNI's Executive Roundtable series assembles executive teams (usually the chief librarian and chief IT officer, but varying depending on the topic) from about 10 member organizations for a focused discussion on a topic of interest on the morning of the first day of each membership meeting. Launched in 2003, the Executive Roundtables build on the theme of collaboration between librarians and information technologists that has been at CNI's foundation. Recent topics have included cloud hosting vs. local hosting, challenges of itinerant researchers, moving content to the cloud, strategies for preserving email, supporting digital humanities, privacy in the age of analytics, funder mandates, compliance and access to research results, institutional strategies for OERs, library and IT partnerships with campus museums, and rethinking IR strategies. Reports of Roundtables are available on the CNI website.

The Fall 2019 Executive Roundtable will focus on institutional approaches to electronic lab notebooks. The next few roundtables will address student privacy, data science as a support service, and new strategies for acquiring digital instructional material.

Building Technology, Standards, & Infrastructure

CNI continues to be engaged in key areas of standards and infrastructure development. We are particularly concerned with facilitating the difficult and delicate transition of standards and technologies into operational infrastructure for the research, higher education and library

communities. For example, federated identity management is becoming a key infrastructure component to support research using resources beyond a single campus. Another example: while there has been good work recently on linked data and on annotation, there are practical deployment questions, regarding where data is actually hosted and where computation occurs, that still need to be fully explored.

In addition to the specific program initiatives described here, CNI participates in and tracks a wide range of developments in areas as diverse as identifiers, digital books, metadata standards, distributed and federated network services, harvesting technologies, recommender systems, and personalization technologies. As we look at an evolving landscape that includes commercial web search engines, traditional library automation tools such as online catalogs, stand-alone abstracting and indexing databases, systems deployed by scholarly publishers, museums, and other content providers, and learning management systems, the Coalition is concerned with architectural and standards frameworks that can facilitate integration and interoperation. This perspective has motivated much of our work over the last few years on cyberinfrastructure, IRs, the various components of the Open Archives Initiative (including the protocol for metadata harvesting, the object reuse and exchange protocol, and, most recently, the Open Annotation work), and learning management systems. One of our most important contributions is the ability to promote discussions across project and technology silos that help to reduce redundancy, increase coherence, and facilitate scalability.

Currently, we see a number of trends that we believe will drive a renewed focus on standards and infrastructure, including the proliferation of mobile devices (smart phones, tablets, e-book readers, etc.), the move towards data resources as part of the infrastructure (changes in identity management, bibliographic control, etc.), and the move towards cross-institutional systems (web-scale discovery and resource sharing, cloud computing, and distributed storage). Many of the latest developments couple technical issues with policy challenges in novel ways.

We also continue to track and inform our members about developments in technologies that promise to change the way we can capture or document objects and events digitally (for example, through developments in computational digital photography and image capture), and the way we can share or reproduce them (for example, through 3-D printing technologies), or the way we produce, manage and use content employing new technologies such as AR and VR.

There are more basic technology developments that we are also tracking closely because we believe that they have longer-term but very high impact implications: issues around security; quantum computing; cryptographic infrastructure; resilience in technologies; 5G wireless deployment; machine learning and “artificial intelligence” (usually a misnomer) related systems, to name only a few. We published a discussion of some potential impacts for machine learning in archives and special collections in the fall of 2019.

Emerging Technologies and Research Libraries

As an extension of our overall technology-tracking work, this program year we entered into a partnership with ARL and EDUCAUSE to first develop and vet a list of what we believe will be the highest impact technologies for research libraries over a 5-10 year time horizon; high impact is defined as either directly affecting the work of libraries, or altering the practices of teaching, learning or research in a profound way that will consequently alter the work of research libraries. In this program year, we expect to release initial documents in early 2020, and to discuss these through a series of events connected to the 2020 EDUCAUSE Learning Initiative (ELI) meeting, the 2020 spring CNI meeting, and the spring 2020 ARL meeting. Later in 2020, this effort will shift to focus on potential organizational transformation strategies as it refocuses on institutional responses to the opportunities that these emerging technologies open up.

Institutional Infrastructure to Support Research

There is a renewed focus on campus infrastructure to support research programs. Developments include: policy, technical, and economic influences that are leading to a partial re-centralization of computing functions; radically new high performance network and distributed computing technologies; a rethinking of storage functionality and economics; requirements for long-term data management, curation and preservation; and growing faculty demands for informatics support services. An additional dimension of these needs involves information and technology intensive collaborations among groups at multiple campuses (sometimes characterized as collaboratories or virtual organizations) and virtual research environments that enable such

collaborations. Complementing the organizationally oriented work on e-research already described, CNI is also concerned with the institutional and cross institutional development of technical infrastructure, with a particular focus on large-scale storage and data management (discussed in more detail earlier), and on collaboration tools and environments. Of particular concern is the persistently difficult integration of investment in national-level research infrastructure and campus-level investments and approaches. These issues are also central to strategies for research data management stewardship discussed earlier.

Security, Privacy, Identity and Access Management

CNI takes a broad view of security, integrity, privacy and access management issues as they relate to the management of licensed resources and the stewardship and preservation of digital content. New technological capabilities (notably the ability for users to amass and maintain massive personal digital libraries which include large amounts of copyrighted material drawn from licensed databases or large collections of digital books on proprietary reading platforms) continue to raise complex questions with both technological and policy dimensions. CNI believes that we must continue to explore new behaviors and practices such as the building of workgroup or personal collections combining public and private materials, or large-scale text or data mining that spans published literature and databases and unreleased research results, or the emerging commerce in information about reader behaviors in various contexts.

We conducted an Executive Roundtable at the spring 2015 meeting that broadly explored privacy in an age of analytics. A specific area on which we continue to focus is so-called “reading analytics,” including their interactions with learning analytics in e-textbooks. A major article exploring aspects of such analytics was published in *First Monday* in April 2017 and an additional article was published in *Research Library Issues* in 2019. CNI is also engaged with several IMLS-sponsored projects in this area, as well as various InCommon-related initiatives such as RA21 for authorization. We expect that reader privacy as it relates to scholarly resources will be an important focus area in 2019-2020 and beyond.

The Coming Convergence Of Identity Management, Biography, Bibliography and Social Discovery

We will continue exploring the potential future convergence, or at least linkage, between identities as established by campus-based identity management systems on one hand, and personal names as used in the context of scholarly communication, citation, and bibliographic control name authority on the other. Historically, these worlds have been almost completely separate and highly insular, but the emergence of sophisticated author rights retention strategies, institutional and disciplinary repositories, advanced bibliometrics and webmetrics, faculty activity tracking and research management systems, and directories and social discovery systems in academic settings, are clearly bringing them into closer alignment. Connections to public history, genealogy, and prosopography or large-scale biography are also fast emerging, essentially recognizing potential continuity between forward-looking infrastructure and historical documentation. We are also seeing bridges being established between resources of a primarily academic nature and tools used by the broad public (including Wikipedia). A very important development that CNI is helping to advance is the work towards a National (and ultimately international) Archival Authorities Infrastructure through the Social Networks and Archival Context (SNAC) Consortium. We are also exploring the role that linked data may play in facilitating the interchange and reuse of digital biographical information, and hosted an invitational biographical reconciliation summit in November 2019. It seems clear, partially as an outcome of this meeting, that while progress has been glacial by some measures, linked open data technologies are reaching a very promising point, though still facing challenges related to scale, quality of semantics, provenance, and data consistency. CNI will be looking very closely at this area in the coming year or two, with a focus on how to genuinely assess viability and interoperability of these technologies, and, where appropriate, accelerate their adoption.

Selected Recent Publications by CNI Staff

Reports from “Refreshing the Agenda and Priorities for Collaboration” Meetings. A series of discussions convened by CNI to assess the most promising and urgent areas for collaboration between library and IT leadership.

Institutional Policy Challenges in Privacy and Data Governance. Report of the fourth in a series of CNI-convened invitational meetings of senior IT and library leaders, held Sept. 2019 (forthcoming).

The Research Enterprise. Report of the third in a series of CNI-convened invitational meetings of senior IT and library leaders, held June 2019 (forthcoming).

Teaching, Learning, & Student Success. Report of the second in a series of CNI-convened invitational meetings of senior IT and library leaders, held March 2019 (forthcoming).

Refreshing the Agenda and Priorities for Collaboration. Report of the first in a series of CNI-convened invitational meetings of senior IT and library leaders, held Sept. 2018 (Dec. 2018).

Executive Roundtable Reports. CNI Executive Roundtables bring together campus partners to discuss key digital information topics and their strategic implications.

Cloud Hosting vs. Local Hosting: Choices and Implications. Report of a CNI Executive Roundtable held April 2019 (forthcoming).

The Many Challenges of Our Itinerant Researchers. Report of a CNI Executive Roundtable held Dec. 2018 (April 2019).

Strategies for Preserving Institutional and Researcher Email. Report of a CNI Executive Roundtable held April 11-12, 2018 (Sept. 2018).

Responding to the Move of Content to the Cloud: GitHub, Figshare, YouTube, and Similar Services. Report of a CNI Executive Roundtable held Dec. 10-11, 2017 (Feb. 2018).

Selected Recent Publications by CNI Staff

Clifford A. Lynch. “Machine Learning, Archives and Special Collections: A High-Level View.” *Flash*, no. 38 (2019) and *ICA Blog*, Oct. 2, 2019 (<https://blog-ica.org/2019/10/02/machine-learning-archives-and-special-collections-a-high-level-view/>).

Clifford A. Lynch. “Reader Privacy: The New Shape of the Threat.” *Research Library Issues*, no. 297 (2019): 7–14.

Joan K. Lippincott et al. “Library Perspectives on the EDUCAUSE 2019 Top 10 IT Issues.” *EDUCAUSE Review*. February 11, 2019.

Clifford A. Lynch. “Managing the Cultural Record in the Information Warfare Era.” *EDUCAUSE Review*. Nov/Dec 2018.

Clifford A. Lynch. “Practical Consequences of the Elimination of Net Neutrality for the Research & Education Community: A Speculation.” *Research Library Issues* 293 (2018).

Joan K. Lippincott, Quinn Dombrowski. “Moving Ahead with Support for Digital Humanities.” *EDUCAUSE Review*. March/April 2018.

Joan K. Lippincott. “The Link to Content in 21st-Century Libraries.” *EDUCAUSE Review*. January/February 2018.

Clifford A. Lynch. “Stewardship in the ‘Age of Algorithms.’” *First Monday* 22:12 (Dec. 2, 2017).

Clifford A. Lynch. “The Rise of Reading Analytics and the Emerging Calculus of Reader Privacy in the Digital World.” *First Monday* 22:4 (April 3, 2017).

CNI Contributed to these Selected Recent Publications

EDUCAUSE Learning Initiative (ELI). *7 Things You Should Know About Digital Literacies*. EDUCAUSE. July 2019.

Louisa Dale et al. *Jisc and CNI Invitational Roundtable 3 July 2018*. Oxford University, UK. Feb. 2019.

Bryan Alexander et al. *EDUCAUSE Horizon Report: 2019 Higher Education Edition*. Louisville, CO: EDUCAUSE. 2019.

Diane Goldenberg-Hart. *Libraries as Spaces for 21st Century Learners & Learning*. Report of an LSC/CNI Roundtable held Dec. 2018 (Jan. 2019).

National Academies of Sciences, Engineering, and Medicine. *Open Source Software Policy Options for NASA Earth and Space Sciences*. Washington, DC: The National Academies Press. 2018.

Kirk M. Anne et al. *Building Capacity for Digital Humanities: A Framework for Institutional Planning*. ECAR Working Group Paper. Louisville, CO: ECAR, May 31, 2017.

CNI reports, most articles, and selected presentations, interviews, and third party reports are linked to from www.cni.org/publications.

Membership List

(As of November 2019)

Alfred P. Sloan Foundation
American Library Association
American Theological Library Association
American University*
Andrew W. Mellon Foundation
Arizona State University*
Association of College and Research Libraries*
Athenaeum21
Atmire
Auburn University
Baylor University
Binghamton University
Bodleian Libraries
Boston College
Boston University
Brandeis University
Brigham Young University
Brown University*
Bryn Mawr College
Bucknell University
California Institute of Technology
California Polytechnic State University
California State University, Fullerton
California State University, Office
of the Chancellor*
Carnegie Mellon University*
Case Western Reserve University*
Center for Research Libraries
Central Washington University
Claremont Colleges Library
Clemson University
Colgate University
The College of William and Mary
Colorado State University*
Columbia University*
Connecticut College
Cornell University*
Council on Library and Information Resources
Crossref
Dalhousie University Libraries
Dartmouth College
DePaul University
Deutsche Forschungsgemeinschaft (DFG)
Drexel University, College of Computing
and Informatics
Duke University
EBSCO Publishing
Elsevier Science Publishers B. V.*
Emory University
Ex Libris (USA), Inc.
Florida Atlantic University
Florida State University
Gale Cengage Learning
George Mason University
George Washington University*
Georgetown University*
Georgia Institute of Technology*
Georgia State University Library
Harvard University*
Illinois Institute of Technology
IMS Global Learning Consortium
Index Data
Indiana University*
Indiana University-Purdue University at Indianapolis
Internet Archive
Internet2
Iowa State University*
ITHAKA
J. Paul Getty Trust
Jisc
Johns Hopkins University*
Joint University Librarians Advisory Committee
JSTOR
Kansas State University
Kent State University*
King Abdullah University of Science
& Technology (KAUST)
Lafayette College
Lehigh University
Library of Congress*
Los Alamos National Laboratory Research Library
Louisiana State University, Libraries
Loyola University Chicago
LYRASIS
Macalester College
Marquette University
Massachusetts Institute of Technology*

McGill University
McMaster University
Memorial University
Michigan State University*
Middlebury College
Mississippi State University
Montana State University
National Archives and Records Administration
National Center for Atmospheric Research (NCAR)
National Institutes of Health Library
National Library of Medicine
Naval Postgraduate School
New York University
North Carolina State University
Northeastern University
Northern Arizona University – Cline Library
Northwestern University*
OCLC, Inc.*
Ohio State University*
Ohio University
Oklahoma State University
Old Dominion University
Ontario Council of University Libraries
Oregon State University
Pennsylvania State University*
Princeton University*
Princeton Theological Seminary Library
Project MUSE/Johns Hopkins University Press
ProQuest
Purdue University
Qatar National Library
Queen’s University
Rensselaer Polytechnic Institute Libraries
Rhodes College
Rice University*
Rowan University
Royal Danish Library / Det Kgl. Bibliotek
Rutgers University*
Ryerson University
San Diego State University
Simon Fraser University Library
Skidmore College

Smith College Libraries
Smithsonian Institution*
Southern Methodist University*
Stanford University*
State University of New York at Albany
Stony Brook University
SUNY System Administration*
Swarthmore College Libraries
Syracuse University*
Temple University
Texas A&M University
Texas A&M University Corpus Christi
Texas Christian University
Texas State University
Texas Tech University
Tufts University
Tulane University
Union College
United States Military Academy Library
Universiteit van Amsterdam
University at Buffalo, State University of New York*
University College Dublin
University of Alabama
University of Alabama at Birmingham
University of Alberta Libraries
University of Arizona*
University of Arkansas
University of British Columbia
University of Calgary
University of California, Berkeley*
University of California, Davis*
University of California, Irvine*
University of California, Los Angeles*
University of California, Merced
University of California, Office of the President*
University of California, Riverside
University of California, San Diego*
University of California, Santa Barbara*
University of California, Santa Cruz
University of Central Florida
University of Chicago*
University of Cincinnati

University of Colorado at Boulder*
 University of Connecticut
 University of Delaware*
 University of Denver
 University of Florida
 University of Georgia
 University of Guelph
 University of Hawaii
 University of Houston
 University of Idaho
 University of Illinois at Chicago*
 University of Illinois at Urbana-Champaign*
 University of Iowa*
 University of Kansas
 University of Kentucky*
 University of Limerick
 University of Louisville*
 University of Manitoba*
 University of Maryland at College Park*
 University of Maryland, Baltimore
 University of Massachusetts Amherst
 University of Miami*
 University of Michigan*
 University of Minnesota*
 University of Mississippi Libraries
 University of Missouri
 University of Nebraska at Lincoln*
 University of Nebraska Medical Center
 University of Nevada, Las Vegas
 University of Nevada, Reno
 University of New Brunswick
 University of New Hampshire Library
 University of New Mexico
 University of North Carolina at Greensboro
 Libraries
 University of North Carolina, Chapel Hill
 University of North Texas
 University of Northern Iowa
 University of Notre Dame*
 University of Oklahoma*
 University of Oregon*
 University of Ottawa
 University of Pennsylvania*
 University of Pittsburgh*

University of Rhode Island
 University of Rochester*
 University of San Diego Copley Library
 University of San Francisco
 University of Saskatchewan
 University of Sheffield
 University of South Carolina
 University of South Florida
 University of Sydney Library
 University of Tennessee*
 University of Texas at Arlington
 University of Texas at Austin*
 University of Texas at San Antonio
 University of Texas Rio Grande Valley
 University of the West Indies
 University of Toronto
 University of Utah
 University of Victoria
 University of Virginia
 University of Washington*
 University of Waterloo
 University of Windsor
 University of Wisconsin at Madison*
 University of Wyoming
 U.S. Government Publishing Office
 Utah State University
 Vanderbilt University*
 Vassar College
 Villanova University – Falvey
 Memorial Library
 Virginia Commonwealth University
 Virginia Polytechnic Institute
 and State University*
 Wake Forest University
 Washington University*
 Wayne State University
 Weill Cornell Medicine
 Wesleyan University
 West Virginia University Libraries
 Wichita State University Libraries
 Williams College
 Yale University
 York University

* Denotes charter members

IMAGE CREDITS

Front (left to right; top to bottom):

Sutra or Book Cover with Phoenix and Potted Plants, 16th Century
The Metropolitan Museum of Art, New York, www.metmuseum.org
Anonymous Gift, 1956
CCo 1.0 Universal, Public Domain Dedication

Mandel Zoom 14 Satellite Julia Island
Partial view of the Mandelbrot set. Step 14 of a zoom sequence.
Created by Wolfgang Beyer with the program Ultra Fractal 3.
https://commons.wikimedia.org/wiki/File:Mandel_zoom_14_satellite_julia_island.jpg
Credit: Wolfgang Beyer [CC BY-SA 3.0 (<http://creativecommons.org/licenses/by-sa/3.0/>)]

Astronaut in Space
Credit: Pxhere
CCo 1.0 Universal, Public Domain Dedication

Manuscript Illumination with Initial S, from a Choir Book, 16th Century
The Metropolitan Museum of Art, New York, www.metmuseum.org
The Friedsam Collection, Bequest of Michael Friedsam, 1931
CCo 1.0 Universal, Public Domain Dedication

Back (left to right):

Still Life with Lemons, Oranges, and a Pomegranate
Artist: Jacob van Hulsdonck (Flemish, 1582–1647)
The Getty, www.getty.edu
Object Number: 86.PB.538
Digital image courtesy of the Getty's Open Content Program

Vanitas Still Life, 1662
Artist: Edwaert Collier (Dutch, Breda ca. 1640?–after 1707 London or Leiden)
The Metropolitan Museum of Art, www.metmuseum.org
Purchase, 1871
CCo 1.0 Universal, Public Domain Dedication

Descriptions are from image sources unless otherwise noted.

cni

Coalition for Networked Information



21 Dupont Circle, Suite 800
Washington, D.C. 20036
202-296-5098 • www.cni.org