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LIBRARY INSTRUCTION ROUND TABLE NEWS

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Spring Cleaning

From the Vice President
Kristen Edson

As spring approaches, it brings with it new life, longer days, and warmer temperatures. It makes you want to go outside, soak up the sunshine, and take in all of the new life popping up.

In that frame of mind and in my new position as the Central Library Manager for the Bossier Parish Libraries, I've been doing a lot of spring cleaning to make way for new ideas. It can be hard to let go of possessions and ways of getting tasks done, especially if they have been around for a long time. However, it's part of our jobs to keep current and evaluate the real value of these processes and objects. First and foremost, I think of whether or not the way we are doing a task or a service we are providing is really in the best interest of our patrons. Can we make this better or easier for our patrons? We want them to have the best experience in the library as possible. Asking this question leads me to take a look at what other public, academic, and school libraries are doing for inspiration. I think that we are so lucky to work in a profession of sharing best practices and program content.



If you are looking for a way to connect and collaborate with other librarians, taking a more active role in LIRT is a great way to accomplish this. I know that every time I attend one of our programs or networking events, I find a kernel of information that is useful to my public library. Being a committee member gives you the opportunity to voice your opinion on what our programs cover and to experience collaborating with colleagues across the country from varying backgrounds. It's an easy way to get involved with the larger library community and drive conversations on all the instruction that is happening in every type of library.

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I hope that you will fill out our volunteer form and join one of our many committees for 2018-2020. Appointments will start in March and continue through June 1st. See y'all at ALA Annual in my new home state of Louisiana at the New Orleans Convention Center.

—Kristen



LIRT empowers librarians from all types of libraries to become better teachers through sharing best practices, leadership and professional development, and networking.

From the Editor



by Sherri Brown
LIRT News Editor



Denver Convention Center, photo by Rachel Mulvihill

Learning Opportunities

For those readers who were unable to attend ALA Midwinter this year, you missed cold temps, snow, and some really great programs and discussions! Don't fret, though, because LIRT is always planning and promoting new learning opportunities. In this issue of *LIRT News*, you can find information regarding LIRT's upcoming ALA Annual program on critical information literacy, a report on a presentation about IL instruction for professional programs from the California Library Association annual conference, and materials for teaching about fake news. Meanwhile, the Top 20 Committee is finishing up selecting the top twenty library instruction articles of 2017 to be published in June, and the Transitions to College Committee continues to add to the Connecting Librarians map (<http://www.ala.org/rt/lirt/connecting-librarians-k-20-transitions>). Looking ahead, in June we'll be sending out a short communications survey to help us learn how you prefer to engage with LIRT – we hope you'll participate!

Looking forward to warmer weather and longer days ahead . . .

Sherri

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Contributions to be considered for the **June 2018 issue** must be sent to the editor by **May 1, 2018**.
Production editor: Rachel Mulvihill

Seen in Denver

LIRT Discussion Forum

App-etizing Instruction:
Practical Tips For Teaching
Emerging Technologies



Presenters Rachael Elrod, Sara Russell Gonzalez, Stan Trembach, and Liya Deng

A graphic logo for the ALA Denver Midwinter Meeting & Exhibits. The logo is divided into several sections with stylized illustrations. On the left, a blue box contains the text "The conversation starts here..." above three green leaves. The center features the text "ALADENVER MIDWINTER Meeting & Exhibits" in various fonts, with "ALA American Library Association" below it. On the right, a blue box contains the dates "FEBRUARY 9-13, 2018" above a stylized landscape with mountains, trees, and buildings. A paw print is in the bottom right corner.



Denver in the snow, photo by Sherri Brown



Photo by Rachel Mulvihill



Photo by Rachel Mulvihill



Candidates for LIRT Offices

Candidates for Vice President/President-Elect

Rachael Elrod

Rachael Elrod is the Head of the Education Library at the University of Florida. She is currently working on an Ed.D. in Higher Education Administration from the University of Florida, and holds an MSLS from the University of Kentucky, an M.Ed. in Counseling Psychology from the University of Louisville, and a B.S. in Psychology and Sociology from Campbellsville University. She is a project team member of an IMLS Grant titled "Researching Students' Information Choices: Determining Identity and Judging Credibility in Digital Spaces," which examines how students select digital items for STEM research use and their understanding of digital document types.

She has been a member of LIRT since 2011 and has served in a variety of roles and committees including the Liaison Committee, Membership Committee, and Top 20 Committee. She is currently serving as LIRT Secretary.



Jim Walther



Jim Walther is an Assistant Professor at Emporia State University in the School of Library and Information Management. His teaching stream includes the leadership and management track, as well as adult learning, curriculum, and teaching and learning in libraries and information centers. Currently, he is also serving in Faculty Senate at Emporia State, including chairing the Committee on Campus Governance and on Faculty Senate Executive Committee. Before coming to Emporia State, he had library research and leadership roles in law libraries, and training and development positions at Emerald Group Publishing, The New York Public Library, The Metropolitan Opera, and LexisNexis. In all of these roles, he has developed a strong appreciation for the needs of learning in organizations, which brings him to his involvement in LIRT. In the role as President, he would welcome the opportunity to continue the strong leadership of the Round Table for the profession.

Dr. Walther's degrees include an MLIS from University of Wisconsin-Milwaukee, from where he also has a bachelor of arts in Sociology and Political Science. His doctorate is from The George Washington University, School of Education and Human Development, where he focused on institutional decision-making, finance, scholarly communication and intellectual property, the role of the academic library on campuses, as well as adult learning and curriculum.

Candidates for LIRT Offices continued on page 5



Candidates for LIRT Offices, continued

Candidates for Vice Treasurer/Treasurer-Elect

Mardi Mahaffy

Mardi Mahaffy holds an M.L.S. from Indiana University, and is now the Head of Teaching and Learning at the University of Missouri Kansas City. In this role, she oversees reference services and the teams providing information literacy instruction in general education and disciplinary contexts. Working with a fabulous group of people, Mardi has striven to stretch limited resources in the service of quality face-to-face and online instruction. Mardi is a long time member of LIRT and has served the Round Table in multiple capacities, including as LIRT President in 2012. She welcomes the opportunity to contribute again to the Steering Committee and Executive Board as Treasurer-Elect.



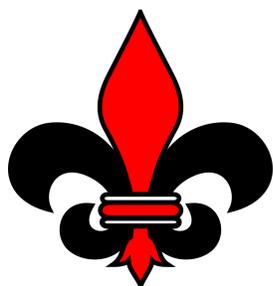
Michael Saar



Michael Saar is an Associate Professor and the Interim Instruction Coordinator at the Mary & John Gray Library at Lamar University. He teaches individualized library instruction sessions in a variety of formats and disciplines and has taught semester-long courses on library research and evaluating information. In addition to his instruction duties, he provides research assistance on the reference desk and serves as the library liaison for students with disabilities. He holds a Master's Degree in Information Resources and Library Science from the University of Arizona and a second Master's in Theatre Historiography from the University of Minnesota. He has been a member of LIRT since 2010 and has worked on the Liaison Committee and the Awards Committee, where he served as chair from 2015-2017.

Candidates for LIRT Offices continued on page 5

LIRT Awards Ceremony at ALA Annual



Make plans now to join us for the LIRT Awards Ceremony at the 2018 ALA Annual Conference in New Orleans. The ceremony and reception will take place on Sunday, June 24th from 5:30p.m. to 7:00p.m. and will include light hors d'oeuvres and a cash bar.

Help us celebrate the work of librarians dedicated to information literacy!



Candidates for LIRT Offices, continued

Candidates for Secretary

Cinthy Ippoliti

Cinthy Ippoliti is the Associate Dean for Research and Learning Services at Oklahoma State University where she provides administrative leadership for the library's academic liaison program as well as services for undergraduate and graduate students and community outreach. Previously, she was Head of Teaching and Learning Services at the University of Maryland where she was in charge of the spaces, services, and programming offered by the Terrapin Learning Commons in addition to coordinating the libraries' first year instruction program.

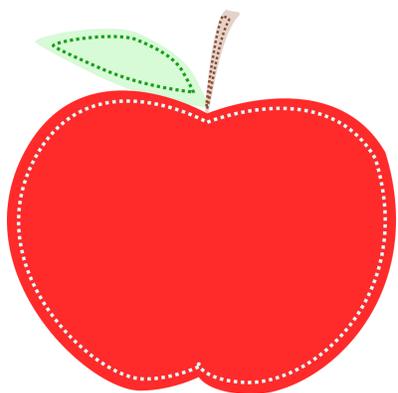


Candidate Statement: Instruction is an ever-changing landscape and we must stay at the forefront of new literacies and pedagogical approaches such as digital, open, critical pedagogy as well as new assessment methods that blend outcomes-based learning with deeper skills such as awareness that information is created, disseminated, and accessed in a context that is not neutral.

Cynthia Kane



Cynthia Kane is a Professor and Director of Assessment at the Libraries and Archives, Emporia State University, Emporia, KS. She coordinates assessment initiatives, in particular information literacy skills assessments in individual classes and throughout the ESU curriculum. She also presently oversees and teaches sections of UL100 (Research Skills, Information, and Technology), a credit-bearing course at ESU that fulfills the general education requirement of "Information Literacy and Technology." Kane served as President of ALA-LIRT in 2005-06 and was active for years in the ALA-LIRT Conference Program Coordinating Committee. In addition, she has served at the state level as President of the Kansas Library Association—College and University Libraries Section, and recently concluded a term as President of the Emporia State University Faculty Senate. Her research interests include the presence of academic libraries and information literacy in regional higher education accreditation associations.



Have you created an instruction program or developed a unique classroom strategy? Please share your experiences with LIRT!

Send your articles to Sherri Brown (sherri.brown@ku.edu)

Instruction-Related Professional Development Report

Session Title:

*Entrepreneurs and Engineers:
Information Literacy Instruction Beyond the Classroom*

Presented at the 2017 California Library Association Annual Conference,
November 4, 2017

Presenters: Sharon Radcliff, Librarian at CSU East Bay University Libraries
sharon.radcliff@csueastbay.edu;
Andrew Carlos, STEM Librarian at CSU East Bay University Libraries
andrew.carlos@csueastbay.edu

Audience: 4-year academic, 2-year academic

Report by: Linda Kobashigawa, Librarian, Fresno City College
kobash88@gmail.com

The California Library Association (CLA) Annual Conference is a gathering for public, school, special, and academic library professionals to share ideas, network, and explore the latest trends in California libraries. The CLA's 119th annual conference was held at the Riverside Convention Center in Riverside, CA. Its theme was "New Worlds Emerge," encouraging presenters and attendees to explore innovative and unconventional approaches in programming and services. The following presentation summary highlights the work of two librarians who took information literacy instruction beyond its traditional boundaries. Librarians Sharon Radcliff and Andrew Carlos recognized that the information needs of students in the California State University, East Bay (CSUEB) Entrepreneurial and Engineering programs were beyond the scope of performing effective research solely for academic purposes. Using research performed by Alison J. Head at Project Information Literacy, Carlos and Radcliff focused on information literacy skills required by individuals making the transition from students to professionals, otherwise known as workplace information literacy. They found that the information needs of professionals in the workplace tend to be more diverse than academic needs and that the resources available through an academic institution may not be available to professionals after graduation.

Similar to most upper division and graduate projects, the design of projects offered in the Entrepreneurial and Business programs at CSUEB mirror those that students will manage in the workplace. Almost all research is performed in groups. Students must complete SWOT (Strengths, Weaknesses, Opportunities, Threats) analyses, research industries and competition, and develop business plans. The information they need may not necessarily be available in an academic subscription database, therefore requiring them to be capable of searching for, finding, and evaluating different types of information. Information needs may include local government regulations, statistics, trade and industry publications, and professional standards. During these projects, librarians act as consultants, meeting with each group individually, as the projects are so diverse that a single instruction session would not adequately meet the information needs of every group.

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Instruction-Related Professional Development Report, continued

Students in the Engineering and Construction Management programs are required to construct literature reviews for their projects. Carlos explained that many students in the program are international students and can require additional assistance learning how to research and develop a thorough literature review. Information seeking behavior of students in the Engineering and Construction Management programs includes: rarely using library resources, preference for resources they have prior experience using, and receiving research assistance in-person. Currently, these projects do not require library resources; however, Carlos provides one-shot sessions to capstone courses and provides one-on-one research consultations. He is in the process of surveying construction companies to determine the information needs of and competencies for the construction workforce.

Biggest Takeaway: Personally, this presentation called attention to the information literacy needs of students enrolled in vocational programs. In the few years I have worked as an academic librarian, I have tended to focus my efforts on courses and programs with research-intensive assignments and projects using academic sources. It can be easy to overlook the *lifelong learning* tenet of information literacy, focusing my efforts on the skills students need as students at a point in time, and rarely addressing the skills needed after they leave.

What might you do with this information: Mr. Carlos and Ms. Radcliff concluded the session by leading a think-pair-share activity about what participants can do to develop information literacy instruction that prepares students for the competencies needed in their professions. My partners and I discussed working more closely with career and technology faculty to better understand student learning outcomes and developing drop-in workshops or tutorials specifically for these programs.

Resources for Teaching about Fake News

While fake news is a menace to a free society, the new popular awareness of it does give librarians opportunities to teach about evaluating information and applying that perspective to consuming the news as engaged citizens. This is a great time for us to be relevant to the needs of our patrons!

At Lone Star College—North Harris, we librarians frequently teach open workshops and student classes about fake news. I would like to share with you resources for the practical act of teaching these classes.

This PowerPoint presentation (goo.gl/zfGhhL) is a good starting point for a classroom discussion on fake news. In order to assess the effectiveness of our instruction, I devised student assignments and grading rubrics to follow up on our classroom presentations. At the request of professors, I have both a long version (goo.gl/UnGDUr) and a shorter, abbreviated version (goo.gl/86g1FW) that gauge student understanding of the content. In order to reach our online students, I have also created a tutorial video (goo.gl/Bm2R46) that describes fake news and how to avoid being deceived by it.

I encourage my fellow librarians to use and alter these materials as they think best in order to promote civic literacy.

By David Puller, Lone Star College—North Harris

More from Denver



Denver at night, photo by Sherri Brown



Denver Convention Center, photo by Rachel Mulvihill



LIRT Steering Committee Meeting Attendees

Member A-LIRT

Stephanie Otis
Associate Dean for Public Services
J. Murrey Atkins Library
University of North Carolina at Charlotte



Q: What brought you to LIRT?

About 5 years ago, I was a new Library Instruction Coordinator and felt a little out of my depth. I was looking for resources and colleagues to help refine and energize my work.

Q: What was your path to librarianship?

My path is one that is fairly common in our profession, I think. I was in a PhD program for English and decided that the life of full-time departmental faculty was not for me. I wanted to stay in higher education, so the academic library appealed to me. I didn't finish the PhD, but I feel like I have the opportunity to continue learning and to contribute to student learning as a librarian.

Q: Tell us about your current position. What do you like most about it?

In my current position as Associate Dean for Public Services, I most enjoy the variety and ongoing surprises of my job. I get to work on many different projects or priorities in a single day. As a research and instruction librarian before this position, I didn't have much experience with Access Services. It has been a joy to learn and do something new, and to get to know the delightful people who provide such valuable service and a front line face of the library to our patrons. I also very much enjoy supporting and advocating on campus for the work of our liaisons and others in the library who are doing innovative, thoughtful, meaningful work for our university and community.

Q: In what ways does it challenge you?

The variety, while energizing, can also be overwhelming. I also sometimes wonder what it is I actually do! The bureaucracy and minutiae of administration is staggering at times, and it leaves me feeling very removed from the most valuable work of the library, with our patrons and community.

Q: Throughout all of your educational experiences, what teacher inspired you the most and why?

I had an undergraduate English professor who helped me see that research and writing were about more than finding and repeating information from other sources. She taught me to keep asking questions, to look for new connections, and to find my place in the scholarly conversation. I've tried to incorporate those lessons into my own work with students in the library.

Q: When you travel, what do you never leave home without?

A folder full of plans, and a heavily marked up map. I'm a planner, and I take almost as much pleasure in organizing the trip as in taking it!

Member A-LIRT continued on page 11

Member A-LIRT, continued

Stephanie Otis
Associate Dean for Public Services
J. Murrey Atkins Library
University of North Carolina at Charlotte

Q: If you could change one thing about libraries today, what would it be?

This is a tough one, but I would like to see us slow down and take pride and pleasure in what is great about libraries in this moment, rather than always focusing so much on what's coming next or what we've lost or left behind. Mindfulness!

Q: Tell us one thing about yourself that most of us probably don't know.

I'm originally from Kentucky, and while I've never been into horses, I am a real bourbon enthusiast.

Q: Please tell us about your time working on the LIRT newsletter and with LIRT.

The two best things about working with LIRT and on the newsletter are the new connections made with colleagues from all over and the way it gives shape to my conference attendance. I think professional committee work in general is good for the ways it takes us outside our (sometimes very small) local and immediate issues and problems to get fresh perspective and to be a part of something more generally relevant to the profession.

LIRT Committee Reports

Awards Committee

Chair: Beth Fuchs

The Awards Committee spent much of the fall focused on spreading the word about the LIRT Awards to encourage submissions. We also created a nomination checklist to help further clarify the award nomination process and expectations for would-be submitters. We have recently selected award winners. Future plans include preparing for the LIRT Awards ceremony at the ALA Annual Conference, which will be held on Sunday, June 24 from 5:30-7:00pm, and updating our procedures manual. We will need new members for the 2018-2019 year and welcome anyone who would be interested in joining us!

Conference Planning Committee

Co-chairs: Ilka Datig, Meggan Houlihan

This year, the Conference Planning Committee has been solidifying our program on critical information literacy for ALA Annual 2018 and organizing our panel speakers. We also drafted a program proposal for ALA Annual 2019 on mindfulness in library instruction.

Liaison Committee

Chair: Cynthia Fisher

In 2017-18, the Liaison Committee has worked on a streamlined template to make sure that our reports from meetings, conference sessions, or webinars are uniform, succinct, and enable readers to find resources from the highlighted presentation.

LIRT Committee Reports continued on page 12

LIRT Committee Reports, continued

Newsletter Committee

Chair: Sherri Brown

In addition to publishing our quarterly LIRT newsletter, the Newsletter Committee has been busy envisioning how to best consolidate LIRT communications. A future Communications Committee will oversee *LIRT News*, social media communications, and the LIRT web presence. Initial co-chairs will be Sherri Brown, current chair of the Newsletter Committee, and Billie Peterson-Lugo, current chair of the Web Advisory Committee. In addition, the committee has been working to draft a communications survey to be distributed to LIRT members and others in June 2018.

Top 20 Committee

Co-chairs: Paula Johnson & Eveline Houtman

The Top Twenty Committee works virtually to select the best 20 articles related to library instruction from the previous year. The group uses Zotero to collect and share articles; communicates via Slack; and enters article scores in Google Sheets. Articles are scored using a rubric that was developed to facilitate equitable scoring for articles with a practical versus theoretical focus, and for both upper level and lower level educational settings. This being said, a majority of the literature is practice-related and applies to higher education. This year, the committee was comprised of ten members, who spent late fall collecting articles for the group library and the months of January and February scoring their assigned articles. Each of the 124 articles selected for 2017 had two evaluators for the first round. The top scorers, plus those with one outlying high score of 14 or 15 (total possible score = 16), were moved to the final round. All committee members review and score this group, which this year contains 43 articles. Those that place in the top twenty will make up the 2017 list. For your pleasure, a word cloud generated from the title words of the final 43:



Transitions to College Committee

Co-chairs: Matt Upson & Beth West

The Transitions to College Committee will continue to promote and add to the Connecting Librarians map, with the intent of shifting responsibility from original planners to the committee. The committee will work with the Lifelong Information Literacy (LILi) group in California on opportunities for collaboration, including updating the mapping project for various sets of IL standards (AASL, ACRL Framework, etc). A committee member completed a short report on LILi with items to consider for moving forward. The committee will update the existing bibliography/reading list on transitions in ALA Connect. A committee member has volunteered to lead this effort and form a small team.



LIRT

LIRT President's Program

Moving Beyond the Threshold:

Next Steps in Critical Information Literacy

Where: ALA Annual 2018, New Orleans, LA, Location TBA
When: Saturday June 23, 2018 from 1:00p.m. to 2:30p.m.

There is little doubt of the importance of critical information literacy and the role of librarians, but many librarians are asking themselves, what should come next? Recently, academic, school, and public librarians have been working tirelessly to document, articulate, and discuss our progressively challenging role in cultivating social responsibilities within our communities and amongst our students, in order to frame the conversation for growth. Join leading experts to hear more about breakthroughs in this area.

Speakers:

Ian Beilin (he/him/his) is Humanities Research Services Librarian at Columbia University. Ian is on the editorial board of the open access, open peer-reviewed journal [In the Library with the Lead Pipe](#) and is co-editor of the forthcoming book [Reference Librarianship and Justice: History, Practice, and Praxis](#) (Library Juice Press, 2018). He has written and presented on topics in critical librarianship, critical library instruction, and critical information literacy, including "Critical Librarianship as an Academic Pursuit," in Karen Nicholson and Maura Seale, eds., *The Politics of Theory and the Practice of Critical Librarianship* (Library Juice Press, 2018); "Student Success and the Neoliberal Academic Library," *Canadian Journal of Academic Librarianship* (2016); and "How Unplanned Events Can Sharpen the Critical Focus in Information Literacy Instruction," in Nicole Pagowsky and Kelly McElroy, eds., *Critical Library Pedagogy Handbook* (ACRL, 2016).

Betty Brackins and **Leola Mitchell** are librarians at Baton Rouge Magnet High School in Baton Rouge, Louisiana. In 2014, they won the prestigious James O. Modisette Award for High School Libraries from the Louisiana Library Association.

Amita Lonial (she/her/hers) is currently the Learning, Marketing and Engagement Principal Librarian at San Diego County Library. She also serves as co-chair for PLA's inaugural Equity, Diversity and Inclusion (EDI) Taskforce. Prior to becoming a librarian, she spent eight years in the non-profit sector organizing for racial and economic justice. She is deeply committed to exploring how libraries can create racially just and equitable communities through public programs and services.

Tech Talk

By Billie Peterson-Lugo, Baylor University
Billie_Peterson@baylor.edu

Dear Tech Talk– The other day, someone from IT referred to IPv6, and for the life of me I could not figure out what she meant; however, she seemed very passionate about it and now I’m wondering if I, too, should care about it; or at least have a wee bit more knowledge? *Idly Interested in IPv6*

Dear III– IPv4 and IPv6 are versions of Internet Protocol, which along with TCP (Transmission Control Protocol), makes up the Internet Protocol Suite (TCP/IP). Without TCP/IP technology, the internet – as we know it – would not exist.

First, an elementary review of how the internet works to ensure everyone is familiar with key terms and concepts.

Consider mailing ten chapters of a book in ten separate envelopes to the same destination. Each envelope has a “to” and “from” address. Each chapter in the envelope is clearly identified with a chapter heading and has sequential page numbering. Once dropped in a mailbox, there is no control over when the individual envelopes will arrive at the final destination. However, once all of the envelopes have arrived, the envelopes are opened and the book easily reassembled from the chapter and pagination information provided.

Now move this scenario to the internet. Every device (node) that accesses the internet must have a unique address – an IP address – that consists of 4 sets of numbers (octets), separated by periods, ranging from 0 to 255. Go to Google and type: what is my ip, and you’ll see the IP address associated with the device you’re using, for example: 72.178.128.76. Every bit of data sent through the internet has a source and destination IP address and takes the fastest route to get from one to the other, using routers. The data itself is broken into smaller, sequential bits and encapsulated in small packets with a header (source IP address, destination IP address, sequencing information, and other technical details) and a payload – bits of the actual data. The many packets associated with a single internet action may or may not travel the same route and may or may not arrive at the destination in the correct order. Some packets even get lost and have to be retrieved again. Ultimately all the packets **do** arrive, at which point they are reassembled in the correct order.

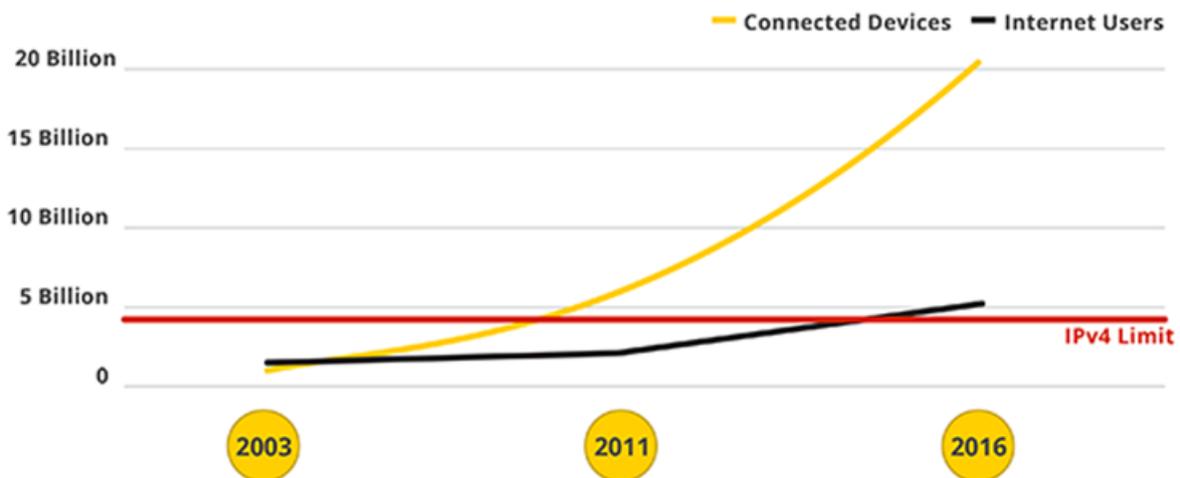
Now multiply this example by the hundreds of billions of packets traveling through the internet each day. Google alone estimates that it “processes over 40,000 search queries every second on average, which translates to over 3.5 billion searches per day and 1.2 trillion searches per year worldwide” (<http://www.internetlivestats.com/google-search-statistics/>). All of these searches then translate into gazillions of packets traveling around the internet. All of this lightning-speed activity is largely controlled through and monitored by TCP/IP. Summarizing, TCP is responsible for ensuring reliability during transmission (<https://www.lifewire.com/tcp-transmission-control-protocol-3426736>), and IP is responsible for defining exactly where data needs to be sent and ensuring that packets of data are sent and received to the same place (<https://www.pcmec.com/article/what-is-tcpip-and-how-does-it-work/>).

Tech Talk continued on page 15

Tech Talk continued

Now, let's revisit the statement that every device that accesses the internet must have a unique address. Think about the number of devices using the internet in the early 1980s when the first public Internet Protocol (IPv4) was introduced – desktop computers, routers, servers, and a few others. Also consider how many people in the early 80s had more than one device that accessed the internet. Now consider the maximum number of unique IP addresses available with IPv4. As stated previously, IPv4 uses 4 octets of numbers between 0 and 255 (each octet is 8 bits or $2^8 = 256$), which means the maximum unique IP addresses available is about 4.3 billion (2^{32}). In the early 1980s this appeared to be an infinite number of addresses – in the early 21st century, not so much.

How many devices are currently connected to the internet? Connected devices include desktop and laptop computers, tablets, smart phones, automobiles (navigation systems and more), home security and camera systems, smart speakers, smart TVs, home thermostats, refrigerators, smart buttons from Amazon, children's toys, not to mention servers, routers, and other appliances needed for basic infrastructure. Not only that, but how many people use only one internet-enabled device? In developed regions, many people have at least two devices that connect to the internet – a smart phone and a computer or tablet. Many have significantly more than two devices, especially if they use the Internet of Things (IoT). Suddenly, the 4.3 billion unique IP addresses seem much, much smaller, as is illustrated by this graph from Google.



Source: <https://www.google.com/intl/en/ipv6/>

Even though this graph indicates an exhaustion of IP addresses around 2010, as early as August 1990, it was predicted that class B addresses [xxx.xxx.000.000 – xxx.xxx.255.255] would be exhausted by 1994 (Blanchet, 2006, p. 33), well before the onslaught of mobile computing and IoT. With the sky rocketing eruption of the IoT, the number of needed IP addresses will not level off any time soon, as is illustrated by Gartner's projection in the table below.

Tech Talk continued on page 16

Tech Talk continued

Table 1: IoT Units Installed Base by Category (Millions of Units)

Category	2016	2017	2018	2020
Consumer	3,963.0	5,244.3	7,036.3	12,863.0
Business: Cross-Industry	1,102.1	1,501.0	2,132.6	4,381.4
Business: Vertical-Specific	1,316.6	1,635.4	2,027.7	3,171.0
Grand Total	6,381.8	8,380.6	11,196.6	20,415.4

Source: Gartner (January 2017)

Source: <https://www.gartner.com/newsroom/id/3598917>

If the internet surpassed the number of unique IP addresses quite some time ago, how is it that the internet still functions? IT professionals developed work arounds, such as Network Address Transformation (NAT), which is a technique that remaps one IP address space into another (https://en.wikipedia.org/wiki/Network_address_translation). Using NAT, an entity has a unique IP address that it presents to the external network (the internet), for example: 129.62.25.000. Internally, a private sub-network (the organization's intranet) is created that uses IP ranges that duplicate numbers on the internet, but are unique on the intranet. This technique significantly increases the number of possible unique IP addresses – internally. However, NAT comes with overhead because of the constant IP-address translation required as data moves from the intranet to the internet and vice versa. Additionally, some services simply won't work with NAT – they require a direct end-to-end connection from and to specific IP addresses. Last, there can be security risks with these private sub-networks. So, although NAT is a solution, it's not a viable long-term solution.

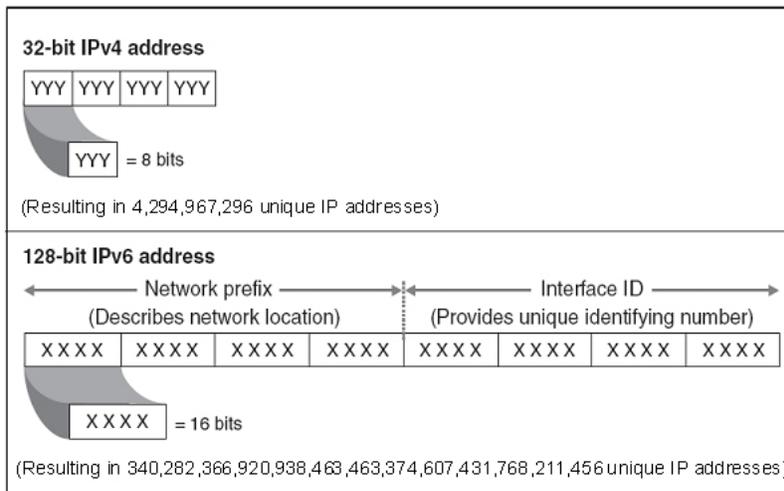
Enter the development of IPv6. Blanchett (2006) stated that the first version of IPv6 specification was published in December 1995 (p. 33); while Wikipedia (2018) indicates that it "became a Draft Standard in December 1998, but did not formally become an Internet Standard until 14 July 2017." Although definitely not the only issue, the most significant issue addressed by IPv6 is to greatly expand the number of unique IP addresses. IPv6 moves from 32 bit addressing (2³²) to 128 bit addressing (2¹²⁸) – 340,282,366,920,938,463,463,374,607,431,768,211,456 theoretical addresses to be exact or 340 trillion, trillion, trillion addresses or 340 undecillion addresses! (Anonymous, 2007). At last, number of IP addresses available in IPv6 appears to be infinite.

As is illustrated by the figure below, the IPv6 address consists of eight groups of four hexadecimal digits (16 bits instead of 8 bits), with each group separated by a colon: xxxx:xxxx:xxxx:xxxx.

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Figure 1: Comparison of IPv6 and IPv4 Address Scheme



Source: GAO.

Source: <https://www.fcc.gov/consumers/guides/internet-protocol-version-6-ipv6-consumers>

Basing IPv6 on hexadecimal (base 16, as opposed to base 10) means that “it uses sixteen distinct symbols. . . the symbols 0–9 to represent values zero to nine, and A, B, C, D, E, F (or alternatively a, b, c, d, e, f) to represent values ten to fifteen” (<https://en.wikipedia.org/wiki/Hexadecimal>). Use of base 16 means the IP address looks substantially different from those we currently use.

A sample IPv6 address might be: 2001:0db8:0000:0000:0000:ff00:0042:8329. Two techniques that simplify the address-include removing all leading zeroes and replacing consecutive sections of zeroes with a colon. For example:

Initial address: 2001:0db8:0000:0000:0000:ff00:0042:8329

After removing all leading zeroes in each group: 2001:db8:0:0:0:ff00:42:8329

After omitting consecutive sections of zeroes: 2001:db8::ff00:42:8329 (Wikipedia, 2018)

However, even with the simplifications, this IP address still looks strange and is challenging to remember.

It is possible to convert from IPv4 addresses to IPv6 addresses (and vice versa). For the more mathematically adventurous, use the information at Routing-bits (<https://routing-bits.com/2009/03/19/converting-ipv4-to-ipv6/>); for others, use the tool provided by UltraTools (<https://www.ultratools.com/tools/ipv4toipv6>).

While increasing the pool of addresses is one of the most often touted benefits of IPv6, there are other important changes in IPv6 that improve the IP protocol. Beal (2017), Blansit (2010), and Wikipedia (2018) all identify advantages of IPv6 over IPv4. The more easily understood benefits of IPv6 include:

- Both increased amount and better allocation of address space;
- Improved mobile experience;
- Restoration of end-to-end connectivity (meaning the elimination of NAT), as well as the elimination of private address collisions;
- Improved network security;

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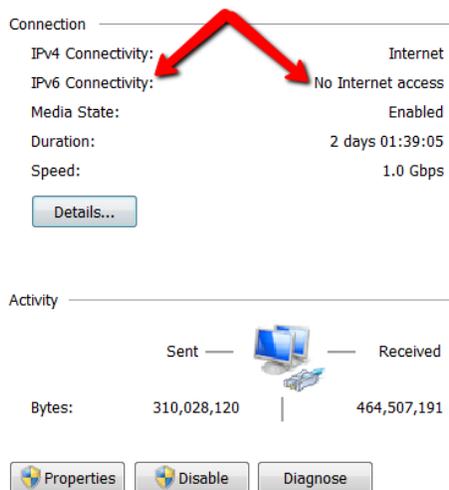
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- Improved network administration;
- Simpler packet headers;
- Improved router processing;
- Multicasting (the transmission of a packet to multiple destinations in a single send operation) is part of the IPv6 base specification;
- Distribution of “jumbograms” (packets with payloads of up to 4GB, vs. 64KB), when appropriate.

IPv6 has existed for at least 20 years, and yet it only became an internet standard in 2017 (Wikipedia, 2018). Only now is the general public starting to hear more about IPv6. If IPv6 fixes a significant problem – an insufficient supply of IP addresses – and has additional benefits, why hasn’t it completely replaced IPv4 by now?

It’s complicated. Millions of people, businesses, governments, places of education, organizations, etc. rely on the internet day in and day out – all expecting 99.9% up time! Consequently, the changes need to be seamless. Almes, et. al. (2013) state, “Because IPv6 includes protocol changes and is not simply an address translation, new approaches will be necessary for network and security engineering and system management” (p. 13), making it impossible to flip a switch to eliminate IPv4 one moment and activate IPv6 the next. IPv6 is not backward compatible with IPv4; it is a parallel, independent network, meaning that IPv4 and IPv6 can/do/will coexist but technological changes must be embedded throughout the environment.

For the foreseeable future, **any** device (whether an end-user device or a behind-the-scenes device) that connects to the network must be capable of dealing with both IPv4 and IPv6. Most devices created within the last 3-5 years have this capability. For example, below is an image from Windows 7 that shows the availability of IPv6, although it’s



disabled.

Ultimately, this transition means that the vast majority of network devices must be updated, most likely via replacement. Most organizations have replacement cycles built into their technology operating budgets, but those costs are usually cyclically balanced over a period of 3-5 years (sometimes even longer) in order to manage on-going costs

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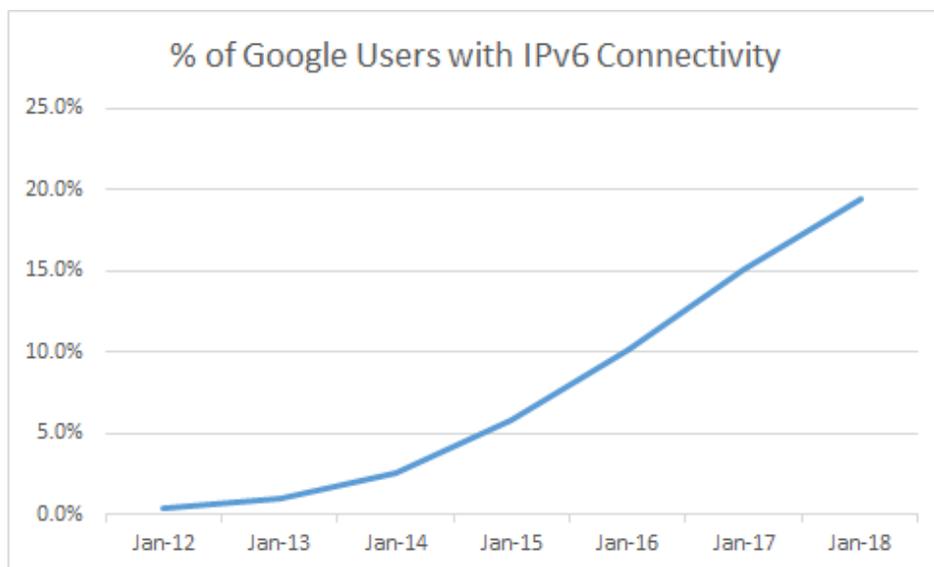
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more effectively. When you look at personal replacement cycles, the issue worsens, especially considering those who keep their computers 10 or 15 years – because “they still function”. Yet more reasons why it is not possible to set a date and flip a switch.

An unintended consequence of the shortage of IP addresses is that available IP address ranges have become a “hot commodity”. Companies are faced with the cost of moving to IPv6 or the cost of adding to their exhausted supply by buying unused IP ranges from those who have “extra”. According to McMillian (2015), “Microsoft Corp. spent \$7.5 million in 2011 on 666,624 addresses [\$11.25/address] formerly owned by the bankrupt networking company Nortel Networks.” “According to Sandra Brown, president of IPv4 Market Group, which brokers such sales, ‘Prices are going to rise’” (McMillian, 2015).

In 2012, “Facebook Inc. chose a different tactic. The social network moved 90% of its network from the old-school IPv4 system to the next-generation IPv6” (McMillian, 2015). No one knows how much money Facebook spent to make this change, but the research firm Gartner suggests a guideline of about 6% of the company’s annual IT budget to completely transform from IPv4 to IPv6 (Rickard, 2010, p.3). According to researchers at Forrester, companies spent \$2.2 trillion on IT in 2014 (McMillian, 2015). Additionally, Young and Munch (2017) report that “attempts to transition even midsize networks have revealed many unexpected problems and hidden costs” (p. 53).

Nevertheless, in spite of the costs and challenges of shifting to IPv6, the shift is gaining momentum, especially since 2012 when the Internet Society launched World IPv6 Launch (<http://www.worldipv6launch.org/>), as is illustrated by this data from Google:



Source: <https://www.google.com/intl/en/ipv6/statistics.html#tab=ipv6-adoption&tab=ipv6-adoption>

World IPv6 Launch is also a source for identifying networks that are deploying IPv6 (currently 316), as well as the completeness of that deployment. While you can search for specific networks, you can also sort by the completeness of the deployment. Below are a few familiar organizations that are at least 70% deployed:

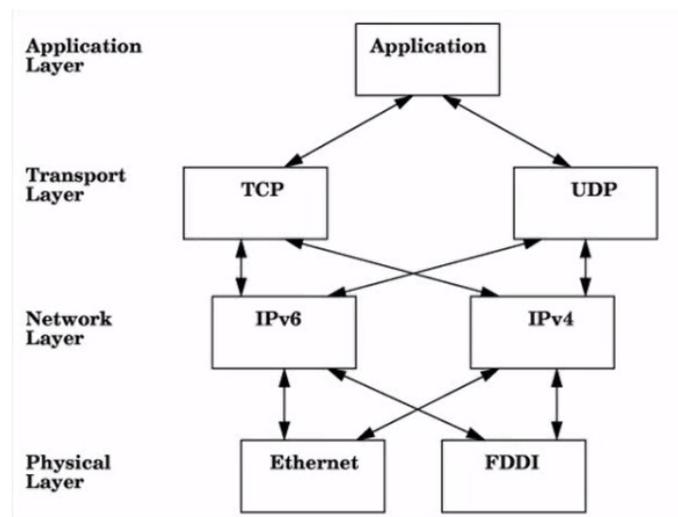
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- T-Mobile – 91.22%
- Virginia Tech – 83.63%
- Verizon Wireless – 82.04%
- University of Buffalo – 80.89%
- University of Pennsylvania – 74.61%
- Google Fiber – 74.15%
- University of Iowa – 71.95%

Curious about the availability of IPv6 on networks you use? Experiment with the Test for IPv6 (<https://test-ipv6.com>). One of the statements you might see after running this test is, “You appear to be able to browse the IPv4 Internet only. **You will not be able to reach IPv6-only sites.**” We already know that Facebook – a heavily trafficked site – converted to IPv6 in 2012, and yet people use IPv4 to connect to Facebook all the time. The uninterrupted connections to Facebook demonstrate that IPv4 and IPv6 must coexist. In the YouTube video IP Version 6 (2007), Martin explains how this coexistence transpires through the use of *dual stacking and tunneling*.

Dual stacking is a software solution that allows a single device to have both versions of the protocols working at the same time alongside each other, thereby enabling gradual, one-by-one, step-by-step updates to applications while allowing older applications to continue to function.



Source: <https://youtu.be/yrlK26D3crY>

Tunneling, on the other hand, enables the “smuggling” of IPv6 packets inside of IPv4 packets until they reach their IPv6 destination, where the shell is stripped away. This technique means that an IPv4 router never sees the IPv6 packets. For packets from an IPv6 host that need to go to an IPv4 service, the router completely translates the IPv6 packets into IPv4 packets and delivers them to the service; on the way back the reverse translation takes place, returning them to their original IPv6 form. A border router that can either translate or encapsulate IPv6 packets is required to enable tunneling (IP Version 6, 2007). However, a caveat expressed by Almes, et. al. (2013), “This [6-to-4] tunnel can be a bottleneck, slowing the user experience, and some links may not work”(p. 11).

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For libraries of all types, the conversion from IPv4 to IPv6 has the potential to significantly impact both on-site and off-site access to e-content, since this access is commonly controlled by IP authentication and proxy services (i.e., EZproxy). IP addresses and ranges will change and those changes must be conveyed to all the e-content providers; information in proxy services will need to change. Even now, EZproxy recommends using an IPv6 directive in the EZProxy configuration file (<https://tinyurl.com/y77jyaoj>). What about the end users? If IPv6 is effectively implemented with providers and proxy services, will end users encounter issues accessing e-content via their personal/home devices that will require specialized troubleshooting? What do library providers and your institution's network administrators have on the horizon for IPv6 implementation?

Thus far, searching for IPv6 associated with major library vendors yields very little information. The Ex Libris knowledge base indicates support for IPv6 for Primo (<https://tinyurl.com/ydcqr2y6>) and implies support of IPv6 for Alma (<https://tinyurl.com/y7rrgxgq>); but Ex Libris is only one provider. Librarians should start asking their providers about IPv6 compatibility and definitely ask the question if they are considering migration to another online system. Likewise, librarians need to open conversations with their institution's IT administrators to both understand their plans and timelines for IPv6 migration and to make them aware of the impact these changes will have on library services, especially access to e-content.

In a "Hype Cycle" report from Gartner, Young and Munch (2017) placed IPv6 on the slope of enlightenment, with an estimated 5-10 years before it reaches "mainstream development" (p. 5). They defined slope of enlightenment as, "Focused experimentation and solid hard work by an increasingly diverse range of organizations lead to a true understanding of the technology's applicability, risks and benefits. Commercial off-the-shelf methodologies and tools ease the development process" (p. 60).

So, migration to IPv6 is not an if, but a when. For years and years and years, people have been predicting the exhaustion of IPv4 addresses. In summer 2015, the American Registry for Internet Numbers ran out of new IPv4 addresses (<https://tinyurl.com/y89747lv>). There are still "extra" IPv4 addresses available that can be acquired for a price, but that is a short-sighted – albeit easy – solution; as are the various address-shortage work arounds that have developed. Almes, et. al. (2013) suggest, "An ordered, thoughtful approach to IPv6 planning will secure campus commitment and put your campus on the road to a less risky, methodical path to IPv6 that will allow you to continue to serve the needs of research, instruction, and campus business effectively; secure your cyberinfrastructure; attract research grants; and position your campus for the future" (p. 17). Although written for the academic environment, the overall concept applies to any organization that uses the internet – which effectively means **all** organizations, including all types of libraries. It's not too soon to become familiar with IPv6 and to identify and work with those at your institution who will develop the plans and timelines for these changes.

Additional Resources

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