Everything old is new again: ISSN in the digital environment[1]

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Abstract

If the International Standard Serial Number (ISSN) did not exist, someone would have to invent it. It's that simple. In the current environment where databases contain many millions of records, unique identifiers are crucial. Most databases, indexes, and registries of journals require the use of the ISSN. ISSN is now a key element of OpenURL link resolution services that connect users to article content. New types of resources that require ISSN for identification continue to be created. New needs for ISSN, such as its role in identifying titles for print and digital archiving, continue to emerge. In a future world of linked data for libraries, identifiers – including the ISSN – will play an essential role. Dodds and Davis, authors of Linked Data Patterns, state that the single most important part of the Linked Data approach is the adoption of webscale identifiers (URIs) to identify things of interest. This case study will provide background on the ISSN; describe ISSN traditional uses in the library, publishing, and information communities; discuss the enlarging scope of resources that are assigned ISSN; and elaborate on ISSN uses in the current digital environment including ROAD, a new ISSN database of open access scholarly resources. The case study will conclude with an exploration of ISSN potential in the future linked data environment.

Keywords: ISSN. Digital environment. Data environment. Linked data. Semantic web.

Tudo velho é novo outra vez: o ISSN no ambiente digital

Resumo

Se o Número Internacional Normalizado para Publicações Seriadas (ISSN) não existisse, alguém teria que inventá-lo. Simples assim. No atual ambiente onde bases de dados contêm muitos milhões de registros, identificadores únicos são cruciais. A maioria das bases, índices e registros de periódicos exigem o uso do ISSN. O ISSN é hoje um elemento-chave nos serviços de resolução de links OpenURL que conectam usuários ao conteúdo dos artigos. Novos tipos de recursos que exigem o ISSN para identificação continuam a ser criados. Novas necessidades para o ISSN, como seu papel na identificação de títulos para arquivamento impresso e digital, continuam a surgir. Em um mundo futuro de dados conectados para bibliotecas, identificadores – incluindo o ISSN – terão um papel essencial. Dodds e Davis, autores de Padrões de Dados Conectados, afirmam que a parte mais importante da abordagem de Dados Conectados é a adoção de identificadores em escala Web (URIs) para identificar coisas de interesse. Este estudo de caso oferece um

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histórico do ISSN; descreve os usos tradicionais do ISSN em bibliotecas, publicações e comunidades informacionais; discute o escopo crescente de recursos que recebem atribuição de ISSN; e elabora nos usos do ISSN no ambiente digital atual, incluindo ROAD, uma nova base de dados do ISSN de recursos acadêmicos de acesso aberto. Conclui com uma exploração do potencial do ISSN em ambientes futuros de dados conectados.

Palavras-chave*: ISSN. Ambiente digital. Ambiente de dados.*

Todo lo viejo es nuevo otra vez: el ISSN en el ambiente digital

Resumen

Si no existiera el Número Internacional Normalizado para Publicaciones Seriadas (ISSN), alguien tendría que inventarlo. Es así de simple. En el ambiente actual donde bases de datos contienen muchos millones de registros, los identificadores únicos son cruciales. La mayoría de bases, índices y registros de periódicos requieren el uso del ISSN. El ISSN es hoy un elemento clave en servicios de resolución de enlaces OpenURL que conectan usuarios al contenido de los artículos. Nuevos tipos de recursos que requieren el ISSN para identificación continúan siendo creados. Nuevas necesidades para el ISSN, como su papel en la identificación de títulos para archivo impreso y digital, continúan apareciendo. En un mundo futuro de datos conectados para bibliotecas, los identificadores – incluyendo el ISSN – tendrán un papel fundamental. Dodds y Davis, autores de Linked Data Patterns, afirman que la parte más importante de la llegada de los datos conectados es la adopción de identificadores en la Web (URIs) para identificar cosas de interés. Este estudio de caso ofrece una visión histórica del ISSN; describe los usos tradicionales del ISSN en bibliotecas, publicaciones y comunidades informacionales; discute el alcance creciente de recursos que reciben ISSN; y explica el uso del ISSN en el ambiente digital actual, incluyendo ROAD, una nueva base de datos del ISSN de recursos académicos de acceso abierto. Concluye con una exploración del potencial del ISSN en ambientes futuros de datos conectados.

Palabras clave*: ISSN. Ambiente digital. Datos.*

THE ISSN: WHAT AND WHY

ISSN can be thought of as *the Social Security Number of the serials world*. Serial titles can be notoriously generic (Annual Report), ambiguous (Decorating Magazine's Kitchen Decorating Ideas), commonplace (Insight), or inscrutable if represented in a script unknown to the user. The eight-digit ISSN is unique, unambiguous, suited for digital access, and always written in Arabic numerals.

ISSN BACKGROUND

ANSI Z39.9, the American ISSN standard, was approved in 1970 and published in 1971. (It has since been withdrawn in favor of the international version.) International work on serials identification and description resulted in a recommendation in 1970 to establish an International Serials Data System (ISDS), the original name of the ISSN Network. ISSN first appeared as a draft ISO standard in1971 and was first published in 1975 as ISO 3297 (ISSN INTERNATIONAL CENTRE, 2015).Numerous revisions of the standard and broadening of its scope have made the ISSN ever more relevant and essential. The most recent revision of the standard, published in 2007, included significant expansions in its scope, as well as additional sections to accommodate the digital environment. The ever-increasing growth of the ISSN Register (ISSN

INTERNATIONAL CENTRE a, 2015) – the official database of ISSN that now includes almost 1.8 million ISSN and metadata records – and the growth in the workloads of ISSN centers worldwide are evidence of the ongoingcritical need for ISSN.

The ISSN standard is supported by an infrastructure of 88 ISSN national centers coordinated by the ISSN International Centre (PORTAL ISSN, 2015)in Paris. The ISSN International Centre is responsible for the ISSN Register and products that provide access to the Register, such as the ISSN Portal (PORTAL ISSN, 2015),a continually updated Webbased subscription product. Unlike the International Standard Book Number (ISBN) (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, 2005), ISSN (the acronym ISSN is both singular and plural) are not provided in blocks for publishers to assign but rather assigned by the ISSN national center in the country of publication. The ISSN International Centre assigns ISSN for international publications and publications from countries that do not have an ISSN center. The ISSN does not change when a new publisher takes over, nor when the country of publication changes. ISSN only change with a major change of title or format (e.g., when a print version ceases and an online version begins).

An ISSN consists of eight digits, in two groups of four numbers each, connected with a hyphen, always preceded by the letters ISSN, and including a check digit based on the modulus 11 formula. An ISSN identifies a specific continuing resource in a particular medium at a high level of granularity. That is, separate ISSN are assigned, for example, to the print, online, and CD-ROM versions of a given serial, but the ISSN assigned to the online version applies to the HTML, PDF, and any other online format versions. Although the term eISSN is sometimes used to refer to the ISSN assigned to an online version of a resource, this is an unofficial term and there is no difference in the construction, representation, or functionality of any ISSN assigned to a resource in a specific medium.

A new use of ISSN, the linking ISSN (ISSN-L) (ISSN INTERNATIONAL CENTRE b, 2015) was introduced with the 2007 revision of ISO 3297. The ISSN first assigned or first entered into the international ISSN Register to any medium version of a continuing resource also becomes the linking ISSN. The linking ISSN (always identified by the prefix ISSN-L) functions as a grouping device to apply to all medium versions of a resource in situations where it is desirable to represent the title without reference to a specific medium. ISSN-L is intended to be included as a separate element in bibliographic records and other databases containing information about serials. New subfields were added to the ISSN field (022) in MARC 21 (022 - INTERNATIONAL STANDARD SERRIAL NUMBER, 1999) for this purpose. Upon request, users needing a table of ISSN and the corresponding ISSN can download a current table of this data.

WHY ISSN?

The most common use for ISSN in its early days was as an identification number displayed on print serials. Early ISSN uses, still applicable today, include searching in library catalogs, as well as ordering, claiming, and interlibrary loan. ISSN facilitates internal workflows in the publication and distribution process. ISSN enables file matching, database update

and linkage, retrieval, and transmission of data about serials. In 1978, the US Postal Service began using ISSN to manage its database of periodicals mailed at what was then called *second class rate* and is now called *periodicals rate*. The Copyright Clearance Center has long required the ISSN for identification of serial titles for rights management purposes. ISSN is also used by CISAC, the International Confederation of Societies of Authors and Composers. ISSN use in rights management for digital assets continues to grow. As the digital environment has become ever more allencompassing, and as the linked data environment emerges, significant roles for the ISSN are taking shape, as will be described in the final two sections of this case study.

EXPANSION OF ISSN SCOPE AND COVERAGE

In order for the ISSN to grow in its roles and uses, expansion of its scope and coverage had to take place. Since its inception, ISSN has been applicable to any resource that met the definition of serial in force at the time. The definition in ISO 3297:1975 as quoted in the ISDS Manual, 1983 was:

> A publication in printed form or not, issued in successive parts usually having numerical or chronological designations and intended to be continued indefinitely. Serials include annuals (reports, yearbooks, directories, etc.), the journals, memoirs, transactions, proceedings, etc. of societies, and monographic series. Note - this definition does not include works produced in parts for a period predetermined as finite.(International Serials Data System, 1983, p.12)

One of the most significant developments in the ISSN standard occurred with the revision of ISO 3297 that was published in 2007. This revision broadened the scope of ISSN to include *continuing resources*.

> Continuing resource: A publication, in any medium, that is issued over time with no predetermined conclusion and made available to the public.
>
> Note 1: Such a publication is usually issued in successive or integrating issues which generally have numerical and/or chronological designation.
>
> Note 2: Continuing resources include serials such as newspapers, periodicals, journals, magazines, etc., and ongoing integrating resources such as loose-leaf publications that are continually updated and Web sites that are continually updated.(ISSN Manual, 2012).

The expansion of ISSN scope meant that in addition to serials, whose definition requires content to be published in sequential issues, ISSN could now be applied to other resources that exhibited *seriality* (i.e., an ongoing pattern of publication), such as databases and websites, provided they had no predetermined conclusion. This same revision also codified the principle that at a high level of granularity – e.g., print, online, CD-ROM, etc. - separate ISSN are assigned to versions in different media. ISSN thus became applicable to a much greater range of online resources.

Speaking historically, it is also useful to note that from the very beginning of the application of the ISSN standard, *dead* serials were in scope. The applicability of ISSN to long ceased serials has become very relevant today when digitizing historic serials and back runs of serials is increasing. In fact, ISSN for both the print and online versions of what is considered to be the first serial published in the modern era, Journal des sçavans (later called Journal des savants), published since 1665, have been assigned ISSN by the French national ISSN center.

The emergence of a new type of continuing resource is always of interest and sometimes of

concern to ISSN centers because they may be faced with requests for ISSN assignment before provisions are made for handling these resources. Rules often have to be developed for ISSN assignment, cataloging, and perhaps legal deposit or retention in the host library. Certainly when electronic newsletters, magazines, and journals first began to appear in the late 1980s, ISSN centers had to quickly learn to handle these new resources. The US ISSN Center assigned the first ISSN to an online serial, made available on Bitnet (an early pre Web online network), in 1988. The new eligibility of databases and websites for ISSN that occurred with publication of the revised ISSN standard in 2007 brought the challenges of working with these resources to ISSN centers. The possibility that the ISSN Network would need to register impossible numbers of websites resulted in some practical limitations on the broad scope set forth in the standard. In 2010, a set of eligibility criteria for databases as websites was issued (ISSN INTERNATIONAL CENTRE c, 2015). These criteria, still in effect for at least the time being, exclude websites of organizations and require other websites to show evidence of editorial oversight and state updating intent or frequency. More recent types of resources now determined to be in scope for ISSN include blogs, continuing resources available on mobile devices, open access journals, and institutional repositories.

E-RESOURCES

The ISSN main role is identification. The nature of continuing resources is that they evolve and change. In the print world, at least the past life of a serial is fixed. In the digital world, neither the past, present, or future of a continuing resource is fixed–a situation that presents great challenges for identification. A key question has been how to determine which e-versions can use the same ISSN and which require different ISSN. The ISSN Review Group, the group charged with maintaining the ISSN Manual, drafted the following provisional instruction for the June 2012 revision of the Manual. This instruction expresses the general approach taken by the ISSN Network since ISSN began being assigned to online resources, namely that all *online* versions share one ISSN:

> A single ISSN is assigned to identify all online versions made available under the same title including: versions digitized from print, born digital versions, versions available simultaneously in different encoding formats such as PDF or HTML, and versions for devices such as mobile phones, e-readers etc. However, separate ISSN are assigned to any of the online versions which belong to different content types (spoken words vs. text for example). (ISSN MANUAL, 2012)

Inclusion of versions for mobile devices into this policy was agreed to provisionally by the ISSN directors in 2011. However, further investigation by the Review Group and discussion within the ISSN Network is planned to clarify which e-versions of a given resource are sufficiently different to warrant separate ISSN. For example, the Review Group has informally agreed that when the PDF version of a print newspaper and that newspaper's website differ so much in content as to be considered different resources, the two resources should have different ISSN.

Coverage of e-resources with ISSN is another challenge faced by ISSN centers. ISSN centers perform both *systematic* ISSN registration and ISSN registration by request. Assignment of ISSN to all titles that are received under a country's legal deposit

system is an example of systematic registration. In the United States, the majority of ISSN assignments are made in response to requests, most often from publishers but also from other users such as libraries, subscription agencies, barcoding agencies, or rights management agencies. Although online resources have been registered by the larger ISSN centers since at least the early 1990s, the fact that many publishers did not realize that separate ISSN were needed for online versions meant that they did not request these ISSN and many print titles lacked ISSN for the online versions. To help remedy this situation, especially problems caused when the print ISSN was being used to identify the online version, the ISSN International Centre launched a series of *Core e-Journals* campaigns by matching prominent databases such as LOCKSS (LOCKSS: LOTS OF COPIES KEEP STUFF SAFE, 2015),CLOCKSS (PORTAL CLOCKSS, 2015),Portico (PORTAL PORTICO, 2015),certain A&I services and others against the ISSN Register and providing lists of electronic journals without ISSN to the appropriate ISSN center. As a result of several campaigns, coupled with a growing awareness among publishers of the need for separate ISSN for online versions, the number of ISSN for online resources in the ISSN Register grew from 50,000 in 2007 to more than 165,000 in 2015. The US ISSN Center is responsible for 19% with 31,697 ISSN assigned.

BLOGS

The first blogs to apply for ISSN were the equivalent of online personal diaries, largely describing an individual's daily life. Bloggers wanted what they perceived to be the legitimacy that ISSN could provide them. The US ISSN Center and other ISSN centers around the world were not quite sure how to handle these new and very personal resources, especially since personal webpages had already been deemed out of scope. Even more problematic was the challenge of deterring the insistent bloggers. As the ISSN Network debated the issue, topical blogs started being issued in greater numbers and some blogs became respected and citable sources of current information and current thinking. ISSN are now being assigned to topical blogs. The ROAD directory of open access scholarly resources will begin to include scholarly blogs some time in 2014. The Library of Congress (LC) now harvests science blogs and, in a future project, ISSN will be assigned to US science blogs harvested by LC.

CONTINUING RESOURCES AVAILABLE ON MOBILE DEVICES

As of May 2014, a search of the Kindle, Nook, and Zinio websites indicated that there were 646 magazines and 177 newspapers available for Kindle and more than 2,000 for Nook. Zinio, a site that calls itself a *mobile newsstand*, states that it contains more than 5,500 titles for any device. There are also scholarly journals available for e-readers as well as smartphones. As continuing resource versions designed for mobile devices became more common, ISSN centers began receiving questions about whether separate ISSN were required for these versions. While the ISSN Network was gaining more experience in assigning ISSN to versions for mobile devices, the existing policy of generally assigning the same ISSN to all *online* versions of a resource was provisionally expanded, as quoted in the E-Resources section of this chapter, to include versions for mobile devices. This policy means that

– at least for the time being – the mobile device version of a serial shares the same ISSN as the online version or versions of that same resource. If the mobile device version is the only electronic version, the mobile device version is assigned its own ISSN. Thus, in the most typical situation, the online and mobile device versions share one ISSN. It remains to be seen if clarification of the principles of ISSN assignment to digital versions and further exploration of ISSN user needs might require separate ISSN to be assigned to versions for mobile devices.

OPEN ACCESS JOURNALS

In a New York Times article by Gina Kolata, she describes the positive initial reception of open access: "open access got its start about a decade ago and quickly won widespread acclaim with the advent of well-regarded, peer-reviewed journals like those published by the Public Library of Science, known as PLoS" (KOLATA, 2013).

Unfortunately, a dark side to the bright side of open access publishing now challenges the ISSN Network. Jeffrey Beall, a librarian at the University of Colorado, Denver, has developedBeall's List: Potential, possible, or probable predatory scholarly open-access publishers (BEALL, 2015).His characterization of these publishers helps to explain why 32 out of the 73 ISSN centers who responded to a 2014 ISSN Network Survey indicated they had problems with publishers who exhibit these behaviors:

> predatory publishers…publish counterfeit journals to exploit the open-access model in which the author pays. These predatory publishers are dishonest and lack transparency. They aim to dupe researchers, especially those inexperienced in scholarly communication. They set up websites that closely resemble those of legitimate online publishers, and publish journals of questionable and downright low quality. Many purport to be headquartered in the United States, United Kingdom, Canada or Australia but really hail from Pakistan, India or Nigeria.(Beall, 2012)

Although ISSN is simply an identifier, not an indicator of quality or legitimacy, ISSN centers are faced with the dilemma of carrying out the general policy of assigning an ISSN to any resource that meets basic ISSN eligibility while not wanting to facilitate dishonest or deceptive practices. In addition, because of the way these publishers represent their place of publication, ISSN centers have difficulty determining which national center should be responsible for assigning or refusing an ISSN. The following recent policies have been posted on the ISSN International Centre's website:

> We reserve the right to refuse an ISSN assignment if it is considered that misleading information has been provided by the requestor or printed/displayed on the publication regarding, for instance: the place of publication (publisher's address), the members of the editorial board, the referencing by indexing services or databases, the participation in digital preservation programs or the authorship of the articles provided….we also reserve the right to revoke an ISSN if it subsequently comes to light that misleading information has been provided. (ISSN, 2013)

Prompted in part by a desire to leverage the ISSN to help answer questions about the quality of open access journals, the ISSN Network with support from Unesco, launched a beta version of ROAD, Directory of Open Access Scholarly Resources, in December 2014. The directory includes metadata records for more than 7,000 titles. ROAD is a selective subset of the comprehensive ISSN database. ROAD records have been enhanced by the addition of

subject categories and information about coverage by abstracting and indexing services, registries, and journal evaluative indicators. Resources included in ROAD must be fully open access; hybrid journals or journals with moving walls are not eligible. Types of resources included in ROAD are e-journals, conference proceedings, monographic series, institutional repositories, and, soon, blogs.

Retrospective and ongoing selections from among fully open access titles are made by using the ISSN as a matching key for aggregating data about the use, the prominence, and the quality of open access resources that have been identified by an ISSN, using coverage lists provided by abstracting and indexing databases, registries, and journal indicator databases. ISSN centers also flag titles to be considered for ROAD as they assign the ISSN. ROAD can thus serve as something of an antidote to the proliferation of low quality open access journals. A ROAD presentation at the United Kingdom Serials Group Annual Conference and Exhibition prompted a very favorable review entitled, "New resource aims to provide quality insight into OA resources" (SIAN HARRIS REPORTS, 2014).

INSTITUTIONAL REPOSITORIES

The institutional repository (IR) is becoming a more prominent source of open access content but until the launch of the ROAD project the IR had not been covered in any significant way by the ISSN Network. As databases, IRs have been eligible for ISSN assignment since the revision of the ISSN Manual in 2003. The ROAD project, with its emphasis on open access resources, has brought IRs to the attention of ISSN centers, including the US ISSN Center.

As of May 2014, there were 181 institutional repositories listed in ROAD. The US ISSN Center is using OpenDOAR (PORTAL DOAR, 2015),the directory of open access repositories, to assess IRs published in the United States for inclusion in ROAD. Because there are no specific instructions in RDA (RDA: RESOURCE DESCRIPTION AND ACCESS, 2015)for IRs, catalogers in the US ISSN Center have had to use relevant RDA rules for cataloging integrating resources as well the practices for cataloging integrating resources shared by the Program for Cooperative Cataloging's BIBCO and CONSER programs to develop internal guidelines for creating records for IRs. It was also necessary to determine appropriate LC and Dewey class numbers for IRs with multidisciplinary subject coverage.

USES OF THE ISSN IN THE DIGITAL ENVIRONMENT

INTEROPERABILITY

One of the most important reasons for standards is that they allow for interoperability. Thanks to standardized parts, a sewing machine bobbin produced today will fit into a 100 yearold sewing machine made by a different manufacturer. ISSN provides the same capability in the digital environment. The file matching done between an aggregator's journal package and the ISSN Register that was done for the Core e-Journal Project, or the matching done between the ISSN Register and abstracting and indexing databases for ROAD are examples of how the ISSN provides interoperability between two systems despite the fact that MARC records are being matched against non-MARC records. The US Postal Service maintains a database

of titles mailed at *periodical rate* and includes ISSN in that database, thus allowing for interoperability between their files and any others that use ISSN.

In addition, ISSN interoperates with other identifier systems. Although ISSN and ISBN are often mutually exclusive in that a resource is usually either a monograph or a serial – a book or a journal – there are some situations in which both identifiers are applicable and acceptable. For example, an e-book that is an annual directory can display both the ISBN for the 2014 directory and an ISSN that is for the ongoing e-resource. A book within an openended series, such as The Cooking of France in a series entitled World Cuisines Series, can dis- play an ISBN to identify The Cooking of France and an ISSN to identify World CuisinesSeries.The 2007 revision of the ISSN standard includes an informative annex (Annex E), with sections that describe how ISSN and the linking ISSN (ISSN-L) can be used with DOI, URN, EAN barcodes, and OpenURL[1].

DIGITAL OBJECT IDENTIFIER

The Digital Object Identifier (DOI) section of ISO 3297:2007 Annex E (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, 2012)provides examples of how ISSN can be used as the DOI suffix to identify manifestations of continuing resources at the title level, as well as how the ISSN-L can be a DOI suffix that identifies a continuing resource regardless of medium. NISO's recommended practice, PIE-J: The Presentation and Identification of e-Journals (PIE-J WORKING GROUP, 2013), also provides an appendix with information and examples about ISSN and DOI interoperability, particularly in the context of CrossRef (PORTAL CROSSREF, 2015). The appendix also clarifies the relationship between CrossRef title level DOIs and ISSN.

ISSN identifies a serial title. A CrossRef title level DOI does not identify a journal as a whole. Instead, it identifies and creates a durable link to a journal title page, ensuring persistent access to information about the title. ISSN is used as the primary identifier of titles within the CrossRef system.

UNIFORM RESOURCE NAME

ISO 3297:2007 also includes information about how the ISSN can be used as a URN (URN SYNTAX, 1997).The ISSN International Centre has been experimenting with URN:ISSN since 2001 when an Internet Engineering Task Force Request for Comment (IETF RFC), Using the ISSN (International Standard Serial Number) as URN (Uniform Resource Name) within an ISSN-URN Namespace (RFC 3044) was published (INTERNET ENGINEERING TASK FORCE, 2001).A new draft of URN:ISSN is planned for submission to the IETF after current IETF URN discussions have reached consensus (PORTAL W3, 2015).Ultimately, a URN:ISSN service is intended to be implemented at the ISSN International Centre[2].

EUROPEAN ARTICLE NUMBER

The UPC (Universal Product Code), the most common product barcode in the United States, does not incorporate the ISSN but the European Article Number 13 (EAN-13)code (INTERNATIONAL

[1] ISO 3297: 2007

[2] Privately distributed documents for the ISSN General Assembly Meeting, 2014.

ARTICLE NUMBER, 2015),a product barcode widely used throughout the rest of the world, and uses the ISSN as the title identifier within the code. For serial publications, the EAN-13 barcode is structured as follows: the first 3 digits correspond to the 977 prefix assigned to serial publications, the next 7 digits correspond to the ISSN (without the hyphen and without the end check digit), the 11th and 12th characters are variable and the publisher can use them to express additional information (e.g., change of price), and the 13th character is a check digit calculated according to the modulus 10 formula. The ISSN International Centre's website provides instructions for creating an EAN-13 code using the ISSN (ISSN INTERNATIONAL CENTRE d, 2015).

OPEN UNIFROM RESOURCE LOCATOR

A significant application of the ISSN that has made ISSN an indispensable identifier in the digital environment is ISSN's role as a key element of the Open Uniform Resource Locator, or OpenURL. They are constructed according to ANSI/NISO Z39.88. OpenURL performs *context-sensitive* reference linking to connect researchers to the copy of an article or other content to which that user is entitled based on the user's institution and the subscriptions or licenses that institution has in effect. OpenURL is a standardized URL that contains metadata (e.g., journal title, ISSN, article author, article title, journal issue, and page) about a desired article and the address of a link resolver database against which the citation can be compared to determine if the library can provide access – and from which sources – to the desired article. The IOTA OpenURL Quality Initiative determined that ISSN is one of the most important elements for successful OpenURL linking (KASPROWSKI; MARCIN, 2010).

Even though OpenURL resolution today can often be successful if the OpenURL uses either the ISSN of the print version or the online version, this was not always the case. At the time ISO 3297:1998 was being considered for revision, there were complaints from academia that the proliferation of separate ISSN for print and online versions of journals was causing OpenURL searches to fail (SHEMBERG, 2003).The National Information Standards Organization (NISO) was a vocal proponent of revising the standard to deal better with separate ISSN for print and online versions in the digital environment (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, 2003).

The ISO Working Group that was formed to revise the ISSN standard included members from various sectors of the information community, including representatives from subscription agents and magazine distributors, who regarded the ISSN as a product identifier, and representatives from libraries or abstracting and indexing services, who wanted the ISSN to be a title identifier that could group or identify all the manifestations of title. The linking ISSN or ISSN-L, discussed in the background section of this chapter, resulted in part from the use of ISSN in OpenURL linking.

MACHINE ACCESS TO ISSN DATA: Z39.50 AND OAI-PMH

In addition to subscription access to the ISSN Portal, two types of machine access to ISSN and ISSN metadata are available as paid services. Z39.50 access

is provided to meet the needs of those needing to query several catalogs simultaneously. The Z39.50 protocol (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, 1998) and ANSI/ NISO Z39.50 (PORTAL NISO, 2002)acts as a client-server computer communication protocol; it lets the subscriber per- form searches in different databases via a computerized network.

The OAI-PMH protocol (OAI, 2002) provides subscribers with the ability to automatically update their local version of the ISSN Register on a regular basis or to automatically access metadata corresponding to an ISSN. In this way, subscribers can monitor changes in the ISSN Register at a frequency of their choosing, e.g., monthly, weekly, daily, etc. to access ISSN records by performing automated ISSN searches and to potentially populate portals of selected resources by using predetermined profiles. The application works by sending http queries to the ISSN server, which replies with data in the form of bibliographic records in MARC XML form (ISSN INTERNATIONAL CENTRE e, 2015).

ARCHIVING

In the last ten to fifteen years, the need to preserve e-journal content has spurred the creation of organizations and services such as Portico, JSTOR, CLOCKSS, LOCKSS, and others. These organizations work with publishers so that e-journals can be preserved over the long term. Among the national libraries that have established such preservation projects are the Library of Congress, the National Library of the Netherlands, and the British Library.

The Keepers Registry provides a registry of organizations that are engaged in preservation activities for e-journals. The registry was developed by EDINA, the national data service center at the University of Edinburgh, and the ISSN International Centre in Paris. The Keepers website describes the key role played by the ISSN:

> The ISSN Register, which contains bibliographic metadata for all journals which have been assigned an ISSN, is at the heart of the Keepers Registry. The ISSN Register is used both as an authority source for ISSN and to enrich the supplied records.…The ISSN Register provides a central spine for the Registry. Each of the registered Keepers supplies information about the extent of volume and issue content that it has ingested for each serial title. By using the ISSN-L we are aware of the relationship between the electronic and the print ISSN, and can query on either (PORTAL THE KEEPERS, 2015).

In an article in Serials Review, Peter Burnhill, director of the registry, discussed the importance of archiving journal content and the importance of the ISSN to the Keepers Registry:

> The shift to journal content that is digital, online and held remotely has challenged the essential responsibility that libraries have in ensuring continuity of access to scholarly content for their patrons.… The presence of an ISSN is more than a project convenience. If a resource is worth preserving then it should have an identifier, and if it is a continuing resource and is eligible for an ISSN, then it should have an ISSN and be in the ISSN Register (BURNHILL, 2013).

Print journals are also being preserved as in, for example, the Print Archives Preservation Registry[3] (PAPR DATABASE, 2015) at the Center for Research Libraries (CRL). PAPR supports archiving and management of serial collections byproviding comprehensive information about titles, holdings,

[3] *PAPR*

and archiving terms and conditions of major print archiving programs. Recognizing the need for a standard identifier for the journals in PAPR, CRL has been in discussions with the US ISSN Center about making ISSN assignments for journals in the registry that lack ISSN. Even smaller scale projects where an institution's print journals are being moved to remote storage locations benefit from the unique identification that ISSN can provide.

At the Library of Congress, print and digital archiving and preservation projects that use ISSN include the Copyright e-Deposit Project (U.S. Copyright Office, 2015) and Chronicling AmericaAt present, e-Deposit encompasses 228 titles published only in digital form. If ISSN for the e-journals to be deposited as part of the Copyright Project do not already exist, the ISSN for US e-journals are assigned by the US ISSN Center and the ISSN for nonUS titles are requested from the appropriate center in the ISSN Network. Chronicling America is a website that provides access to information about historic newspapers and selected digitized newspaper pages drawn from the directory of the National Digital Newspaper Program (NDNP). A staff member from the Library's Serial and Government Publications Division has been trained to assign ISSN to newspapers included in the project. As of this writing, almost all of the 1,300 newspapers on the site have ISSN. New titles receive ISSN as they are added to the site.

ISSN AND LINKED DATA: THE FUTURE

The ISSN is well positioned to become a key identifier in the linked data environment where identifiers will play a crucial linking and identification role. ISSN is a *natural key*, an identifier that already exists in the domain being identified. The ISSN Network's critical mass of almost 1.8 million existing identifiers and associated rich metadata, its extensive infrastructure of 88 ISSN centers coordinated by a proactive ISSN International Centre, and its welldocumented registration process enhances the potential of the ISSN to function in this future environment. As a natural key, ISSN can be used to mint linked data URIs.

The ISSN International Centre's ROAD Directory of Open Access Scholarly Resources is serving as a test bed for the output of ISSN data as linked data. As of mid-2014, ROAD records are available as a MARC XLM data dump, but later in 2014, ROAD will also provide outputs using the PRESSoo model developed by the ISSN International Centre and the Bibliothèque nationale de France (PRESSoo, 2013). Use of RDF will allow the ISSN Network to exploit its data and participate in the broader web environment to a much fuller degree. In 2010, W3C chartered a Library Linked Data Incubator Group that worked from May 2010 until August 2011. That group's final report recommends, "ideally, library data should integrate fully with other resources on the Web, creating greater visibility for libraries and bringing library services to information seekers" (W3C INCUBATOR GROUP, 2011).

ISSN is currently the most widespread and powerful identifier for serials and other continuing resources. ISSN has the potential to be even more powerful when transformed into a linked dataURI. AndersSoderback, who works with the National Library of Sweden's open linked data catalog, Libris, strongly advocates the use of linked data for library catalogs. He asks a thought-provoking question about library catalogs, one that can be

applied readily to the ISSN Register, "the question is not *what is a catalog [the ISSN Register]*but *what can a catalog [the ISSN Register] become"* (SODERBACK, 2009). The possibilities for what the ISSN Register might become are myriad and exciting.

In such a future world, ISSN information works invisibly to connect users to journal articles, magazine photos, or the content of online directories and databases. In such a world, users can jump smoothly from one article to other articles written by the same author, or to articles written from authors at the same institution, or written on the same subject, or any combination of these and other elements. In such a world access to information and about journals, magazines, and other continuing resources and their contents might be as simple using a smartphone to scan a QR code.

As exciting as the possibilities of linked data are, linked data will likely not be the only future environment. The future will likely encompass many standards and formats, each able to be mapped to others, or able to interoperate by a *hub and spoke* mapping environment. Future systems used in libraries will have the ability to ingest a variety of formats and output them as well. The ISSN International Centre has an advantage in its extensive experience with multiple formats such as MARC, UNIMARC, XML, and soon RDF.

Linked data also has the potential to free ISSN metadata from the con- fines of discrete library records where there is one record per ISSN and one ISSN per record. Unfortunately, but not surprisingly, ISSN records do not always align with what other communities and ISSN users perceive to be their data units. One of the long-standing challenges of serials is how to handle their propensity to change titles. The debate over keeping all information on one bibliographic record, despite changes of title (latest entry) vs. creating a new record for every major title change (successive entry) has raged for over 50 years. A more recent but equally contentious debate over whether to create single or multiple records for resources in multiple formats erupted when online resources first came to the fore in the late 1980s and has not completely abated since.

In current record- andformat-based systems, these challenges have seemed insurmountable. For serials, freeing the descriptive and access elements from the confines of the serial record has the potential to solve these problems, allowing appropriate elements to be combined or separated on the fly to provide the user with a complete title and format history or to present exactly the title and format desired. There would no longer be a need to choose the whole picture or part of the picture; rather, both would be possible, depending on the user's needs and wishes. If a user were interested in the entire history of a serial, a snapshot of that history in the form of a diagram, complete with ISSN, date spans, publishers, and relationships could be presented to that user. If a user were only interested in articles under one particular title, or the English translations of a title, or the online versions of a title, only these options could be presented.

Linked data's potential for disaggregation and recombination of ISSN data into units that are meaningful to various consumers of ISSN data will allow use of ISSN and ISSN data to interact much more easily in a variety of environments. Freeing ISSN data from a MARC-based and a record-based environment will allow ISSN data to be more readily

amalgamated with data from all the communities that use ISSN, a much broader range than libraries. ISSN could be coupled programmatically with citation data, with abstracts, with data sets from journal articles, and with mobile phone applications that could locate journal articles in libraries and specialty magazines in libraries or bookstores. All kinds of mash-ups to form new data, and linkages to connect with existing data, would be possible.

CONCLUSION

ISSN has come a long way from its origins as a simple identifier mostly used for identifying print serials in the 1970s. In the early days of the National Serials Data Program (the former name of the US ISSN Center), staff would vie for the privilege of working on ISSN requests from publishers, as opposed to assigning ISSN to serials cataloged by the Library of Congress. Copies of journal pages that printed an ISSN were so rare that they were posted on a bulletin board. Today, staff in ISSN centers around the world work hard to accommodate ISSN requests for the digital continuing resources that are proliferating as new uses and users of ISSN emerge. A challenge already appearing over the horizon is the potential need to assign ISSN to all those ceased serials now being digitized or archived, a need that will likely be met by a combination of manual and automated processing. Some ISSN centers are using a process called *semi-automatic ISSN assignment* to add ISSN to existing authoritative metadata record. The grand vision stated in the introduction to the first ISSN manual (UNESCO, 1973) "to provide a reliable registry of world serial publications, covering the full range of recorded knowledge" has become even more relevant today.

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