



Digital object identifier system: an overview

DOI system

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Abstract

Purpose – This paper aims to describe the digital object identifier (DOI) system, an implementation of the Corporation for National Research Initiatives handle system, where a handle is designed to provide an efficient, extensible, and secured global name to an intellectual object.

Design/methodology/approach – Explains the overview of DOI system, its components with examples in addition to benefits of DOI to user communities.

Findings – The management of intellectual objects in a digital environment such as the internet, which is flooded with various kind of objects like research articles, e-books, electronic theses and dissertations etc. requires the existence of persistent, reliable identifiers for each distinguishable piece of content and associated services activated by these identifiers to manage access and other digital rights. The DOI is the essential part of the electronic publishing especially for the management and the access of the resources is concerned. The DOI system is the new technology developed for persistent identification and interoperable exchange of intellectual property on digital networks.

Originality/value – This paper offers a useful explanation of DOI and their implementation in simple way for the professionals.

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Paper type Technical paper

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Introduction

The digital object identifier (DOI) is one of the members of the private identifier family, which are maintained by self-contained systems like digital repositories for allowing access to resources within an encapsulated environment and designed to work without human intervention (Scott-Wilson, 2004). The DOI is defined as “a character string used to identify intellectual property in the digital environment” (*Information Standards Quarterly*, 2004). The DOI is an initiative of the publishing community for protecting its assets in the digital environment. It provides a framework for managing intellectual content including activities such as linking users with content owners, facilitating electronic commerce, and enabling automated copyright management for all type of media. In addition, the DOI extends an extensible framework for managing content in any form and at any level of granularity in a digital environment. The International DOI Foundation (IDF), a not-for-profit membership organization established in 1998 controlled by an Executive Board elected by the members of the Foundation, supports the needs of the intellectual property community in the digital environment, by the development and promotion of DOI System as a common infrastructure for content management (www.doi.org).

Format-wise, the DOI is composed of the prefix and the suffix; both are separated by forward slash ‘/’. The prefix is a combination of the directory code < DIR > and the registrant code < REG > , which identifies the creating organization that wishes to



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register DOIs. The suffix is made up of DOI suffix string < DSS > , which identifies or locates information about particular object, which is always unique to a given prefix. Thus, DOI is a combination of “Prefix” and “Suffix” without having limitation on the length either in DOI string or any of its components, which is always globally unique in nature. The DOI is assigned by the registration agencies (RAs), which is appointed by the IDF. The IDF has appointed various RA for dealing with the specific client community, where the CrossRef (www.crossref.org) is the first major DOI Registration Agency works for electronic publishing (Figure 1). Accordingly, the syntax of the DOI is:

< DIR > . < REG > / < DSS >

Valid value for Directory Code < DIR > , which is numeric in nature, is 10 assigned by IDF. Registrant’s Code < REG > , which is separated from < DIR > by “.” within the DOI prefix, assigned by IDF to the individual organization. It can be any character within Unicode. In the example < REG > 1108 is assigned to the Emerald Group Publishing Ltd. (EGPL) by the CrossRef Registration Agency.

Suffix or < DSS > , which is also known as item identifier, is assigned by the Registrant to the object being published by the registrant. < DSS > is case sensitive and any character within Unicode cannot start with */where *, which is reserved for future use. In the above example < DSS > 146845202104338 is assigned by registrant “EGPL” to an article published in *Online Information Review* of EGPL entitled “Multi-script bibliographic database: an Indian perspective”.

The DOI system

According to the *DOI Handbook* (www.doi.org) the definition of the DOI system is, “The integrated system – comprising enumeration, description, resolution and policy making – managed by the IDF, providing an identifier i.e. an implemented system of labels through a numbering scheme in an infrastructure using a specification”. The DOI system gives persistent identification and interoperable exchange of intellectual property on digital networks. The DOI System is an implementation of the handle system (www.handle.net) which is a general-purpose distributed information system, designed to provide an efficient, extensible, and secured global name service for use on networks such as the internet (Lannom, 2000). It is a defined collection of internet protocols and software libraries that are used to implement handle system functionality. The system was developed by the Corporation for National Research Initiatives (CNRI) (http://cnri.reston.va.us) and funded by the Defense Advanced Projects Agency to the Computer Science Technical Reports Project. The handle system manages handle which are persistence and always unique for digital objects regardless of there presence (Scott-Wilson, 2004). The DOI system is made up of four

| DOI | Prefix | | Suffix |
|-----------------------------|--------------------|-------|-------------------|
| <Handle> | <Naming Authority> | | <Item Identifier> |
| DOI | <DIR> | <REG> | <DSS> |
| DOI 10.1108/146845202104338 | 10 | 1108 | 146845202104338 |

Figure 1.
Structure of DOI

Identifier

Resolution

a) DOI for the “Author’s Licensing and Collecting Society’s Byline Service”

b) DOI (incorporating a SICI) from an article in the "Journal of the American Society for Information Science", published by John Wiley & Sons:

c) DOI for an article from the Journal of American Medical Association:

d) DOI for the article "ABO Blood Group System" from Encyclopedia of Immunology Online, 2nd edition, published by Academic Press:

10.1006/rwei.1999.0001
 □ □ □
 DIR REG DSS

Source: American National Standards Institute (2000)

renamed as C-DAC, Mumbai), which is then used to communicate with that internet host. But, in the case of the handle/resolution system, the resolution is from a DOI/handle i.e. 10.1108/14684520210438705, to one or more pieces of typed data.

Metadata or description

The third DOI component is aimed at interoperability of metadata that describes the object being identified. Every identifier is registered with an accompanying set of metadata describing the object being referred in the string, where the metadata is provided keeping in view the usefulness of DOI string. Actually, both humans and machines need more information than just an identifier to make use of an information resource, especially outside the system in which the identifier was assigned.

Policy

The most important component of the DOI system is the policy and government. Norman Paskin, Director of the International DOI Foundation, has emphasized that persistence is a function of organizations, not technology. A persistence organization is necessary to ensure the ongoing support and management of a persistence identifier (www.doi.org).

Handle/resolution server

The handle system allows handles to be resolved in a distributed fashion, using dedicated clients, common clients such as web browsers using special extensions or plug-ins, or unextended clients going through various proxies. In all cases, communication with the handle system is carried out using handle system protocols, and in all cases, those protocols have both a formal specification and some specific implementations (www.doi.org). Figure 3 gives an example of the handle/resolution server.

Stepwise description of “an example of handle/resolution system”

Step 1. In the above example step 1 represents that the client is in need of one article entitled “Multi-script bibliographic database: an Indian perspective” written by Rajesh Chandrakar published with *Online Information Review*, which is assigned a DOI number 10.1108/14684520210438705 by EGPL (Figure 4). Where “10.1108” is a prefix represents the publisher code and “14684520210438705” is a suffix represents the unique identifier for said article. Arrow in the example indicates that the client sends a DOI request (handle) to the resolution server (handle server) (<http://dx.doi.org>) for resolution (Figure 5).

Step 2. The resolution server consists of a collection of handle services owned by various registration agencies. Where one global handle service, is responsible for knowing the locations and name space of all the public local services (LHS). Respectively, each of the LHS knows how to access the global handle service and helps a resolution query to enter the resolution server at any point and routes to the specific service and server as well. In the above example, the CrossRef, which is a registration agency (RA) for IDF in the area of electronic publishing and EGPL is one of the members for assigning the DOI number to the articles. Thus, here in the above

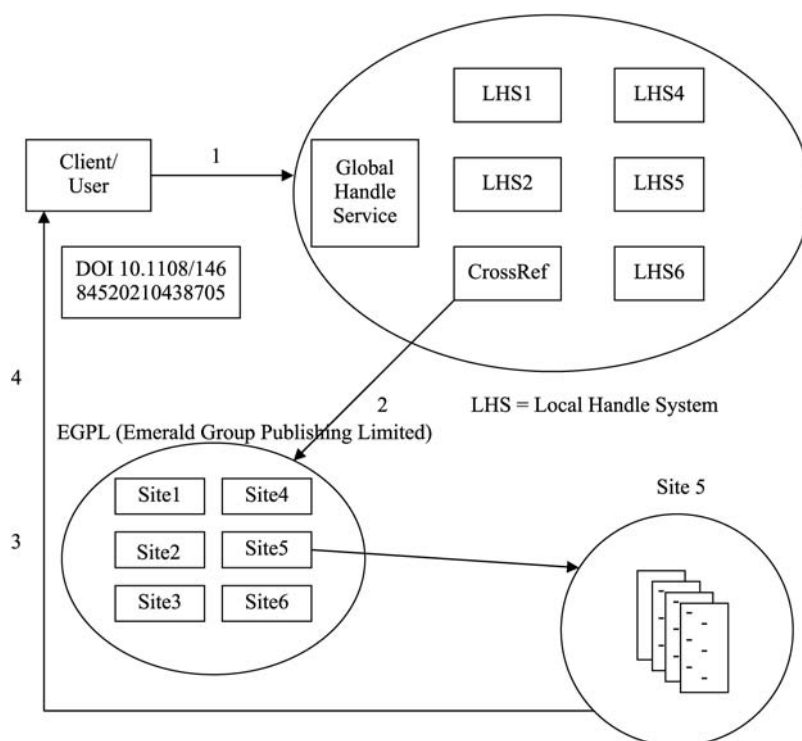


Figure 3.
Handle/resolution server

example, 10.1108/14684520210438705 is a DOI number assigned by EGPL to the said article.

Steps 3 and 4. Each handle can be associated with one or more pieces of typed data. Steps in the example shows that the DOI 10.1108/14684520210438705 is associated with EGPL and resolves to a URL <http://iris.emeraldinsight.com/vl=6347518/cl=145/nw=1/rpsv/cgi-bin/cgi?ini=xref&body=linker&reqdoi=10.1108/14684520210438705> by returning in to the user's browser (Figure 6).

Benefits of the DOI system

By integrating an identifier into a DOI, the identifier becomes actionable as a standard hyperlink (but, unlike URL with persistence), and can function in DOI applications across a variety of platforms. A variety of different identifier systems become readily interoperable when incorporated into DOIs. DOIs may be assigned to ISBN entities (books) to achieve this; DOIs may be used to identify related entities or linked material in any form. Using one system enables one set of tools to be applicable across many platforms, media, standard identification schemes, etc. and promotes interoperable

DOI 10.1108/14684520210438705 Multi-scri t biblio ra hic database: an Indian ers ective

Figure 4.
An example of
handle/resolution system

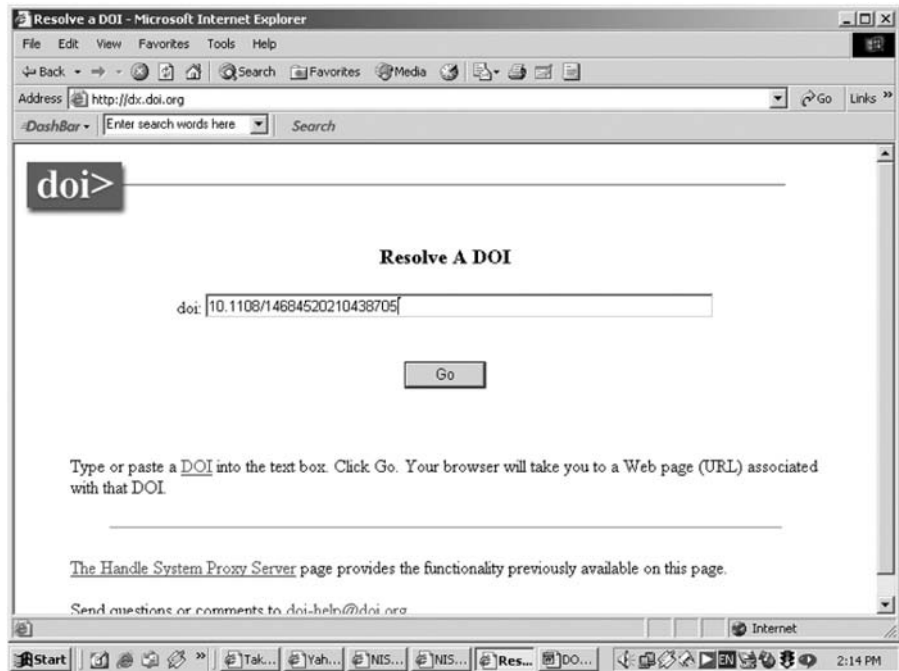


Figure 5.
Handle/resolution server
(step 1)

transactions of intellectual property. On the downside, the DOI, in the first instance, seems to be an issue for publishers, when multiple copies of a digital object available on different servers, but it is not as difficult in practice as the resolution system takes the query to the concerned server which has been registered for.

Some other benefits of the DOI are as follows:

- globally accepted unique identifier of electronic resources;
- persistence;
- provides multiple instances;
- extensible namespace;
- international organizational support;
- works under distributed service model;
- works with secured name service;
- part of distributed administration service; and
- provides efficient resolution service.

Conclusion

The DOI is a system for interoperably identifying and exchanging intellectual property in the digital environment. A DOI assigned to content enhances a content producer's ability to trade electronically. It provides a framework for managing content in any form

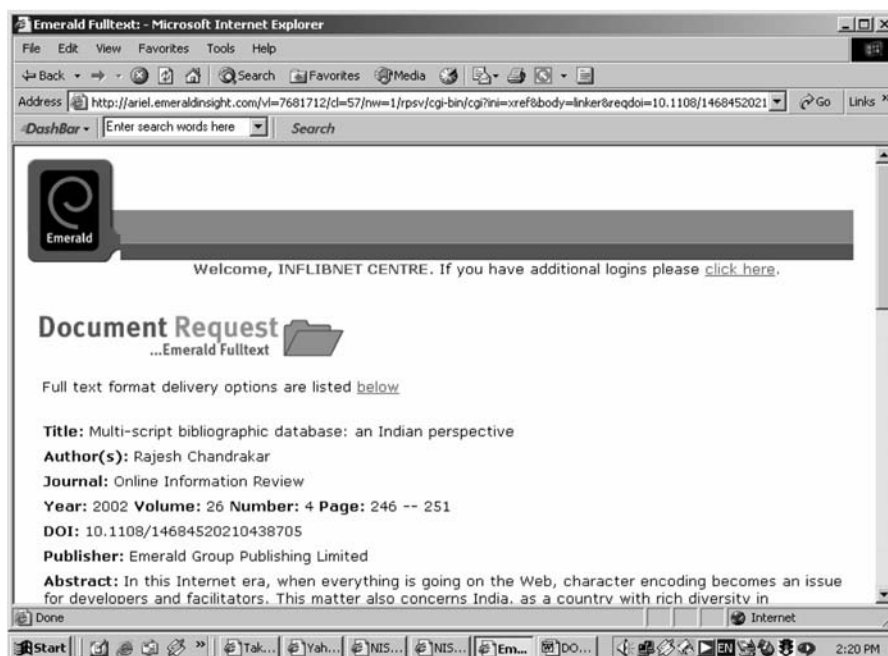


Figure 6.
Resolution (step 4)

at any level of granularity, for linking customers with content suppliers, for facilitating electronic commerce, and enabling automated copyright management for all types of media. The International DOI Foundation, a non-profit organization, manages development, policy and licensing of the DOI to registration agencies and technology providers and advises on usage and development of related services and technologies.

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About the author

Rajesh Chandrakar is currently Scientific and Technical Officer at INFLIBNET (Information and Library Network) Centre, Ahmedabad, India, where has been for the last eight years. He is working with the Database Development & Management Group, and the Networking and Quality Control Group. Rajesh holds a Bachelor degree in Science (Physics, Chemistry and Mathematics) from Government Model College of Science, Raipur, and a Masters degree in Library and Information Science from Pt. Ravishankar Shukla University, Raipur, Chhattisgarh, India. He also has the Postgraduate diploma in Computer Application from Pt. Ravishankar Shukla University, Raipur. He is Convener of MARC21 Core Group of INFLIBNET Centre. He has been nominated an Alternate representative of the Bureau of Indian Standards (BIS), Technical Committee MSD5 from INFLIBNET Centre and an Alternate Voting Representative to NISO (National Information Standards Organization). He was Joint-Convener of International CALIBER2005 held at Cochin University of Science and Technology, Kochi (Kerala). He also pursued the Training on Managing Academic Libraries as a Commonwealth Professional Fellow at Middlesex University, London during 2005. Rajesh Chandrakar can be contacted at: rchandrakar@yahoo.com or rajesh@inflibnet.ac.in