

If you use the internet to manage content or information about assets, you can benefit from being



The more assets you have, the harder it becomes to keep track of them. Users will find your assets through many different routes. Updating assets becomes problematic.

Over time, assets evolve. What started life as for example a single video might come to exist in different electronic formats, in different language versions, in edited or extended variations. New services arise to be offered with your assets. Keeping track of all of these is a challenge in itself. But without efficient management of all this information, sharing content and information with others – whether in a commercial transaction or in a collaborative effort – becomes increasingly difficult.

This can lead to ***lost opportunities, inefficient operations and management headaches.***

That's where the DOI System – the Digital Object Identifier – offer advantages for you and your community.

DOIs identify content ***permanently***. And as they are coupled with metadata, they can be modified over time to keep track of the locations and characteristics of the objects they identify, both for you and your users.

You benefit from efficient management and accurate tracking, as well as gaining the ability to more easily automate processes and collaborate with partners in your community.

And that means adding value to your content.

What is a DOI?



A DOI is a Digital Object Identifier. That is a **Digital Identifier** of an **Object**, not an **Identifier** of a **Digital Object**.

10.1234/456-mydoc-456584893489 is an example of the DOI format. It consists of a **Prefix** and a **Suffix**. The prefix always begins '10' indicating this is a DOI name; the second part of the prefix is typically four digits, and is allocated to the DOI assigner. The suffix is created by the assigner, and can be any length and incorporate other numbering schemes (including an existing identifier) if desired. Existing data can also be linked in the DOI record.

A DOI can be assigned to any **Object**. An object can be anything you want to manage: a piece of online content in a particular version, or a related object, such as an author or a party to an agreement; or a physical asset, a DVD or an item of equipment, for example.

DOIs can be assigned at different levels of granularity to suit differing needs, e.g. a collection, a book, a table within the book, the related source data for the table etc. When assigning DOIs, the registrant links metadata with an appropriate level of detail to identify a separate entity within the DOI system.

DOIs in use

- First applications launched in 2000
- Currently being assigned by well over 5000 naming authorities e.g. publishers, science data centres, movie studios etc
- Around 100 million DOI names assigned
- Over 1.5 billion DOI resolutions per year

How do DOIs help you manage your assets?



DOIs allow objects to be identified and accessed with certainty. Once DOIs are allocated, they never change for that object. That means items allocated a DOI can be easily found should their locations change. But the information associated with that object can be added to, edited or grouped in various ways at any time to suit your operational needs. Related objects such as versions can also be separately differentiated and linked.

Standard

DOIs are an ISO standard (ISO 26324-2012). They are unique worldwide. Tools and applications are available to work with DOIs, and new applications are continually being developed. DOIs comply with existing Internet standards and build on a widely used open technology.

Permanence

A DOI is unique, and once allocated can only ever apply to that object. For example, a publication might change its owner as a result of business mergers; but the DOI of that publication does not change. The new owner might move the content to a different hosting server or additional locations, or add new data about it; the DOI does not change. Anyone looking for that publication using the DOI can be sure they have found the correct material, even though it's not owned by who they thought or located where they expect it to be. Other information can be associated with the object through the DOI system, such as a statement of rights ownership, or links to related material, or anything else.

Redirection

The capacity to redirect uses the Handle System, an internet technology specifically developed for efficient, extensible, and secure resolution

services for unique and persistent identifiers of digital objects. The Handle System was developed by the Corporation for National Research Initiatives, and is now an infrastructure on which applications serving many different purposes have been built, both for specific one-off applications and for community-wide standards such as DOI.

Among the objects that have been identified by DOI so far are millions of journal articles, science datasets, movies and broadcasting metadata, government documents, and a growing variety of other material.

The DOI system utilises the Handle System as one component in building an added value application, for the persistent, semantically interoperable, identification of intellectual property entities. Other components of the DOI system are the metadata model and the social and technical infrastructure provided by the International DOI Foundation.

Metadata description

The data model component of the DOI system pioneered, and shares a common basis with, leading content interoperability initiatives (such as the Linked Content Coalition). Every object identified through the use of a DOI also has metadata associated with it. The metadata can be from existing records or can be newly created. The DOI system focusses on metadata creation interoperability and standardisation to provide a set of tools for creating reliable metadata that describes the object in whatever detail is appropriate for you. This metadata can be added to over time, allowing you to refine the description of the object or to associate further data that will allow it to be used in new applications.

Persistence

As with any identifier, DOIs function, through being in a managed system. As with any identifier, DOIs function through being in a managed system. The DOIs need to be registered and structured; metadata needs to be maintained and organised in a manner that ensures compatibility across users and platforms; and this needs to be enduring, so that the permanence of DOIs is not compromised.

This persistence in the implementation of DOIs is not only a challenge for technology, but for organisations. DOIs are underpinned by an established –and growing – social community. These organizations define the processes and agreements that provide the social infrastructure of the identifier system, including planning for changes in the organisations.

How do I know I can rely on DOI in the future?



A federation of Registration Agencies (RAs) exists as a central hub for the operation of DOIs, creating an interdependency and mutual support network, with default options in the event of any single Agency being unable to continue to contribute. Agencies commit to ensuring they have processes in place to guarantee DOI persistence.

All these Agencies are members of the International DOI Foundation (IDF), which provides governance, implementation policies, tools, and standards to ensure that the DOI system is robust in the long term, but delegates flexibility within individual industries and sectors to appropriate Agencies.

RAs work together with the communities they serve, assigning and allocating DOIs in one of several different ways according to their needs. RAs manage the metadata and share in the technology infrastructure that makes DOI a powerful tool in managing intellectual property.

New Registration Agencies can be created. RAs share the costs of funding the common infrastructure on a not-for-profit basis. RAs may in turn charge for the services provided and are free to develop their own applications based on the DOIs they manage. RAs share tools they develop which are applicable to all DOIs.

While the IDF focuses on developing better tools for all RAs, for example, multiple resolution or semantic interoperability, RAs are free to build specific applications for their own sectors. This community focus and consensus is key to allowing innovation and development of the value of DOIs, and in establishing principles that emphasise coherence and cooperation for the benefit of all involved rather than regulation and control. Sector-specific communities that grow up around the RAs also develop tools, products, and services that take advantage of DOI features.



How do DOIs work?



DOIs are designed to work across the internet. They are platform independent and created to an agreed international standard, formally specified in **ISO 26324**.

DOI Registration Agencies – a federation of independent organisations, each a contributor to the co-ordinating DOI Foundation – work to the international standard and provide the community structure that underpins DOI technology.

The Registration Agencies (RAs) manage the DOI records for their communities. They manage the databases of metadata that enhance the value of DOIs, and participate in the development and application of the DOI system.

By ensuring that DOIs are implemented and metadata created to consistent standards, the RAs ensure that sharing and interoperability becomes possible. Users can then reliably build upon this to maximise the commercial and operation benefits that the DOI system offers.



How can I benefit from using DOIs?



Introducing DOIs to the management of your content and assets can bring you a number of benefits.

Save on the time and costs

DOIs work to a common standard with an agreed syntax and semantic content. That makes sharing data from different sources easier.

- Easier to collaborate and maximise the value of your content by sharing with others
- Easier to track your assets with multiple output formats
- Easier to automate processes
- Objects with similar properties can be grouped as a single class that can be allocated its own DOI, allowing the entire content of the class to be managed in one process

Know exactly what assets you have, and on which terms

The permanence and persistence of DOIs means that your assets are always tracked and information about them is easy to find, by you and by your users and third parties.

The associated metadata can be modified over time, allowing you to add to the description of objects to facilitate services, integration with partners' data, or to ease transactions with other organisations.

Locate assets quickly and choose them with ease and accuracy

DOIs are not only the key to locating your assets permanently, they can also resolve to other services and to multiple locations of the same object with certainty that the objects are indeed the same – for example, the same material residing in a publisher's hosted content and in a third party open repository.

DOIs can also provide additional information directly in the DOI metadata, through links in the DOI metadata, and through services provided by the RA and DOI application developers. Examples include rights information, purchase options, and references to external metadata sources.

Introducing DOIs within your management processes offers:

- Persistence
- Interoperability
- Extensibility
- Platform independence
- Dynamic updating
- Multiple resolution
- Class management
- Standards compliance

Create applications to leverage maximum value from your content and assets

As the DOI system is platform-independent, data from different sources can be shared easily and output in multiple formats to suit your goals, and is future-proofed.

By making it easier to share information about content and to collaborate with others, the DOI system opens up opportunities to easily create applications that are relevant to your industry or sector.

DOIs can be used to manage whole classes of objects. This is especially powerful because the relationships among the objects in the classes are captured in the DOI metadata. This in turn means that applications can be tailored to treat the objects either individually or as a group.



Bringing clarity to citations in scholarly publications

CrossRef is a not-for-profit network of publishers using DOIs to make reference linking throughout online scholarly literature efficient and reliable. It has become a single source for citation linking with the overwhelming majority of academic and scholarly publishers participating.

As well as avoiding broken links, the use of DOIs in the CrossRef services avoids the need for multiple bilateral linking agreements amongst publishers, since a single agreement with CrossRef serves as a hub-and-spokes model of efficiency. Publishers also obtain automated pre-publication population of outbound links to cited sources, saving considerable effort, and the CrossRef linking enhances the accessibility of inbound links adding to the usability and quality of content.

Beyond citation linking, Cross Ref has developed additional services that capitalise on the possibilities of DOIs. These include tools to prevent plagiarism, collection of cross-publisher metadata for authorised partners, and identification of funders of published research linked to outputs as a measure of productivity.

In collaboration with others, CrossRef has also developed services to assist other parties to more easily work together including allowing publishers and data repositories to interlink their content more easily, and address the problem of ambiguous author names in scholarly content.

- CrossRef enables pre-production reference matching so that live links can be included in newly published material. One hub and spoke system replaces a maze of lateral agreements for sharing information on citations between individual publishers: one agreement with CrossRef is a linking agreement with all other 4,600 CrossRef participants.
- CrossRef DOIs are maintained and managed, so solving the problem of “LinkRot”: 404 not found messages. Over time, fewer and fewer links in references work: studies have found that in some cases within four years half of the links in an article are broken without the use of persistent identifiers.
- Publishers can keep their existing article identifiers if they wish and incorporate these into DOIs: in this way, a variety of otherwise different identifier schemes become easily interoperable.
- The combination of a registry of DOI identifiers, metadata, services and a core community has proved to be a powerful system for collaboration in persistent linking, discoverability, and trust. CrossRef is a brand that publishers feel they can rely on, providing a firm platform for journals to build their brands by performing essential services of registration, certification, promoting awareness and maintaining context.
- The existence of a core common service and community of reference linking then enabled the development of new services, providing added value, all on the same cross-publisher principle, e.g. cited-by linking; metadata feeds; plagiarism screening; update identification; funder identification; text and data mining.
- Many of these new services are innovative uses of DOI such as embedding DOIs in plagiarism tools (CrossMark); linking funder information to the work funded (FundRef), etc.



Giving data its due

DataCite brings together the datasets community to collaboratively address the challenges of making research data visible and accessible.

Using DOIs, DataCite supports researchers by helping them to find, identify, and cite research datasets with confidence, supports data centres and libraries by providing persistent identifiers for datasets, workflows and standards for data publication, and supports journal publishers by enabling research articles to be linked to the underlying data.

With more than 2 million DOI names registered by early 2014, DataCite is in the forefront of developing applications to allow metadata generation, metadata exposure and resolution services to make data more discoverable and more easily shared and negotiated. DataCite also sets out Business Models Principles describing some of the current best business practices and responsibilities for DataCite members and their clients in managing their data.

- DataCite provides a consistent way of registering and citing **material of many different forms** which is of use to researchers: datasets, software, scientific films, 3D objects, simulations, “grey literature” reports, etc. These various forms of data have different identifier schemes (or often, no identifier scheme), inconsistent metadata, and no easy way of managing them interoperably. By creating the DataCite registry, all of these problems are solved under one interoperable identifier scheme, DOI.
- DOIs **add value for researchers** by making their data objects (which were not otherwise visible beyond the authors laboratories) citable, persistent, and precise.
- In the past, researchers only had easy access to their own data: data can now be reliably accessed and cited from **non-local sources**
- The DataCite database now enables easy discovery of **related items** e.g. related identifiers, related supplement publications, journal articles, etc.
- DataCite’s existence has led to development of **new services** working with other DOI agencies (e.g. CrossRef) and with non-DOI identifier services (e.g. ORCID and strategic activities (e.g. STM, RDA)
- Data Cite, CrossRef and other RAs collaborate through e.g. **Content Negotiation**. CrossRef and DataCite register DOIs in separate services using separate procedures and, through the DOI handle system and proxies, those sets of ids and those metadata databases are function as a single coordinated infrastructure that can provide multiple services. Those services can be extended and altered fairly easily with a couple of handle changes and a little code change at the proxies or the metadata databases.



Keeping users in the picture

DOIs are used by EIDR – the Entertainment Identifier Registry – to provide the film and television industry with a powerful, efficient and low cost way of tracking content in the explosion of formats and value chain interactions. EIDR uses the DOI system to manage relationships between all these items and relate them to external systems.

From creation, through post-production and distribution, EIDR DOIs help studios, production companies and other industry players to accurately and efficiently track and manage the titles, edits, encodings, clips, mash-ups and myriad other outputs of a dynamic and complex business environment. EIDR DOIs also simplify retrieving and collating information about an asset from multiple sources – reviews from one source, cast and crew listings from another source, and trailers from someplace else.

EIDR DOIs enable services that help users to

- Eliminate costly translations between proprietary ID systems.
- Lower risks of misidentification caused by duplication and lack of ID uniqueness.
- Improve internal asset tracking and reduce complexity in log distribution pipelines.
- Improve their ability to match assets and metadata from different databases, service providers, or suppliers.
- Improve automation of the digital distribution path from producer to consumer, including delivery via broadcast television, cable networks, and digital retailers.

EIDR is used for improved search and discovery in commercial applications as well as in the academic and heritage sectors. EIDR members are also developing services to offer more accurate rights tracking and reporting and detailed consumption metrics. Making these applications interoperable with other systems and identifiers gives users reliable and accurate information, and maximum commercial leverage from their assets.

- The Entertainment Industry confronts the problem that in the digital world there are more and more ways to package film and broadcast content. One Hollywood film can generate over 1,000 different assets which need not only to be separately distinguished but also related to each other in defined ways: e.g. original disc format, extended version, 3D version, video on demand, file download, catch-up TV, in flight version, etc. EIDR solves this problem by maintaining a consistent database of assets, each identified in the DOI System.
- The EIDR identifier provides a common link for an unlimited number of value-added services, such as offer terms; ownership and licence rights; contributor metadata (cast, crew, etc.); digital revenue reporting; metrics and analytics; etc.
- Proven benefits of using EIDR include reduction in quality control efforts, reduction in customer queries, and improved reporting and invoicing capabilities. An independent analysis by Cognizant captured the benefits of a pilot implementation of an EIDR-based system between Warner Bros. and Microsoft: the EIDR identifier was integrated across the content ordering and delivery workflows, and sales and royalty reporting for theatrical titles sold on Xbox. Benefits were identified and measured with total estimated direct savings of 650 employee-hours/year for integration with a single partner, and similar added savings realized with every additional partner added to this work flow.
- The entertainment industry needs a uniform identifier for all programs to automate direct measurement of viewership across an increasing number of platforms. Panel ratings alone are not sufficient for new TV platforms, smart phones,

tablets, PCs, connected TVs, etc. Direct measurement offers greater reach and accuracy, but requires a standardized IDs for programs and ads, which EIDR provides. In a pilot study, the CIMM-TAXI industry group in North America endorsed EIDR for program ID and estimated a \$2.5Billion benefit to the media industry will result from using EIDR alongside the existing Ad-id system..

- As with other DOI RAs, once the RA's underlying system and first few applications are developed, new ones are stimulated. For example
 - o EIDR is being used to develop tools for **Content Rating**. This requires ensuring the correct rating is attached to the right version of the film, since the existing system based on modified titles is error-prone and confusing; pilot projects underway in both the US and UK have shown the EIDR can simplify the process and remove errors and ambiguity
 - o There are emerging applications of EIDR in the process of **rights recovery** (mapping and matching scheduling data, broadcast data, and actual cue sheets and claims for royalty dues) where the use of interoperable identifiers can shorten the time from claim to payment.

Non-English uses

In China, Registration Agencies are using DOI to provide linking relationships between bibliographies in Chinese characters and the equivalent original English language abstract and original article material, enabling consistent linkage to local services and partnerships to access international databases.

How do I start using DOIs?



If you recognise the benefits of having your assets “Driven by DOI” and would like to begin to use DOIs within your management processes, the first step is to contact a Registration Agency.

There are a growing number of RAs, covering a variety of industries and sectors.

You can start working with a DOI RA to register and use all the DOIs you need. If you are unsure which Registration Agency is right for you, or want to discuss wider aspects of DOI use, contact the International DOI Foundation.

More information on RAs can be found at http://www.doi.org/registration_agencies.html

Once you begin implementing DOIs, you’re part of the whole DOI community.

You’re now working cooperatively alongside all the other partner organisations who are building on the existing power and potential of the DOI system to deliver better information management and more successful realisation of the value of content and assets.

You’re **Driven by DOI**.





If you have any questions or require
further information on DOIs, please contact
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