

A Persistent Web Identifier (PWID) URN Namespace
draft-pwid-urn-specification-10

Abstract

This document specifies a Uniform Resource Name (URN) for Persistent Web Identifiers for web material in web archives using the 'pwid' namespace identifier.

The main purpose of the standard is to support specification of references that are not covered by other reference techniques: to support references to material in web archives with restricted access. Furthermore, it supports persistent technology agnostic references to web archives in general, in a form that can work as an algorithmic basis for finding web archive resources in general. An additional important benefit is that the standard can be used for specifying web collections, which can then form a persistent computational basis for the extract of the archived collection parts.

The PWID URN is designed to meet requirements for proper referencing needed by researchers. Therefore, it is designed as general, global, sustainable, humanly readable, technology agnostic, persistent and precise web references for web materials in web archives.

Table of Contents

1. Namespace Registration Template	2
2. References	11
2.1. Normative References	11
2.2. Informative References	12

1. Namespace Registration Template

Namespace Identifier:
PWID

Version:
1

Date:
2019-10-11

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Purpose:

The PWID URN is a supplement to existing reference standards, where the PWID URN will support references to web archives, including areas that are not supported today: support of references to material in web archives with restricted access. Furthermore, the PWID URN enables technology agnostic references to web archives in general, which can be needed, for instance for references to dynamic web material with frequent updates (e.g. a news site) or a specific version of a web material (e.g. specific version of the DOI handbook).

The PWID URN is in a form which can work as an algorithmic basis for finding the resource. This also enables computation of archived web parts to a collection from one or more web archives, if the collection parts are specified by PWID URNs.

Furthermore, the PWID URN includes information about the resource which makes it possible to find alternative resources, in cases where the original precise resource has become unavailable.

The PWID URN is designed to be a persistent reference that is general, global and technology agnostic in order to enhance its chances of being sustainable. Furthermore, it is designed to be humanly readable and with an ability to specify precision about what the referenced web archive resource covers. This design enables a PWID URN to:

- o be used in technical solutions, e.g. to make them resolvable
- o cover references to materials from all sorts of web archives

The motivation for defining a PWID namespace is the growing challenges of references to archived web resources, and the PWID as a URN can assist in overcoming a lot of these challenges. The standard is needed to address web materials meeting precision and persistency issues on par with precision in traditional references for analogue

material. Furthermore, it is needed in order to address web archive resources that are not freely available online. The PWID URN covers both referencing of web resources from research papers and definition of web collections/corpora. In detail the challenges are:

- o Persistent Identifier systems (like DOI [DOI]) will only cover registered resources. In general, citation guidelines do not cover general and persistent referencing techniques for web resources that are not registered. However, an increasing number of references point to resources that only exist on the web, e.g. blogs that turn out to have a historical impact. In order to obtain persistency for a reference, the target needs to be stable. For non-registered web resources, the common rule is that the resource will change, since the live-web is constantly changing. Persistency can only be obtained by referring to something stable, i.e. an archived version of the resource from the web. The PWID URN is therefore focused on referencing archived web material in a technology agnostic way (research documented in [IPRES2016] and [ResawRef]).
- o References to materials, which only exist in web archives (i.e. no longer on the live web) are not well supported, especially not for materials that only exist in archives with restricted access. There are many new initiatives for web archive referencing, - most of which are centralized solutions offering harvesting and referencing, but these cannot be used for materials that only exist in web archives. The PWID URN can be used for all web archives, including web archives with restricted access.
- o One of the referencing initiatives for open web archives uses URLs which depend on the current setup of the web archive's access platform. These URLs are usually technology and placement dependent, and therefore such a reference style is not suited for references that are important to retrace for a long period. The PWID URN can be used for such reference purposes, since it is technology agnostic.
- o Another referencing initiative, for open web archives, is omitting specification of the web archive where the resource was found. This strategy is used in order to open the possibility of using alternatives from other archives. However, this also adds a risk of imprecision since different archives tend to have different versions even when harvesting at the same time. Therefore, such a reference style is not suited for references where it is important that the reference is precisely the verified reference. The PWID URN can provide an exact reference for where the reference was validated. Additionally, the PWID contains the needed information in order to search for alternative resource, if needed.
- o For web collections/corpora (possibly across different web archives), recent research have found that various legal and sustainability issues has led to a need of a collection definition of references to their web parts. Furthermore, there is a need for a similar persistent referencing for all parts for calculation and sustainability reasons. So far, there has been no stable standard for definition of such collection parts. The PWID URN can be used for such definitions in order to fulfil these requirements (research documented in [ResawColl]).

The PWID URN is especially useful for web material where precision is in focus and/or there are references to materials from web archives requiring special permissions in order to gain access. The precision regards two aspects. Firstly, pointing out the archive where the resource was found and validated against its purpose (other archived versions in other web archives may differ both regarding completeness and contents even within short time periods) Secondly, specifying whether the referred resource is a web page or a part in form of one file.

The possibility of specifying the part/file precision enables the PWID URN to be used in specification of contents of a web collection. Definitions of web collections are often needed for extraction of data used in production of research results, e.g. for future evaluations. Current practices are not persistent as they often use some CDX version, which vary for different implementations.

Strict syntax is needed for the PWID URN, in order to ensure that it can act as a reference which can be used for computational purposes. This is especially relevant for automatic extraction of parts from web collection definitions. Furthermore, today's readers of research papers are expecting to be able to access a referenced resource by clicking an actionable URI, therefore a similar possibility will be expected for references to available archived web material, and this is possible with a strict syntax. A prototype for resolving URN PWIDs has been developed for the Danish web archive data and open web archives with standard patterns for the current technologies. Implementations for resolution of PWID URNs for other web archives may be developed.

The purpose of the PWID URN is also to express a web archive reference as simple as possible and at the same time meet the requirements for sustainability, usability and scope. Therefore, the PWID URN is focused on having only the minimum required information to make a precise identification of a resource in an arbitrary web archive. Recent research has shown that this can be obtained by the following information [ResawRef]:

- o Identification of web archive
- o Identification of source:
 - * Archived URI or identifier
 - * Archival timestamp
- o Intended precision (page, part/file)

The PWID URN represents this information in a human readable way as well as a well-defined way that enables technical solutions to interpret the URN.

Syntax:

The syntax of the PWID URN is specified below in Augmented Backus-Naur Form (ABNF) [RFC5234] and conforms to URN syntax defined in [RFC8141]. The syntax definition of the PWID URN is:

```
pwid-urn = "urn:" pwid-NID ":" pwid-NSS
pwid-NID = "pwid"
```

```

pwid-NSS = archive-domain ":" archival-time ":" precision-spec
          ":" archived-uri

archival-time = utc-date ["T" utc-time] "Z"
utc-date     = utc-year "-" utc-month "-" utc-day
utc-year     = 4DIGIT
utc-month    = 2DIGIT ; 01-12
utc-day      = 2DIGIT ; 01-28, 01-29, 01-30, 01-31 based on
                ; month/year in UTC time
utc-time     = utc-hour ":" utc-minute [":" utc-second [secfrac]]
utc-hour     = 2DIGIT ; 00-23
utc-minute   = 2DIGIT ; 00-59
utc-second   = 2DIGIT ; 00-58, 00-59, 00-60 based on leap second
                ; rules
secfrac      = "." 1*9DIGIT

precision-spec = "part" / "page"

```

where

- * All parts of the pwid-NSS are case insensitive, except for cases where the archived-uri represents a URI with case sensitive parts. According to [RFC8141] (section 3.1) this means that the PWID URNs in general are case insensitive, except from cases where it includes a case sensitive archived URI.
- * 'archive-domain' is defined as in (section 3.5) [RFC1034]. The 'archive-domain' must identify the web archive by the domain for the archive leading to descriptions of how to access (or apply for access) materials in the archive. (Discussion of this way to identify the web archive is described in the "Assignment" section and discussed in the "Additional information" section).
- * 'archival-time' is a UTC timestamp which conforms to ISO8601 [ISO8601-1][ISO8601-2] and a subset of date-time specified in [RFC3339] (except from allowing partial time specification). The 'archival-time' may be specified at any of the levels of granularity, as long as it reflects exactly the granularity of the timestamp recorded in the archive (which is in accordance with the WARC standard [ISO28500]).
- * 'DIGIT' is defined as in [RFC5234].
- * 'archived-uri' is defined as 'URI' in [RFC3986] but where occurrences of "[", "]", "?", "#" and "%" are %-encoded in order not to clash with URN reserved characters [RFC8141] as well as having unambiguous use of "%". The 'archived-uri' must be the URI for the archived source.

The precision specification is expressing the intended precision of the reference, which is needed for specification of

- * precise coverage of the reference
e.g. to an html file, since the precise meaning of what the reference covers can be very varied (the html file itself? the web page it renders to?) or precise web parts of a collection specification.

- * degree of how precise the reference is with respect to what can be viewed in the future
The html file itself will be the same. However for web pages, there are interpretation involved, which mean the result of rendering them in the web archive can change over time. This may happen in case the web archive's algorithm for calculation of which archived web parts to use for the web page. It may also happen if the web page refers to parts which are added to the web archive later, and therefore will give another expression than the originally referenced expression.

The following valid precision-spec values exists:

- * 'page'
Meaning that an application like Wayback calculates a resulting web page based on calculated referenced web parts (display templates, images etc.). For example, an html page displaying an image will need both the html and the referred image.
- * 'part'
Meaning the single archived file/web part harvested as from the specified URI. For references to web pages with html code (i.e. pages where there is an option to "View page source"), this will mean the actual file with the html code. It is relevant to refer to web pages this way, in case it is part of a collection specification or in case it is the html that is of interest (e.g. java scripts or hidden links that are not visible when rendering the web page).
For all other types of files, the URI will be for single files to be interpreted a file.

Assignment:

The PWID URNs do not have to be assigned by an authority, as they are based on the information created at the time of archiving. In other words: a PWID URN is created independently, but following an algorithm which ensures that the referred item can be found if it is still available. A prerequisite for assignment of a PWID is that the web archive can be located (with a domain describing the web archive) and that it has registered metadata about the archived URI and the time of archiving (also discussed in section "Additional Information").

A PWID URN is created by finding the relevant information of the syntax parts of the PWID:

```
"urn:pwid:" archive-domain ":" archival-time ":" precision-spec
                ":" archived-uri
```

The PWID URN for an archived item at hand can be constructed by exchanging the unspecified PWID parts with relevant information, as explained in the following:

- o archive-domain (identification of web archive):
This must be the domain of the web archive which assists in locating the web archive and separate the web archive from other web archives (e.g. archive.org for Internet Archive's open web archive and netarkivet.dk for the Danish web archive with

restricted access). The web archive domain is used, since most web archives have a web archive domain page that leads to a description of how to access the web archive, e.g. by online access or by applying for access grants. Furthermore, it is more precise than e.g. the name of the archive, since there may be more than one installation of web archives at the same organization, e.g. archive.org and archive-it.org are both covered by Internet Archive.

- o archival-time (archival timestamp):
The archival time for the archived item must be specified with as much granularity as possible in order to make sure it uniquely identifies the resource at hand. The archival time may be displayed along with the archived item, but there are different implementations. It is important to be aware of whether a more precise timestamp can be found, and whether the correct timestamp is used. In many Wayback implementations, the precise timestamp can be found as part of the URI used for viewing the archived item. For example, the archive http URI <https://web.archive.org/web/20160122100823/https://www.dr.dk> for an archived resource viewable via the Internet Archive's Wayback installation, the number 20160122100823 represents the archival time 2016-01-22T10:08:23Z. In other installations, the most precise timestamp may be found in the URI from a search result leading to the resource (which usually redirects on basis of a call to the underlying archive index). Especially for web pages with frames, there may be cases where the actual time is not displayed with the source, since only the times for the contents of the frames are displayed.
- o precision-spec (part or page):
The precision specification specifies how the referred item should be regarded. A typical PWID URN reference in a paper would be 'page', where a tool will be needed to render the web page. Alternatively, the precision-spec can be 'part', which is the most precise reference since it reference a specific file where no additional calculations are needed (e.g. as part of a collection, a specific html file with hidden links or to indicate that a single image is referenced). In order to see whether a viewed browser page is a computed web page or a single file, browsers have a function "View page source" which is not activated if for single files).
- o archived-uri (archived URI):
The URI that was harvested by the web archive for the referenced resource.

A much easier way to construct PWID URNs is to use tools that construct them. Currently, there is also a prototype for a SOLR-Wayback tool (Source at <https://github.com/netarchivesuite/solrwayback>) [PWIDprovider], which can assist in finding the most precise reference to an archived web page. This Wayback version can provide all PWID URNs belonging to a shown page where the page PWID URN is provided at the top of the PWID URN list with 'part' precision, i.e. the page PWID URN can be taken replacing the 'part' with 'page' or all provided PWID URNs can be taken and e.g. used in a collection definition.

Security and Privacy:

Security and privacy considerations are restricted to accessible web resources in web archives. Resolvers to PWID URNs will usually only be possible using the web archives' access tools, where security and privacy are covered by these tools. In such cases, security and privacy will be as covered by these tools.

It should be noted that an archived web page or part could be just as dangerous as a "live" page or part; for instance, it could include insecure scripts, malware, trackers, etc. Furthermore, an archived page can in fact be more dangerous, because it could include outdated scripts with known vulnerabilities that can never be patched because the script is archived for all time in a vulnerable state.

Interoperability:

This is covered by comments in the Syntax description:

- o the PWID URN conforms to the URI standard defined as in [RFC3986] and the URN standard [RFC8141]
- o the 'archival-time' of the PWID URN conforms to the UTC timestamp as described in ISO8601 [ISO8601-1][ISO8601-2] and is in accordance with the WARC standard ISO 28500 [ISO28500].
- o for 'archived-uri', this URI conforms to the URI standard defined as in [RFC3986], with %-encodings of "[", "]", "#", "?" and "%" in order to conform to the URN standard [RFC8141] as well as having unambiguous use of "%"

Resolution:

The information in a PWID URN can be used for locating a web archive resource, for any kind of web archive. It includes the minimum information for web archive materials, which enables resolvability, manually or by a resolver. Resolution of a PWID URN is the primary motivation of making a formal URN definition, instead of just textual representation of the needed parts of a PWID.

Resolution is done based on the PWID parts. This can be done manually by using information from the PWID parts to lookup the web archive and use the web archives tools to search for the resource. It can also be done automatically by using the information from the PWID parts to construct an URI to locate the archived resource the internet (for online web archives) or a local restricted network (for web archives with access restrictions). The relevant information from the PWID parts are:

- o Web archive domain for web archive holding referred resource
The domain name for the web archive. For the manual solution, this domain is used to find a description of how to access the web archive's materials. For example, "archive.org" is the domain name leading to the Internet Archive's interface to their online web collection, and "netarkivet.dk" is the domain name leading to the website for the Danish web archive with information about how to apply for access permission to the web collections. For an automatic solution, the domain will be used to calculate the pattern for the URI for the resource.

- o Archived URI of archived resource
For the manual solution this domain, the archived URI for the resource must be used in search for the resource. For the automatic solution, this is used as a parameter for construction of the URI for the resource.
- o Date and time associated with the archived item
The archival date and time must be used in manual search for the resource or as parameter to automatic construction of the URI for the resource.
- o Precision of what is referred
The precision contributes to the guidance of how to view the referred item. If the precision is 'page', the resource must be browsed using the web archive browsing tool, which computes all parts needed for browsing of the page. If the precision is 'part', the "View page source" browser function can be used for pages to get the referred resource. If the resource is a single file (this option is not activated, since the full resource is already shown). The part precision can also be indicator for tools (e.g. a collection extraction tool) that they can fetch the contents by fetching the file pointed to.

In the following, the different resolution techniques are explained (manual as well as via a service) using the following PWID URN as an example:

```
urn:pwid:archive.org:2016-01-22T10:08:23Z:page:https://www.dr.dk
```

In this example the information from the URN PWID parts are:

- o "archive.org"
Current domain of the Internet Archive used for their open access web archive.
- o "2016-01-22T10:08:23Z"
UTC date and time associated with the archived URI
- o "page"
Clarification that the reference cover the full web page with all its inherited parts selected by the web archive
- o "https://www.dr.dk"
archived URI of the referenced resource

A manual resolution technique would be to go through the following steps using the specified web archive's search interface (which will work for both open web archives and web archives with restricted access onsite):

- o Browse the web archive domain "archive.org"
In this case, the domain leads directly into a page where you can search for archived URIs (in other cases there may be need for additional clicks to get to search interface or descriptions of how to apply for access).
- o Enter the archived URI "https://www.dr.dk" in the search field and make a search, which will result in an overview of the different times that the resource was archived.

- o Use the archival time "2016-01-22T10:08:23Z" to select the correct resource

The "page" information is used in verification that the right precision level is reached. In case the precision-spec had been 'part', it would require an extra step selecting "View page source" on the resulting page.

It is also noteworthy that the information in the PWID can help in finding an alternative resource, in case the original referred resource is no longer available. The archived URI can be searched in other web archives, where the date and time can help to find the best match, e.g. via Memento [MEMENTO] (for some open web archives) or via possible coming web archive infrastructures.

Alternative resolution (automatically or manually) of this URN PWID can be deduced based on the current (2019) knowledge of Internet Archive's open Wayback access web interface, which has the pattern:

```
https://web.archive.org/web/<time>/<uri>
```

Using this pattern (where only digits from the timestamp is included), it is possible to deduce the online https URI:

```
https://web.archive.org/web/20160122100823/https://www.dr.dk
```

The same recipe can be used for other Wayback platforms for open web archives. For web archives with restricted access, there may be similar recipes, but it may also require special applications to extract the local URI for the resource (e.g. for Netarkivet, it is constructed using an API which uses the local CDX to generate the correct local URI for the resource).

A resolving service is currently available in form of code for a prototype which run at the Royal Danish Library [PWIDresolver] and is planned to be more widely available. This service currently covers both the Danish web archive (with the proper rights) and open web archives with access services based on a pattern including archive, archival time and archived URI. In other words, for open web archives it covers conversion of PWID URNs for: archive.org, archive-it.org, arquivo.pt, bibalex.org, nationalarchives.gov.uk, stanford.edu and vefsafn.is. For the Danish web archive with restricted access, the prototype works locally accessing the CDX of the library, and providing access via a local proxy to a restricted environment. The source code for this prototype is available from <https://github.com/netarchivesuite/NAS-research/releases/tag/0.0.6>.

Documentation:

None relevant

Additional Information:

Background:

The PWID was originally suggested as a URI, based on research between a computer science researcher with knowledge of web archiving and researchers from humanity subjects (History and Literature). This resulted in the paper "Persistent Web References - Best Practices and

New Suggestions" [IPRES2016] from the iPres 2016 conference. In this paper, the PWID is referred to as WPID. However, feedback was received displaying a concern that WPID was interpreted as a PID related to a PID-system, e.g. as the DOI. Although the definition of a PID does not contradict the name "WPID", there would still be a danger of confusing it with PID-systems, which is not the intension. Consequently, this suggestion names the PWID instead. Comments on the drafted PWID URI ([DraftPwidUri]) have suggested that it should be a URN rather than a URI, which is why the PWID URN is defined here.

There has been expressed interest for the PWID at several occasions, where it has been presented (iPRES 2016 [IPRES2016] paper, RESAW 2017 [ResawRef][ResawColl] papers, iPRES 2018 [IPRES2018] best poster, iDCC 2019 [IDCC2019] poster. Especially, web researchers from digital humanities have expressed a strong interest in the PWID, since it will fill a gap and make it possible for the researchers to make the necessary references.

Limitations to when a PWID URN can be created:

It can be argued that the PWID URN should not have any restrictions to which material it can be applied. However, in order to make a standardized general way to identify material, there need to be assumptions on a set of information that can be used for identification.

The limits made are can also be argued to be essential for material that are to be referenced on a long time basis, to have information about which archive, when it was archived and what was archived.

Possible extensions to be investigated:

This first version of the PWID only contains a basic definition, which means that it does not include all of the possible extensions which have been suggested at different conferences. The reason is that these suggestions are not mature enough to be included at this stage. The extensions suggested so far have been:

- o Having web archives identified by registered identifiers. There will be work on looking at an update to the PWID URN, if there can be found a workable solution e.g. by making such a registry by IANA.
- o Having the possibility to use PWID for other web material than archived URIs, e.g. snapshots and collections
- o Discussion of how to extend use of PWID URNs via plugins in browsers, standardized way to ask web archives for resource specified as a PWID URN and access via future web research infrastructure

Revision Information:

This is the first version of PWID as a URN.

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