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J. Wackerow  
DDI Alliance  
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## A URN Namespace for the Data Documentation Initiative (DDI)

### Abstract

This document describes the Namespace Identifier (NID) "ddi" for Uniform Resource Names (URNs) used to identify resources that conform to the standards published by the Data Documentation Initiative (DDI) Alliance.

The DDI Alliance is not affiliated with the Internet Engineering Task Force (IETF) or Internet Society (ISOC). This Independent Submission is not a standard nor does it have IETF community consensus.

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## 1. Introduction

This document registers a formal Namespace Identifier (NID) for URNs associated with DDI resources in accordance with the process defined in [RFC8141].

The DDI Alliance is an international collaboration dedicated to establishing metadata standards and semantic products for describing social science data, data covering human activity, and other data based on observational methods. DDI specifications are free standards that document and manage different stages in the research data lifecycle, such as conceptualization, collection, processing, distribution, discovery, and archiving. Documenting data with DDI facilitates understanding, interpretation, and use -- by people, software systems, and computer networks.

The specifications DDI Codebook [DDI-C] and DDI Lifecycle [DDI-L] are expressed in XML Schema; DDI Extended Knowledge Organization System (XKOS) [DDI-XKOS] in OWL/RDF; Structured Data Transformation Language (SDTL) [DDI-SDTL] in JSON Schema; and the upcoming DDI Cross Domain Integration (DDI-CDI) in UML. DDI is aligned with other metadata standards like Dublin Core Metadata Initiative [DUBLINC]; Statistical Data and Metadata Exchange [SDMX] for exchanging aggregate data; ISO/IEC 11179 [IS11179] for building metadata registries, such as question, variable, and concept banks; and ISO 19115 [ISO.19115.2003] for supporting geographic information systems.

DDI URNs support reusability of DDI resources inside a single DDI instance and in a distributed network of DDI instances.

The DDI specification is developed and maintained by the DDI Alliance [DDI-ALL]. The DDI Alliance is a self-sustaining membership organization whose over 40-member institutions have a voice in the development of the DDI specifications. This memo describing the ddi URN is an informational specification. It is not a standard and is not the product of the IETF.

## 2. Conventions Used in This Document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

In this document, these words will appear with that interpretation only when in ALL CAPS. Lowercase uses of these words are not to be interpreted as carrying [RFC2119] significance.

DDI: Data Documentation Initiative. The single term is often used as a synonym for the DDI specification.

DDI agency: An organization that maintains DDI resources.

## 3. Specification

This section provides the information required to register a formal namespace according to the registration procedure defined in [RFC8141]. The URNs conform to the syntax defined in [RFC8141].

### 3.1. Declaration of Syntactic Structure

#### 3.1.1. Description

The Namespace Specific String (NSS) of all URNs using the "ddi" NID is a globally unique identifier consisting of the DDI agency-identifier (registration authority identifier), the identifier of the DDI resource (data identifier), and the version of the resource (version-identifier) [DDI-ID]. This structure is according to the International Registration Data Identifier (IRDI) defined in "Information technology - Metadata registries (MDR) - Part 6: Registration", Annex A [IS11179].

A description of the DDI resource identification is available in the Identification section of the "DDI Lifecycle 3.3 Technical Guide" [DDI-ID].

The DDI NSS has the following structure:

<agency-identifier>:<resource-identifier>:<version-identifier>

agency-identifier is the identifier of a DDI agency that maintains DDI resources. This identifier basically follows the rules of reversed domain names and is case insensitive. This way, the DNS resolution of DDI agency-identifiers is supported. The hierarchy of domains descends from the left to the right label in the name; each label to the right specifies a subdivision, or subdomain, of the domain to the left. The left-most label of agency-identifier conveys the top-level domain. It SHALL be a country code corresponding to ISO 3166 alpha-2 codes [ISO3166] or another top-level domain maintained by IANA [TLD]. All two-letter top-level domains are reserved for current and future ISO 3166 codes. Assignment of identifiers for DDI agencies in the requested namespace is managed by the DDI Alliance (see Section 3.5 on "Process of Identifier Assignment"). The next subdomain identifies the agency within that top-level domain. Further optional subdomains can follow. The top-level domain and possible subdomains are separated by the full stop character. The full stop character is not allowed within top-level domain names or subdomain names. The top-level domain and subdomains are composed from the limited set of characters for the preferred form of a DNS label ([RFC1035], Section 2.3.1). The length of the label and the full name are restricted by DNS rules ([RFC2181],

Section 11). The agency identifier is case insensitive ([RFC4343], Section 2).

resource-identifier is the identifier of a DDI resource of a DDI agency. The value MUST be unique in the scope of this DDI agency. The resource-identifier is case sensitive.

version-identifier is the version of a DDI resource of a DDI agency. The value MUST be unique in the scope of this resource. The resource version is case sensitive.

### 3.1.2. ABNF Grammar

The following syntax specification for the complete URN uses the Augmented Backus-Naur form (ABNF) as described in [RFC5234].

```
; Rules are case sensitive, if not stated otherwise.
ddi-urn          = urn separator ddi separator ddi-irdi
; urn is case insensitive, see [RFC8141].
urn              = "urn"
; ddi is the URN namespace identifier.
; ddi is case insensitive, see [RFC8141], Section 2.1.
ddi              = "ddi"
; ddi-irdi is the namespace specific string (NSS).
; ddi-irdi - international registration data identifier,
; see [IS11179] Annex A.2.
ddi-irdi         = agency-identifier separator
                  resource-identifier separator
                  version-identifier
; agency-identifier is case insensitive, see [RFC4343], Section 2.
; For allowed characters, see [RFC1035], Section 2.3.1.
; For length restrictions, see [RFC2181], Section 11.
agency-identifier = top-level-domain
                  sub-separator ddi-authority-id
                  *(sub-separator ddi-sub-authority-id)
                  ; length limit is 255 characters
                  ; see Section 11 of [RFC2181]
top-level-domain  = dns-label
ddi-authority-id  = dns-label
ddi-sub-authority-id = dns-label
dns-label         = (ALPHA / DIGIT)
                  [ *(ALPHA / DIGIT / "-")
                    (ALPHA / DIGIT) ]
                  ; length limit is 63 characters
                  ; see Section 11 of [RFC2181]
resource-identifier = restricted-string
                    *( "/" restricted-string )
version-identifier  = restricted-string
                    *( "/" restricted-string )
restricted-string   = 1*(unreserved / sub-delims / "@")
; Definitions for unreserved and sub-delims from
; [RFC3986], Section 2.2.
unreserved         = ALPHA / DIGIT / "-" / "." / "_" / "~"
sub-delims         = "!" / "$" / "&" / "'" / "(" / ")" /
                    "*" / "+" / "," / ";" / "="
separator          = ":"
sub-separator      = "."
; ALPHA and DIGIT are actually defined in the ABNF
; specification. They are declared here for convenience
; purposes.
ALPHA              = %x41-5A /          ; uppercase letters
                  %x61-7A          ; lowercase letters
DIGIT              = %x30-39          ; digits
```

Figure 1: ABNF Grammar

### 3.1.3. Regular Expression

The used syntax is the XML Schema flavor, which can be easily used in other flavors. These regular expressions implicitly anchor at the head and tail. The following regular expression syntax uses components (component names indicated by angle brackets, i.e. <component>) and is written in free-spacing mode for easier reading (the XML Schema flavor does not support that). Please note that use of multiple quantifiers in regular expressions can result in false outcomes due to so-called greediness. Therefore, there are separate regular expressions for the length restriction and other purposes for the components agency-identifier and dns-label.

```
ddi-urn          := [Uu][Rr][Nn] : [Dd][Dd][Ii] :  
                  <agency-identifier> :  
                  <resource-identifier> :  
                  <version-identifier>  
agency-identifier := <top-level-domain> \.  
                  <ddi-authority-id>  
                  (\. <ddi-sub-authority-id>)*  
agency-identifier := .{1,255}  
  
top-level-domain  := <dns-label>  
ddi-authority-id  := <dns-label>  
  
ddi-sub-authority-id := <dns-label>  
dns-label          := [A-Za-z0-9]([-A-Za-z0-9]*[A-Za-z0-9])?  
  
dns-label         := .{1,63}  
  
resource-identifier := <restricted-string>  
                  (/ <restricted-string>)*  
  
version-identifier := <restricted-string>  
                  (/ <restricted-string>)*  
  
restricted-string  := [A-Za-z0-9-._~!$&'()*+,@]+
```

### 3.1.4. Examples of DDI URNs

The examples are taken from the DDI Lifecycle 3.3 documentation [DDI-ID]. Please note that the resource-identifiers are simplified. In real applications, they are much longer for unique identification purposes. They don't relate to DDI types like the examples might suggest.

```
urn:ddi:us.ddial:R-V1:1
```

Figure 2: URN of a Represented Variable

The DDI represented variable identified by "R-V1" with the version "1" of the DDI agency "ddial" located in the domain "us" [DDI-EXRV].

```
urn:ddi:us.ddial:PISA-QS.QI-2:1
```

Figure 3: URN of a Question Item

The DDI question item identified by "PISA-QS.QI-2" with the version "1" of the DDI agency "ddial" located in the domain "us" [DDI-EXQU].

```
urn:ddi:int.ddi.cv:AggregationMethod:1.0
```

Figure 4: URN as Reference to a Controlled Vocabulary

The DDI controlled vocabulary identified by "AggregationMethod" with the version "1.0" in the scope of the DDI agency "ddi" and sub-agency

"cv" in the domain "int" [DDI-CVAG].

### 3.2. Relevant Ancillary Documentation

An introductory article on DDI can be found at [DDI-INTR].

Information on the DDI specifications (DDI-C, DDI-L, XKOS, Controlled Vocabularies, and SDTL) can be found in the standards section of the DDI Alliance website [DDI-ALL].

Information on domain names can be found in the relevant RFCs.

- \* For an overview, see [RFC1034].
- \* Regarding case insensitivity, see Section 2.3.3 of [RFC1035].
- \* Regarding syntax, see the "Lexical grammar" in the "Grammatical Host Table Specification" section of [RFC0952] and Section 2.1 of [RFC1123].
- \* Regarding size limits, see Section 2.1 of [RFC1123] and Section 2.3.4 of [RFC1035].

### 3.3. Identifier Uniqueness Considerations

Assignment of identifiers for DDI agencies in the requested namespace will be managed by the DDI Alliance, which will ensure that the assigned DDI agency-identifiers are consistent with the directives for unique identification of DDI agencies.

Assignment of URNs for resources of a DDI agency in the requested namespace will be managed by the respective DDI agency, which ensures that the assigned URNs are unique for the scope of the agency.

### 3.4. Identifier Persistence Considerations

Persistence of identifiers is dependent upon the suitable delegation of resolution at the level of the DDI agencies and the persistence of DDI agency assignment. The persistence of the referenced resource is also the responsibility of the DDI agency.

### 3.5. Process of Identifier Assignment

Assignment of identifiers for DDI agencies in the requested namespace is managed by the DDI Alliance. A registry for DDI agency identifiers ensures through an approval process that the syntax of agency-identifiers complies with the associated rules [DDI-REGI].

Assignment of URNs for resources of a DDI agency and sub-agencies of a DDI agency in the requested namespace will be managed by the respective DDI agency.

### 3.6. Process for Identifier Resolution

The DDI Alliance promotes a service discovery system for identifying available services connected to DDI agencies using the Domain Name System (DNS). A DNS request for a DDI agency within the domain ddi.urn.arpa is delegated by the DNS servers of the DDI Alliance to the DNS servers of the relevant DDI agency. The response is a list of available DDI services for the agency identifier under which the agency has assigned URNs. The approach is based on the Dynamic Delegation Discovery System (DDDS) [RFC3401] and especially the straightforward URI-enabled NAPTR (U-NAPTR) [RFC4848].

The DDI Alliance is responsible for operating or delegating resolution requests to the resolution servers of the relevant DDI

agencies. DDI agencies are responsible for operating or delegating resolution servers for the agency-identifier under which they have assigned URNs.

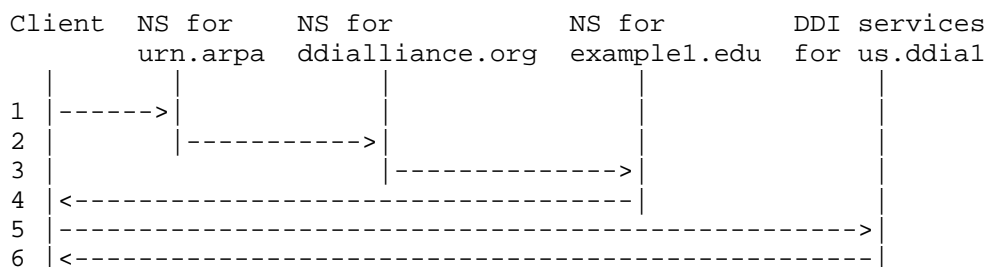


Figure 5: Sample Sequence Diagram for Receiving a List of DDI Services from the Example DDI agency "ddial"

1. The name server (NS) of IANA for the domain "urn.arpa." is reached with the request "ddial.us.ddi.urn.arpa." for the DDI agency "us.ddial".
2. The request is delegated to the name server for "ddialliance.org".
3. The request is delegated to the name server for "example1.edu" (domain of the DDI agency "us.ddial").
4. The server responds with a list of NAPTR records [RFC3403] pointing to available DDI services for the DDI agency "us.ddial".
5. The client selects an appropriate DDI service and sends a request for a DDI URN to this service.
6. The DDI service responds, for example, with a DDI object identified by the requested DDI URN.

See Appendix A for examples of name server records.

### 3.7. Rules for Lexical Equivalence

The DDI agency-identifier basically follows the rules of domain names. Domain names are case insensitive. Thus, the following portion of the URN is case insensitive for matches:

urn:ddi:<agency-id>:

The remainder of the identifier MUST be considered case sensitive.

### 3.8. Conformance with URN Syntax

The NSS conforms to the related section in [RFC8141]. It is composed from the limited set of characters for a URN NSS [RFC8141]. Percent-encoding is not used.

### 3.9. Validation Mechanism

The DDI Alliance will promote development of software for validation purposes.

### 3.10. Scope

The scope is global.

## 4. Namespace Considerations

There is no available namespace that will allow one to uniquely

identify and access DDI resources.

#### 4.1. URN Assignment Procedures

See Section 3.5, "Process of Identifier Assignment".

#### 4.2. URN Resolution/Delegation

See Section 3.6, "Process for Identifier Resolution".

It is RECOMMENDED that sub-agencies for flexible administration be used. For example, delegation of URNs of a sub-agency to different servers would be easily possible.

#### 4.3. Type of Resources To Be Identified

The DDI specifications define resources at a granular level, many of which can be identified by a DDI URN.

#### 4.4. Type of Services

Examples of potential services are listed below. The services and appropriate service tags need to be defined in the future. The mentioned service tags are from [RFC2483].

- \* DDI repository

I2R (URI to Resource): given a DDI URN return, one instance of the resource identified by that URN.

- \* DDI registry

I2C (URI to URC, Uniform Resource Characteristics are descriptions of resources): given a DDI URN return, a description or a summary of that resource.

- \* DDI URN resolution

I2L (URI to URL): given a DDI URN return, one URL that identifies a location where the identified DDI resource can be found.

I2Ls (URI to URLs): given a DDI URN return, one or more URLs that identify multiple locations of the identified DDI resource.

### 5. Community Considerations

#### 5.1. Open Assignment and Use of Identifiers

DDI agency-identifiers can be registered at the DDI Alliance. The DDI Alliance maintains a registry of the assigned values for the DDI agency-identifier used in the NSS. Information may be obtained from the following address: [secretariat@ddialliance.org](mailto:secretariat@ddialliance.org).

DDI agencies assign URNs and potential sub-agencies within the scope of the assigned DDI agency-identifiers.

See also Section 3.3 on "Identifier Uniqueness Considerations".

#### 5.2. Open Operation of Resolution Servers

The DDI Alliance operates publicly accessible name servers for the delegation of DNS requests within the domain `ddi.urn.arpa` to DNS servers of DDI agencies.

#### 5.3. Creation of Software for Service Discovery

The DDI Alliance promotes software for service discovery for identifying available services connected to DDI agencies using the Domain Name System (DNS). See also Section 3.6 on "Process for Identifier Resolution". A basic resolver library is available [DDI-RESO].

## 6. IANA Considerations

IANA has updated the "ddi" entry in the "Formal URN Namespaces" registry to reference this specification.

The following NAPTR record for the key "ddi" has been registered in the urn.arpa zone:

```
ddi IN NAPTR 100 10 "" "" "" registry.ddialliance.org.
```

Requests for the domain ddi.urn.arpa are delegated to the name servers of the DDI Alliance.

## 7. Security Considerations

URN:DDI identifiers are assigned to resources that are public information; therefore, resolving these identifiers has low security profile.

Registration of DDI agencies is approved by the DDI Alliance. Assignment and resolution of URN:DDI identifiers are controlled by the DDI Alliance and approved DDI agencies. The DDI Alliance SHALL have in place control mechanisms in order to make sure that DDI Agency applications from malicious third parties will not be accepted. URN:DDI resolvers will be protected against eavesdropping and attacks with appropriate tools.

This document introduces no additional technical security considerations beyond those associated with the use and resolution of URNs in general.

The security of the DNS-based resolution of DDI agency-identifiers is only as good as the security of DNS queries in general. A full discussion of the security threats pertaining to DNS and possible solutions can be found in [RFC3833]. Further information on security considerations regarding U-NAPTR can be found in [RFC4848], Section 6. "DNS Queries over HTTPS (DoH)" [RFC4848] could be used to increase security by preventing eavesdropping and manipulation of DNS data by machine-in-the-middle attacks. The HTTPS protocol encrypts the data between the DoH client and the DoH-based DNS resolver.

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## Appendix A. Example DNS Records

The examples use NAPTR [RFC3403] and SRV [RFC2782] [RFC3958] records. The values for the services and flags fields of the NAPTR records will be determined by the DDI application ([RFC3403], Section 9).

For a description of the packet format of NAPTR, see [RFC3403], Section 4.1.

### A.1. Delegation of the URN Namespace "ddi"

Example records below are defined at a.iana-servers.net and other authoritative name servers for the domain urn.arpa.

The empty flag indicates that the lookup is not terminal and the next probe to DNS is for more NAPTR records where the new domain is "dns.ddialliance.org".

```
; Delegation to name servers of ddialliance.org
;      order pref flag service regexp replacement
ddi.urn.arpa.
    IN NAPTR 100 10 "" "" "" dns.ddialliance.org.
```

### A.2. Delegation of DDI Agencies

Example records below are defined at dns.ddialliance.org for ddi.urn.arpa.

The empty flag indicates that the lookup is not terminal and the next probe to DNS is for more NAPTR records where the new domain is the DNS server of the relevant DDI agency.

```
; Delegation to name servers of subdomains in ddi.urn.arpa, i.e.
; DDI agencies.
;      order pref flag service regexp replacement
ddial.us.ddi.urn.arpa.
    IN NAPTR 100 10 "" "" "" dns.example1.edu.
ddia2.de.ddi.urn.arpa.
    IN NAPTR 100 10 "" "" "" dns.example2.org.
ddia3.gb.ddi.urn.arpa.
    IN NAPTR 100 10 "" "" "" dns.example3.ac.uk.
```

### A.3. DDI Services

Example records below are defined at dns.example2.org for

ddi.urn.arpa.

The "u" flag states that the rule is terminal and that the output is a URI that contains the information needed to contact that DDI service. The "s" flag states that the rule is terminal and that the output of the rewrite will be a domain name for which an SRV record SHOULD be queried. See also [RFC4848], Section 4.4.

The service I2R returns one instance of the resource identified by the given URN. That service is a repository of DDI resources available at `http://repos.example2.org/I2R/`; possibly a REST-based service. The service I2C returns a description of the resource identified by the given URN. That service is a registry of DDI resources available at `registry-udp.example2.org` port 10060.

U-NAPTR permits regular expressions of a form that does a complete replacement of the matched string with a URI, expressed as a constant string. With this limited form of regular expression ([RFC4848], Section 2.2), applications using NAPTR need not implement full regular expression parsers.

```
ddia2.de.ddi.urn.arpa.
;      order pref flag
IN NAPTR 100 10 "u" "I2R+http"          ( ; service
      "!.*!http://repos.example2.org/I2R/!"; regex
      .                                     ; replacement
      )
IN NAPTR 100 10 "s" "I2C+udp"          ( ; service
      ""                                     ; regex
      registry._udp.example2.org. ; replacement
      )

; all subdomains in ddia2.de.ddi.urn.arpa.
*.ddia2.de.ddi.urn.arpa.
ddia2.de.ddi.urn.arpa.
;      order pref flag
IN NAPTR 100 10 "u" "I2R+http"          ( ; service
      "!.*!http://repos.example2.org/I2R/!"; regex
      .                                     ; replacement
      )
IN NAPTR 100 10 "s" "I2C+udp"          ( ; service
      ""                                     ; regex
      registry._udp.example2.org. ; replacement
      )

;_service._protocol.name
; TTL      class SRV priority weight port targetreplac
_registry._udp.example2.org
14400 IN      SRV 0          0 10060 registry-udp.example2.org.
```

## Appendix B. Algorithm for DDI Service Discovery

The description is based on the Dynamic Delegation Discovery System (DDDS) algorithm [RFC3402].

The application selects the appropriate service from the output described below and contacts the service for the given URN.

The process can be optimized by an application cache for the NAPTR records of already requested DDI agencies.

### B.1. Application Unique String

The Application Unique String is a DDI URN.

### B.2. First Well Known Rule

1. Extracting the characters between the second and third colon (the

agency-identifier).

2. Normalizing case of that string.
3. Reversing the order of the substrings separated by dots.
4. Appending the string ".ddi.urn.arpa" to the end to get a domain name.

### B.3. Valid Databases

The DNS is specified as a DDDS Database for this application, which uses the NAPTR DNS resource records to contain the rewrite rules for service discovery.

The DNS is queried for NAPTR records for the domain name, which is the output of the First Well Known Rule.

### B.4. Expected Output

The expected output is the information necessary to connect to one or more authoritative servers (host, port, protocol, or URL) for an application service within a given DDI agency. The result is a list of terminal NAPTR records pointing to services available for the relevant DDI agency.

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### Author's Address

Joachim Wackerow  
c/o The Data Documentation Initiative Alliance (DDI Alliance)  
ICPSR, University of Michigan  
PO Box 1248  
Ann Arbor, MI 48106-1248  
United States of America  
Email: joachim.wackerow@posteo.de, secretariat@ddialliance.org  
URI: ddialliance.org