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Registration Data Access Protocol Object Inventory Analysis draft-ietf-weirds-object-inventory-01

Abstract

WHOIS output objects from registries (including both Regional Internet Registries (RIRs) and Domain Name Registries (DNRs)) were collected and analyzed. This document describes the statistical analysis process and result of existing WHOIS information. The purpose of this document is to build an object inventory to facilitate discussions of data objects included in Registration Data Access Protocol (RDAP) responses.

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[1.](#) Introduction

RIRs and DNRs have historically maintained a lookup service to permit public access to some portion of the registry database. Most registries offer the service via the WHOIS protocol [[RFC3912](#)], with additional services being offered via world wide web pages, bulk downloads, and other services, such as RPSL [[RFC2622](#)].

Although the WHOIS protocol specified in [[RFC3912](#)] is widely adopted and supported, it has several shortcomings that limits its usefulness to the evolving needs of the Internet community. For example, the WHOIS protocol has not been Internationalized, it does not consistently support Internationalized Domain Name (IDN, described in [[RFC5890](#)]); WHOIS has no query and response format; and WHOIS protocol does not support user authentication, access control for differentiated access.

This document is aimed to build an object inventory to facilitate discussions of registration data objects. Based on this statistics result, it may help to form and specify the RDAP response format.

In number space, there are altogether 5 RIRs. All RIRs provide information about IP addresses, Autonomous System Number (ASNs) and contacts, the data model used is different for each RIR. In domain name space, there are now over 200 ccTLDs and 21 gTLDs. Different domain name registries may have different WHOIS response objects and formats. A common understanding of all these data formats is critical.

This document describes the WHOIS data collection procedures and gives a data object inventory analysis based on the collected data from 5 RIRs and 106 ccTLDs and 18 gTLDs from DNRs. The RIR data objects are classified into IP address, ASN, person or contact and the organization that held the resource. The DNR data objects are classified into domain, contact, nameserver and registrar related objects. Other objects that do not belong to above categories are viewed as private designed objects. In this document, we are not intended to analyze all the query and response types existed in RIRs and DNRs. The most common query objects will be discussed, other objects such as RPSL data structure used by Internet Routing Registries (IRRs) will be added at a later time if the community feels it is necessary.

Since this is a document with statistics analysis and there are no protocol specifications, the [[RFC2119](#)] language does not apply.

2. Terminology

- o Data element -- The name of specific response object.
- o Label -- Different registries may have different naming ways for the same data element. So there may be several labels with the same meaning and belong to one group of data element.
- o Most popular label -- The label which is most supported by the registries.
- o Number of labels -- The number of different labels.
- o Total count -- The number of registries that support a certain data element.

3. Methodology

WHOIS information, including port 43 response and web response data, is collected following the procedures described below.

RIR objects collection process:

- (1) The process of RIR data collection is relatively easy. There are altogether 5 RIRs which are AFRINIC, APNIC, ARIN, LACNIC and RIPE NCC. All the RIRs provide information of IPs, ASNs and contacts. Find the 5 RIR WHOIS servers firstly.
- (2) Query the corresponding IPs, ASNs, contacts and organizations registered in 5 RIRs and make a comparative analysis of the responses data.
- (3) Data elements with the same meaning, but using different labels, are grouped together.

DNR objects collections process:

- (1) A programming script is applied to collect port 43 response data from 294 ccTLDs. "nic.ccTLD" is used as the query string which is usually registered in a domain registry. Responses of 106 ccTLDs were received. 18 gTLDs' port 43 response data is collected from their contracts with ICANN. So the sample size of port 43 WHOIS response data is 124 registries in total.

- (2) WHOIS data from web is collected manually from the 124 registries that have port 43 WHOIS responses.
- (3) Some of the responses which are collected by program may not seem to be correct. So data of top 10 ccTLD registries, like .de, .eu and .uk etc., was re-verified by querying domain names other than "nic.ccTLD".
- (4) In accordance with the specification 4 of new gTLD applicant guide book, [RFC5730], [RFC5731], [RFC5732] and [RFC5733], the response data objects are classified into public and other data objects. Public data objects are those which are defined in the above two documents. Other objects are those which are self designed data elements or objects in different registries.
- (5) Data elements with the same meaning, but using different labels, are grouped together. The numbers of registries that support the data elements is calculated in the total count column.

4. RIR Objects Analysis

4.1. WHOIS Data of Organizations Holding a Resource

The following table shows the organization objects of 5 RIRs.

RIR	AFRINIC	APNIC	ARIN	LACNIC	RIPE NCC
Objects					
Organization name	Organization	role	Name	Owner	org-name
Organization ID	org-name	nic-hdl	Handle	owner-id	organization
Company Name of person responsible	NA	NA	Company NA	NA	NA
Type of organization	org-type	NA	NA	NA	org-type
Country Postal Address	country address	country address	country address	country address	NA address
City State	NA	NA	city StateProv	NA	NA
Postal Code	NA	NA	PostalCode	NA	NA
Phone	phone	phone	phone	phone	phone

Fax Number	fax-no	fax-no	NA	NA	fax-no
ID of administrative contact	admin-c	admin-c	NA	owner-c	admin-c (multiple)
ID of technical contact	tech-c	tech-c	NA	tech-c	tech-c (multiple)
Reference of maintainer	mnt-ref	NA	NA	NA	mnt-ref
Reference of maintainer	mnt-by	mnt-by	NA	NA	mnt-by
Remarks	remarks	remarks	NA	NA	remarks
Date of record creation	NA	NA	RegDate	created	NA
Date of record changed	NA	changed (multiple)	Updated	changed	NA
List of resources	NA	NA	NA	list of resources	NA
Source Reference	source	source	NA	NA	source
	NA	NA	Ref	NA	NA

WHOIS Data of Organizations Holding a Resource

4.2. WHOIS Data of Contact

The following table shows the contact objects of 5 RIRs.

RIR Objects	AFRINIC	APNIC	ARIN	LACNIC	RIPE NCC
Name	person	person	Name	person	person
Company	NA	NA	Company	NA	NA
Postal Address	address	address	Address	address	address
City	NA	NA	City	NA	NA
State	NA	NA	StateProv	NA	NA
Postal Code	NA	NA	PostalCode	NA	NA
Country	NA	country	Country	country	NA
Phone	phone	phone	Phone	phone	phone
Fax Number	fax-no	fax-no	NA	NA	fax-no
Email	e-mail	e-mail	Email	e-mail	NA

ID	nic-hdl	nic-hdl	Handle	nic-hdl	nic-hdl
Remarks	NA	remarks	NA	NA	remarks
Notify	NA	notify	NA	NA	NA
ID of maintainer	mnt-by	mnt-by	NA	NA	mnt-by
Registration Date	NA	NA	RegDate	created	NA
Registration update	NA	changed	Updated	changed	NA
Source	source	source	NA	NA	source
Reference	NA	NA	Ref	NA	NA

WHOIS Data of Contact

4.3. WHOIS Data of IP

The following table shows the IP address objects of 5 RIRs.

RIR	AFRINIC	APNIC	ARIN	LACN	RIPE NCC
Objects				IC	
IP address range	inetnum	inetnum	NetRange	NA	inetnum
IPv6 address range	inet6num/i netnum	inet6num/i netnum	CIDR	inet num	inet6num/i netnum
Description	descr	descr	NA	NA	descr
Remarks	NA	NA	NA	NA	remarks
Origin AS	NA	origin (on route/6)	OriginAS	Orig inAS (future)	origin (on route/6)
Network name/ID	netname	netname	NetName NetHandle	inet rev	netname
Maintainer	NA	mnt-irt	NA	NA	NA
Maintainer	mnt-ref	NA	NA	NA	NA
Administrative contact	admin-c	admin-c	OrgId	owne rid	admin-c
Parent range	parent	NA	Parent	NA	NA

Status	status	status	NetType	stat	status
Registration Date	NA	NA	RegDate	us created	NA
Registration update	NA	changed (multiple)	Updated	changed	NA
Reference	NA	NA	Ref	NA	NA
ID organization holding the resource	org	NA	OrgId	owner	organisation
Referral server	NA	NA	Referral Server	NA	NA
Technical contact	tech-c	tech-c	OrgTechHandle	tech-c	tech-c (multiple)
Abuse contact	NA	NA	OrgAbuseHandle	abuse-c	abuse-mailbox
Referral technical contact	NA	NA	RTechHandle	NA	NA
Referral abuse contact	NA	NA	RAbuseHandle	NA	NA
Referral NOC contact	NA	NA	RNOCHandle	NA	NA
Name server	NA	NA	NA	nsrver	NA

WHOIS Data of IP

4.4. WHOIS Data of ASN

RIR Objects	AFRINIC	APNIC	ARIN	LACNIC	RIPE NCC
Description	descr	descr	NA	NA	descr
Organization	organisation	NA	OrgId	owner	org

Comment	NA	NA	Comment	NA	remarks
Administrative	admin-c	admin-c	ASHandle	owner-id	admin-c
contact ID					
Technical	tech-c	tech-c	OrgTechHandle	routing-c	tech-c (multiple)
contact ID					
Organization ID	NA	nic-hdl	NA	owner-c	organization
Notify	NA	notify	NA	NA	NA
Abuse	NA	NA	OrgAbuseHandle	abuse-c	NA
contact					
Maintainer	mnt-by	mnt-by	NA	NA	mnt-by
Maintainer	mnt-lower	NA	NA	NA	mnt-lower
Maintainer	NA	NA	NA	NA	mnt-ref
Registration Date	NA	NA	RegDate	created	NA
Registration update	NA	changed (multiple)	Updated	changed	NA
Source	source	source	NA	NA	source

WHOIS Data of ASN

4.5. Conclusion

As it can be observed, for each object (Organization, Contact Person, Net-num and ASN) there are fields that are unique to only one or a set of RIRs and there are fields that have the same meaning but are referred differently for each RIR. In order to construct a single data model for each object a selection of the most common and useful fields was made. That initial selection was the starting point of the previous document of [[I-D.ietf-weirds-json-response](#)].

5. DNR Objects Analysis

5.1. Overview

WHOIS data is collected from 124 registries, including 106 ccTLDs and 18 gTLDs. All the 124 registries support domain query. Among 124 registries, 8 ccTLDs and 15 gTLDs support contact query. 10 ccTLDs and 18 gTLDs support name server query. 4 ccTLDs and 18 gTLDs support registrar query. Domain WHOIS data contains 68 data elements that use a total of 550 labels. There are total 392 other objects for Domain WHOIS data. The raw data can be accessed with the following link: WHOIS Statistics Data File [[Stat-Data-File](#)]

5.2. Public Objects

As mentioned above, public objects are those data elements selected according to new gTLD application guide book, [RFC5730], [RFC5731], [RFC5732] and [RFC5733]. They are generally classified into four categories: domain, contact, nameserver and registrar related information.

5.2.1. WHOIS Data of Domain

WHOIS data of domain includes "Domain Name", "Creation Date", "Domain Status", "Expiration Date", "Updated Date", "Domain ID", "DNSSEC" and "Last Transferred Date". The following table gives the element name, most popular label and corresponding numbers of TLDs and labels.

Data Element	Most Popular Label	No. of TLDs	No. of Labels
Domain Name	Domain Name	118	6
Creation Date	Created	106	24
Domain Status	Status	95	8
Expiration Date	Expiration Date	81	21
Updated Date	Modified	70	20
Domain ID	Domain ID	34	5
DNSSEC	DNSSEC	14	4
Last Transferred Date	Last Transferred Date	4	3

WHOIS Data of Domain

Analyzing the above data, about 95.16% of the 124 registries support "Domain Name" data element; 85.48% of the 124 registries support "Creation Date" data element; 76.61% of the 124 registries support "Domain Status" data element. On the other hand, some elements such as "DNSSEC" and "Last Transferred Date" are only supported by 11.29% and 3.23% of all the registries separately.

5.2.2. WHOIS Data of Contact

In domain name space, contacts are typically divided into registrant, administrative contact, technical contact and billing contact.

5.2.2.1. Registrant

The following table shows all the contact information of registrant. 14 data elements are listed below.

Data Element	Most Popular Label	No. of TLDs	No. of Labels
Registrant Name	Name	65	7
Registrant Email	Registrant Email	59	7
Registrant ID	Registrant ID	50	12
Registrant Phone	Registrant Phone	48	6
Registrant Fax	Registrant Fax	44	6
Registrant Organization	Registrant Organization	42	4
Registrant Country Code	Country	42	6
Registrant City	Registrant City	38	4
Registrant Postal Code	Registrant Postal Code	37	5
Registrant State/Province	Registrant State/Province	32	4
Registrant Street	Registrant Street1	31	16
Registrant Country	Registrant Country	19	4
Registrant Phone Ext.	Registrant Phone Ext.	18	2
Registrant Fax Ext	Registrant Fax Ext	17	2

Registrant

Among all the data elements, "Registrant Name", "Registrant Email" and "Registrant ID" are the top 3 data elements.

5.2.2.2. Admin Contact

The following table shows all the contact information of administrative contact. 14 data elements are listed below.

Data Element	Most Popular Label	No. of TLDs	No. of Labels
Admin Street	Address	64	19
Admin Name	Admin Name	60	9
Admin Email	Admin Email	54	12
Admin ID	Admin ID	52	16
Admin Fax	Admin Fax	44	8
Admin Phone	Admin Phone	43	9
Admin Organization	Admin Organization	42	9
Admin Country Code	Country	42	7
Admin City	Admin City	35	5

Admin Postal Code	Admin Postal Code	35	7	
Admin State/Province	Admin State/Province	28	5	
Admin Country	Admin Country	17	5	
Admin Phone Ext.	Admin Phone Ext.	17	3	
Admin Fax Ext.	Admin Fax Ext.	17	3	
+-----+-----+-----+-----+				

Admin Contact

Among all the data elements, "Admin Street", "Admin Name" and "Admin Email" are the top 3 data elements.

[5.2.2.3.](#) Tech Contact

The following table shows all the information about domain name technical contact. 14 data elements are listed below.

Data Element	Most Popular Label	No. of	No. of	
		TLDs	Labels	
+-----+-----+-----+-----+				
Tech Email	Tech Email	59	9	
Tech ID	Tech ID	55	16	
Tech Name	Tech Name	47	6	
Tech Fax	Tech Fax	45	9	
Tech Phone	Tech Phone	45	10	
Tech Country Code	Country	43	9	
Tech Organization	Tech Organization	39	7	
Tech City	Tech City	36	4	
Tech Postal Code	Tech Postal Code	36	7	
Tech State/Province	Tech State/Province	30	4	
Tech Street	Tech Street1	27	16	
Tech Country	Tech Country	18	5	
Tech Fax Ext	Tech Fax Ext	18	3	
Tech Phone Ext.	Tech Phone Ext.	13	3	
+-----+-----+-----+-----+				

Tech Contact

Among all the data elements, "Tech Email", "Tech ID" and "Tech Name" are the top 3 data elements.

[5.2.2.4.](#) Billing Contact

The following table shows all the information about domain name billing contact. 14 data elements are listed below.

Data Element	Most Popular Label	No. of TLDs	No. of Labels
Billing Name	Name	47	5
Billing Fax	Fax	43	6
Billing Email	Email Address	42	7
Billing Country Code	Country	38	4
Billing Phone	Phone Number	34	6
Billing ID	Billing ID	28	9
Billing City	Billing City	28	4
Billing Organization	Billing Organization	28	5
Billing Postal Code	Billing Postal Code	27	4
Billing	Billing	21	4
State/Province	State/Province		
Billing Street	Billing Street1	19	13
Billing Country	Billing Country	13	5
Billing Phone Ext.	Billing Phone Ext.	10	2
Billing Fax Ext	Billing Fax Ext	10	2

Billing Contact

Among all the data elements, "Billing Name", "Tech Fax" and "Billing Email" are the top 3 data elements.

5.2.3. WHOIS Data of Nameserver

114 registries (about 92% of all the 124 registries) have the nameserver data element in their WHOIS response. But there are 63 different labels for this element. Top 3 labels for this element are Name Server which is supported by 25% of all the registries, Name Servers which is supported by 16% of all the registries and nserver which is supported by 12% of all the registries.

Data Element	Most Popular Label	No. of TLDs	No. of Labels
NameServer	NameServer	114	63

WHOIS Data of Nameserver

Some registries have nameserver elements such like "nameserver 1", "nameserver 2" till "nameserver n". So there are more labels than of other data elements.

5.2.4. WHOIS Data of Registrar

There are three data elements about registrar information.

Data Element	Most Popular Label	No. of TLDs	No. of Labels
Sponsoring Registrar	Registrar	84	6
Created by Registrar	Created by	14	3
Updated by Registrar	Last Updated by Registrar	11	3

WHOIS Data of Registrar

67.7% of the registries have sponsoring registrar data element. Elements such as "Created by Registrar" and "Updated by Registrar" are supported by 11.3% and 8.9% of the registries.

5.3. Other Objects

So called other objects are those data elements that are self-designed or are difficult to be classified. There are 392 other objects altogether. The following tables lists the top 50 other objects according to the data collection result.

Data Element	No. of TLDs
Registrant	41
Phone	32
Technical contact	26
Administrative contact	15
source	14
fax-no	13
nic-hdl	13
Billing Contact	12
referral url	11
e-mail	10
WHOIS server	9
Admin Contact	9
Type	9
Website	9
zone-c	8
remarks	7

Registration URL	6
anonymous	6
anniversary	6
hold	6
nsl-id	6
obsoleted	6
Customer Service Contact	5
Customer Service Email	4
Registrar ID	4
org	4
person	4
Maintainer	4
Nombre	3
Sponsoring Registrar IANA ID	3
Trademark Number	3
Trademark Country	3
descr	3
url	3
Postal address	3
Registrar URL	3
International Name	3
International Address	3
Admin Contacts	2
Contractual Language	2
Date Trademark Registered	2
Date Trademark Applied For	2
IP Address	2
Keys	2
Language	2
NIC handle	2
Record maintained by	2
Registration Service Provider	2
Registration Service Provided By	2
Registrar URL (registration services)	2

Top 50 Other Objects

Some elements like "Registrant" are difficult to be classified into any categories. A few registries have two levels of data elements, for example:

Registrant:

Name:

Email:

...

We do not think the first level of elements belong to any part. So they are put into the scope of other objects.

Some other data elements, like "Remarks", "anniversary" and "Customer service Contact" etc., are designed particularly for their own purpose by different registries.

5.4. Conclusion

5.4.1. Preliminary Statistics

Some preliminary statistics conclusion could be drawn from the raw data.

- o All of the 124 domain registries have the object names in their responses although they are in various formats.
- o Of the 118 whois services contacted, 65 registries show their registrant contact. About half of the registries (60 registries) support admin contact information. There are 47 registries, that is about one third of the total number, have technical and billing contact information. And only 7 of all the 124 registries give their abuse email in remarks part. No explicit abuse contact information is provided.
- o There are mainly two presentation formats. One is key:value, the other is data block format. Example of key-value format:

Domain Information

Query: na-nic.com.na

Status: Delegated

Created: 17 Apr 2004

Modified: 14 Nov 2010

Expires: 31 Dec 9999

Name Servers: oshikoko.omadhina.net

ns1.na.afrisp.net

ns2.na.afrisp.net

...

Example of data block format:

Whois database
domain nic.vg

Domain Name nic.vg
Registered 1998-09-02
Expiry 2012-09-02

Resource Records

a 195.153.6.27
mx 10 terpsichore.william.org
www a 195.153.6.27

Contact details

Registrant,
Technical Contact,
Billing Contact,
Admin. Contact AdamsNames Reserved Domains (i)
These domains are not available for registration
United Kingdom
Identifier: neams048s

Servidor Whois de NIC-Venezuela (.VE)

Este servidor contiene informacion autoritativa exclusivamente
de dominios .VE Cualquier consulta sobre este servicio, puede
hacerla al correo electronico whois@nic.ve

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- o 11 registries give local script responses. The WHOIS information of other registries are all represented in English.

5.4.2. Data Elements Analysis

Top 10 data elements are as follows:

Data Element	No. of TLDs
Domain Name	118
Name Server	114
Creation Date	106
Domain Status	95
Sponsoring Registrar	84
Expiration Date	81
Updated Date	70
Registrant Name	65
Admin Street	64
Admin Name	60

Top 10 Data Elements

Most of the domain related WHOIS information is included in the top 10 data elements. Other information like name server and registrar name are also supported by most registries.

We did a cumulative distribution analysis of all the data elements.

- (1) About 5% of data elements are supported by over 111 (90%) registries.
- (2) About 30% of data elements are supported by over 44 (35%) registries.
- (3) About 60% of data elements are supported by over 32 (26%) registries.
- (4) About 90% of data elements are supported by over 14 (11%) registries.

From the above result, we can conclude that only a few registries support all the public objects, most of the registries support just parts of all the objects.

5.4.3. Labels Analysis

The top 10 labels of different data elements include:

Labels	No. of Labels
Name Server	63
Creation Date	24

	Expiration Date		21	
	Updated Date		20	
	Admin Street		19	
	Tech ID		18	
	Registrant Street		16	
	Admin ID		16	
	Tech Street		16	
	Billing Street		13	
+-----+-----+				

Top 10 Labels

As explained above, name server label is a unique example that many registries define the name server elements from "nameserver 1" till "nameserver n". So label numbers of name server are much more than other elements. Other elements about date, street name have more labels.

A cumulative distribution analysis of label numbers was done. About 90% of data elements have more than 2 Labels. So it is very necessary to specify a standard and unified format for object names of WHOIS response.

5.4.4. Other Objects Analysis

According to statistics result, there are 392 other data objects in total that are not easy to be classified or privately owned by various registries. Top 50 other objects are listed in the table in [section 4.3](#). You can find that various different objects are designed for some particular purpose. So in order to ensure uniqueness of JSON names used in the Restful Whois service, establishing an IANA registry is a necessary requirement.

5.5. Limitation

- o The input "nic.ccTLD" maybe is not a good choice.
 - o The classification of local script data elements may not be accurate. 11 registries give local script responses.
 - o The extension data elements are used randomly by different registries. It is difficult to do statistical analysis.
 - o Sample sizes of contact, name server and registrar queries are small.
- * We only use "Whois contactID/nameserver/registrar" as the query commands to check.

- * Some registries may not support contact, name server or registrar queries.
- * Some may not support query contact by ID.
- * Contact information of some registries may be protected.

6. IANA Considerations

This document does not specify any IANA actions.

7. Security considerations

This document does not provide any other security services or introduce any additional considerations.

8. Acknowledgements

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Appendix A. Change Log

Initial -00: Adopted as working group document.

-01:

- * Added Change Log section.
- * Added RIR data objects.
- * Exchanged [section 2](#) and [section 3](#).

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