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# RESTful Provisioning Protocol (RPP) - Requirements

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## Abstract

This document describes the requirement for the development of the RESTful Provisioning Protocol (RPP).

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## Table of Contents

1. Introduction	3
2. Terminology	3
3. Conventions Used in This Document	3
4. General	4
5. HTTP	4
6. REST	5
7. Data Model	5
8. Data Representation	6
9. Operations and responses	6
10. Discoverability	7
11. EPP compatibility	8
12. Security	9
13. Extensibility	9
14. Scalability	11
15. Performance	11
16. Internationalisation	11
17. Clients	11
18. Requirements for object types	12
18.1. Domain Object Type	12
18.1.1. Internationalisation	12
18.2. Host Object Type	12
18.3. Contact Object Type	12
18.3.1. Data Representation	12
18.3.2. Internationalisation	12
19. New features	12
20. IANA Considerations	13
21. Internationalization Considerations	13
22. Security Considerations	13

<a href="#">23. Appendix A. Extensions</a>	13
<a href="#">24. Normative References</a>	13
<a href="#">Authors' Addresses</a>	15

## 1. Introduction

This document describes the set of requirements for the RESTful Provisioning Protocol (RPP), an Application Programming Interface (API) for provisioning objects in a shared database. RPP is based on the HTTP [\[RFC9110\]](#) protocol and the architectural principles of [\[REST\]](#).

## 2. Terminology

In this document the following terminology is used.

REST - Representational State Transfer ([\[REST\]](#)). An architectural style.

RESTful - A RESTful web service is a web service or API implemented using HTTP and the principles of [\[REST\]](#).

EPP RFCs - This is a reference to the EPP version 1.0 specifications [\[RFC5730\]](#), [\[RFC5731\]](#), [\[RFC5732\]](#) and [\[RFC5733\]](#).

RESTful Provisioning Protocol or RPP - The protocol described in this document.

URL - A Uniform Resource Locator as defined in [\[RFC3986\]](#).

Resource - An object having a type, data, and possible relationship to other resources, identified by a URL.

RPP client - An HTTP user agent performing an RPP request

RPP server - An HTTP server responsible for processing requests and returning results in any supported media type.

## 3. Conventions Used in This Document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [\[RFC2119\]](#).

## 4. General

**R1.1.** A well defined architecture **MUST** be defined for RPP, including a description of the responsibilities of the defined protocol layers.

**R1.2.** RPP **MUST** provide a clear, clean, easy to use and self-explanatory interface that can easily be integrated into existing software systems.

//TODO: [Issue #3](#)

**R1.3.** Wherever applicable RPP **SHOULD** leverage existing best practices and well adopted standards for building and documenting RESTful APIs. There **MUST** be a clear justification when deviating from this.

**R1.4.** RPP **MUST** include support for application level status codes, and **MAY** reuse the EPP status codes defined in [\[RFC5730\]](#).

**R1.5.** RPP **MAY** include support for providing detailed information about application status codes, for example as described in [\[RFC7807\]](#)

**R1.6** RPP **SHOULD** support additional information about a successful operation (information or warning) to convey additional information to the client for example about deprecation or partial success.

## 5. HTTP

**R2.1.** The Hypertext Transfer Protocol (HTTP) [\[RFC9110\]](#) **MUST** be used as the transport mechanism for RPP.

**R2.2.** RPP **SHOULD** use the best common practices for designing HTTP based applications, described in [\[BCP56\]](#). There **MUST** be a clear justification when deviating from this.

**R2.3.** Consistent, predictable and meaningful URL structures **MUST** be used for identifying, accessing object resources and enable request routing.

**R2.4.** RPP **MUST** use the existing HTTP status codes and **MUST** define application level status codes and map these to HTTP status codes. RPP **MUST NOT** redefine existing HTTP status code semantics and when overloading (generic) HTTP status codes with multiple RPP status codes, the provided RPP status code **MUST** be used by the client to determine the exact nature of the problem.

## 6. REST

**R3.1.** The RPP architecture **MUST** use the principles of the [\[REST\]](#) architectural style. A RPP server **MUST** conform to at least level 2 of the [\[RICHARDSON\]](#) Maturity Model (RMM).

**R3.2** The RPP architecture **MUST** follow Resource-Oriented Architecture [\[ROI\]](#).

**R3.3.** The RPP specification **MUST** strive to minimise round trips between client and server. Approaches, where client would need to make multiple requests each time to discover resource URL or server capabilities in order to perform operation **SHOULD** be used sparingly and be always well justified.

**R3.4.** *Merged with R12.1*

**R3.5.** RPP specifications **SHOULD** incorporate a machine-readable and well-established API specification, such as [\[!@OpenAPI\]](#) or [\[RAML\]](#). This will facilitate documentation, testing, code generation, and user-friendly extension descriptions. RPP **MUST NOT** require what API specification technology is to be used. The RPP core documents and extension documents may also choose different API specification solutions, this choice is left to the document authors.

## 7. Data Model

**R4.1** The base data model structures **MUST** be data format agnostic. It **MUST** be possible to map the base data model to multiple data formats such as JSON, XML or YAML.

**R4.2** Commonly used EPP extensions **SHOULD** be added to the RPP core data model. An example of this is the DNSSEC extension.

**R4.3** RPP **MUST** allow an extension mechanism that allows clients to signal data omission or redaction, indicating data collected but not transmitted to the registry or redacted.

**R4.4** RPP **MUST** have mechanisms to define profiles to indicate:

- Required parts of the data model
- Mapping definition
- Functional subsets for compatibility.

//TODO: [Issue #15](#)

**R4.5** The RPP architecture **MUST** include loose coupling between the server and the client, allowing for non-coordinated introduction of non-breaking version changes on both sides.

**R4.6** A RPP server and client **MUST** in default ignore unknown properties of representations however there **MUST** be a mechanism for a client to signal that a strict handling is wished where unknown fields are treated as error.

## 8. Data Representation

**R5.1** RPP **MUST** use JSON as the default data format.

**R5.2** It **MUST** be possible to extended RPP to include support other data formats (e.g. XML, YAML).

**R5.3** Validation of request and response message **MUST** be supported for both clients and the servers, in order to determine if the content is valid and no required attributes are missing.

**R5.4** RPP **MUST** define a default media type however the protocol **SHALL** be extensible to enable support for other media types.

**R5.5** A client **MUST** be able to signal to the server what media type the server should expect for the request content and to use for the response content.

//removed: see <https://github.com/ietf-wg-rpp/rpp-requirements/issues/11> // **R5.6** RPP **MUST** support the use of server profiles to define required components of the data model and/or mapping definitions (see: R4.4).

**R5.7** RPP **SHOULD** consider mechanisms for supporting data formats outside of core RPP domain. Especially formats, which lose their properties if transformed, like Verifiable Credentials for contacts which are digitally signed.

**R5.8** RPP **MUST** support partial update of data objects.

**R5.9** RPP **MUST** support full update of data objects.

**R5.10** A generated RPP response representation that includes an object identifier (for example a contact handle) **MUST** also include a URL reference to the location of the object representation.

## 9. Operations and responses

**R6.1** RPP **MUST** include support for a client requesting different depth of data representations, depending on the use case:

- Minimal representation (ID, or ID+name)
- Full representation (all data of the object)
- Full representation + dereferenced referrals (for example domain with contact and host details)

**R6.2** RPP **MAY** return different representations of the same object in different contexts:

- GET request to the resource itself

- GET request to get a collection of objects
- Responses to PUT/POST/PATCH requests

**R6.3** The data representation in a RPP response **MUST** only contain data related to the object, transactional information **MUST** be represented as one or more separate HTTP headers.

## 10. Discoverability

**R7.1** RPP **MAY** include a bootstrap mechanism designed to allow clients to locate the network identifier for the RPP service of a registry operator, e.g. rpp.sidn.nl for the registry operator for the .nl ccTLD.

Solutions may include:

- IANA bootstrap Service Registry
- DNS TXT records

**R7.2** An RPP server **MUST** publish a service discovery document in the well-known directory, described in [RFC5785]. This document contains structured machine readable information that required or useful for the client to be able to generate valid RPP requests. The information may contain, but is not limited to:

- Available services,
- Used Extensions
- Versions used for services and extensions
- Environment name (production, test etc.)
- Server datetime
- Maintenance notices
- Supported profiles
- ...

//TODO: [Issue #8](#)

**R7.3** Server provided functionality, such as the set of supported profiles, languages or extensions, **MUST** discoverable using the discovery document.

**R7.4** RPP **MUST** support versioning of:

- The protocol itself
- Data object types
- Representations
- Operations
- Profiles

- Extensions

**R7.5** Versioning schema **MUST** carry information about breaking vs. non-breaking changes and allow clients to decide whether it is able to interact with the server. The versioning scheme **SHOULD** be like the scheme used for HTTP where minor version changes do not break compatibility.

**R7.5** Versions used by the RPP protocol and used extensions **MUST** be discoverable by the client.

**R7.6** Notices related to scheduled server maintenance timeslots **MAY** be included in the discovery document, this could be a human readable, non machine parsable character string.

//TODO: [Issue #9](#)

**R7.7** RPP **MAY** only support a subset of EPP functionality, the supported functionality **MUST** be discoverable by the client

**R7.8** *Removed*

//SEE: [Issue #21](#)

**R7.9** An RPP response that includes unique object identifiers, **MAY** also include URL references for these objects.

## 11. EPP compatibility

**R8.1** RPP **MUST** provide functional equivalents for core EPP functionalities related to domain name, host, and contact objects as defined in [\[RFC5731\]](#), [\[RFC5732\]](#) and [\[RFC5733\]](#).

**R8.2** The automatic or mechanical mapping or conversion between EPP and RPP data model **MUST** be possible.

**R8.3** Compatibility definitions for a RPP to EPP mapping **MAY** be defined in compatibility profiles (see: R4.4).

//TODO: [Issue #15](#)

**R8.4** RPP **MUST** include an extension framework able to define equivalents of most commonly used EPP extensions, which are not a part of core protocol (see: R4.2)

**R8.5** EPP password based Authorization Information defined in [\[RFC5731\]](#) and [\[RFC5733\]](#) **MUST** be supported in RPP.



**R8.6** RPP SHOULD support client\_id/password authentication to match EPP client authentication.

## 12. Security

**R9.1** RPP MUST support state-of-the-art authentication and authorization schemes allowing for easy integration in modern HTTP infrastructure.

**R9.2** RPP MUST support modern authentication and authorization standards (OAuth, OpenId Connect)

**R9.3** Support for an simplified and quicker object transfer process MAY be included, where approval from the losing registrar is to be obtained interactively by the registrant during the transfer process.

**R9.4** RPP MUST include an authorisation model/framework that goes beyond the current EPP password based Authorization Information (AuthInfo) used for object transfers. The following use cases MAY be supported:

- Object transfers without using an EPP password based Authorization Information
- Registrants using OpenID Connect can interactively allow DNS operator to update their NS records, directly in the registry database or indirectly using a registrar.

**R9.5** RPP MUST employ strong authentication and utilize encrypted transport (HTTPS) to protect sensitive data.

**R9.6** Security mechanisms SHOULD be flexible to allow operators to choose appropriate methods and support federated authentication scenarios.

**R9.7** RPP MAY include a mechanism for cryptographic verification of request and response messages as an additional security layer.

**R9.8** RPP MUST allowing for multiple user accounts linked to a single registrar, registrar user management MAY be delegated to an administrator account linked to a registrar, allowing for self service account management by the registrar.

**R9.9** RPP MUST support a granular authorization matrix, where one or more permissions are coupled to a user account. Allowing for the creation of different types of user accounts, such a readonly users only allowed to fetch data about existing objects, and power users allowed to create and modify objects.

**R9.10** RPP MUST allow users to update their credentials and enforce strong passwords and limited lifetime for passwords and other tokens.

## 13. Extensibility

**R10.1** The protocol MUST be extensible to accommodate new functionalities, data elements, and operations beyond the initial scope.

**R10.2** RPP MUST allow for flexibility in extending the data model e.g. adding new objects or a new attribute to an existing object MUST be possible.

**R10.3** RPP SHOULD promote standardisation of commonly used extension attributes.

**R10.4** Extensions for new operations on existing resources MUST be supported.

**R10.5** RPP MUST support extensions that define new status codes not already defined in the core RPP RFCs.

//TODO: [Issue #20](#)

**R10.6** RPP MUST support extensions adding new HTTP headers.

**R10.7** RPP SHALL have mechanisms to assure conflict avoidance when extending the protocol, including but not limited to data model, representations, operations, parameters, error codes and signalling. There MUST be a mechanism of conflict-free, non-coordinated extending in private/vendor discretion as well as a coordinated process for core, generic or shared elements.

//TODO: [Issue #10](#)

**R10.8** When a public registry for RPP extensions is required, then IANA MUST be used for this function.

**R10.9** RPP extensions MUST include support for versioning, the version of the extension supported by the server MUST be included in the discovery document.

//TODO: [Issue #11](#)

//dropped R10.10: see <https://github.com/ietf-wg-rpp/rpp-requirements/issues/20> // **R10.10** RPP status codes are maintained in an IANA registry for RPP status codes, these include all status codes defined in the core RPP RFCs and by any extension that is also a registered IANA RPP extension.

**R10.11** Extension designers or RPP implementers MAY add new status codes, if a newly created status code is generic enough to be useful for the wider RPP community, then the extension designer SHOULD register the new status code in the RPP IANA registry.

## 14. Scalability

**R11.1** RPP MUST be stateless and MUST NOT maintain application state on the server required for processing future RPP requests. Every client request needs to provide all the information required for the server to be able to successfully process the request. The client MAY maintain application session state, for example by using a JWT token.

**R11.2** RPP MUST support cacheability of responses, if applicable to the operation semantics and MUST not include transaction related identifiers and values.

**R11.3** RPP MUST support load balancing at the level of request messages (URL) and load balancing MUST be possible without processing HTTP body.

**R11.4** Every request message MUST at most contain a single object for the server to operate on, with the exception of operations that are explicitly defined as a bulk operation.

**R11.5** RPP MUST support asynchronous processing for operations on multiple objects, otherwise resource intensive or involving manual steps. The client request results in a confirmation of receipt and a means for retrieving the final completed processing result at a later time.

## 15. Performance

**R12.1** In order to minimise message sizes and needed processing RPP SHOULD be designed not to include a HTTP message body in the request or response when this is not necessary, for example when the required data can be transmitted using the URL and/or HTTP headers.

**R12.2** RPP MAY allow for common bulk operations, resource listing, and filtering capabilities. RPP MUST NOT mandate such functionalities where this may impact scalability or performance negatively.

**R12.3** *Removed*

## 16. Internationalisation

**R13.1** RPP MUST support internationalization, for object types and messages defined in the core protocol and extensions

**R13.2** RPP MUST support human-readable localized response messages.

## 17. Clients

**R14.1** RPP MUST support server applications as clients. This will be a primary use-case of registry/registrar integration.

**R14.2** RPP MUST support interaction from command-line tools or desktop applications capable of sending HTTP requests. These can be generic clients such as `curl` or Postman but also specialized RPP command line tools or scripts.

**R14.3** RPP SHOULD support web browsers as clients, such as SPA (single page applications) without any proxy backend between webbrowser and the RPP server.

**R14.4** RPP SHOULD support mobile applications as clients, also here through direct integration without any proxy backend.

## 18. Requirements for object types

### 18.1. Domain Object Type

#### 18.1.1. Internationalisation

**D13.1** RPP MUST support Internationalized Domain Names (IDNs) - both UTF-8 as well as Punycode representation of a domain name MUST be supported, however one of them MAY be chosen as primary for object URL

### 18.2. Host Object Type

### 18.3. Contact Object Type

#### 18.3.1. Data Representation

**C5.1** RPP SHOULD consider using JSContact [\[RFC9553\]](#) format for contact representation.

#### 18.3.2. Internationalisation

**C13.1** RPP MUST support internationalization (character encoding) for Contact objects in the following areas:

- name
- address data
- any other contact-related data containing human provided or readable text

**C13.2** RPP MUST support internationalised Email addresses [\[RFC6530\]](#) in Contact objects.

**C13.3** RPP MUST support multiple localised expressions of the same data, e.g. fields mentioned in C13.1 having both international and localised variants.

## 19. New features

//MWU: is there a difference between optional features and an extension? i would think so, we can define an optional feature in the core protocol but make it optional. an extension is defined after the completion of the core protocol and is also optional.

//PK: would you see it as a part of generic protocol requirements or an extension

//MWU: using a "MAY" right now it is optional feature but not an extension The server MAY support generating a representation of a historical overview for an object, e.g. show all events linked to the object (create, update ...). The historical time window is determined by server policy and MUST be included in the discovery service document.

## 20. IANA Considerations

TODO

## 21. Internationalization Considerations

TODO

## 22. Security Considerations

TODO

## 23. Appendix A. Extensions

// List of required extions here // see: <https://github.com/ietf-wg-rpp/rpp-requirements/issues/19>

**A.1** An extension for a Search API to allow for searching for objects in the registry database. Includes advanced search capabilities for object info request.

**A.2** An extension that allows a DNS operator to update the DNSSEC key material for a domain object. This extension MAY be used by the DNS operator to update the DNSSEC key material for a domain object, without the need for the registrar to be involved in this process.

TODO

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