      E.164 Number Mapping for the Extensible Provisioning Protocol (EPP)

Status of This Memo

   This document specifies an Internet standards track protocol for the
   Internet community, and requests discussion and suggestions for
   improvements. Please refer to the current edition of the "Internet
   Official Protocol Standards" (STD 1) for the standardization state
   and status of this protocol. Distribution of this memo is unlimited.

Abstract

   This document describes an Extensible Provisioning Protocol (EPP)
   extension mapping for the provisioning and management of E.164
   numbers that represent domain names stored in a shared central
   repository. Specified in XML, this mapping extends the EPP domain
   name mapping to provide additional features required for the
   provisioning of E.164 numbers.

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1. Introduction

   This document describes an E.164 number mapping for version 1.0 of
   the Extensible Provisioning Protocol (EPP). This mapping, an
   extension of the domain name mapping described in [1], is specified
   using the Extensible Markup Language (XML) 1.0, as described in [2],
   and XML Schema notation, as described in [3] and [4].

   The EPP core protocol specification [5] provides a complete
   description of EPP command and response structures. A thorough
   understanding of the base protocol specification is necessary to
   understand the mapping described in this document.

ENUM [6] describes how the Domain Name System (DNS) can be used to
identify services associated with an E.164 number. The EPP mapping
described in this document specifies a mechanism for the provisioning
and management of E.164 numbers stored in a shared central
repository. Information exchanged via this mapping can be extracted
from the repository and used to publish DNS resource records as
described in ENUM [6]. Examples used in this document were chosen
specifically to illustrate provisioning concepts for the example
resource records described in the ENUM specification.

1.1. 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 RFC 2119 [7].

In examples, "C:" represents lines sent by a protocol client, and
"S:" represents lines returned by a protocol server. Indentation and
white space in examples are only provided to illustrate element
relationships and are not a REQUIRED feature of this specification.

XML is case sensitive. Unless stated otherwise, XML specifications
and examples provided in this document MUST be interpreted in the
character case presented to develop a conforming implementation.

2. Object Attributes

This extension adds elements to the EPP domain name mapping [1].
Only new element descriptions are described here.

2.1. E.164 Domain Names

An E.164 domain name is a representation of an E.164 number that has
been translated to conform to domain name syntax, as described in the
ENUM specification [6]. The labels used to describe the name space
of an E.164 domain name are a policy matter that is beyond the scope
of this document.

2.2. NAPTR Fields

According to ENUM [6], Naming Authority Pointer (NAPTR) resource
records are used to identify available ways for contacting a specific
node identified by a domain name created from the translation of an
E.164 number. The basic NAPTR record format is described in RFC 3403
[8]. Rules for structuring and using NAPTR records for use with ENUM
are described in RFC 3761 [6].

Several NAPTR field values are optional per RFC 3403. RFC 3761
describes processing rules that require the presence of certain NAPTR
field values. This document describes field value requirements that
correspond to RFC 3761.

2.2.1. Order

The NAPTR order field, a 16-bit unsigned integer, is represented in
this mapping using the XML Schema "unsignedShort" data type.

2.2.2. Preference

The NAPTR preference field, a 16-bit unsigned integer, is represented
in this mapping using the XML Schema "unsignedShort" data type.

2.2.3. Flags

The NAPTR flags field is represented in this mapping using a single
character. The case of the flag character is not significant.

2.2.4. Service

The NAPTR service field is represented in this mapping using a
character string with an unspecified maximum length. Valid values
are application-dependent.

2.2.5. Regular Expression

The NAPTR regexp field is represented in this mapping using a
character string with an unspecified maximum length. This field can
contain numerous backslashes and should thus be treated with care.

2.2.6. Replacement

The NAPTR replacement field, whose value is a domain name, is
represented in this mapping using a character string with a maximum
length of 255 characters.

3. EPP Command Mapping

A detailed description of the EPP syntax and semantics can be found
in the EPP core protocol specification [5]. The command mappings
described here are specifically for use in implementing ENUM
provisioning processes via EPP.

3.1. EPP Query Commands

   EPP provides three commands to retrieve object information: <check>
   to determine if an object is known to the server, <info> to retrieve
   detailed information associated with an object, and <transfer> to
   retrieve object transfer status information.

3.1.1. EPP <check> Command

   This extension does not add any elements to the EPP <check> command
   or <check> response described in the EPP domain mapping [1].

3.1.2. EPP <info> Command

   This extension does not add any elements to the EPP <info> command
   described in the EPP domain mapping [1]. Additional elements are
   defined for the <info> response.

   When an <info> command has been processed successfully, the EPP
   <resData> element MUST contain child elements as described in the EPP
   domain mapping [1]. In addition, the EPP <extension> element MUST
   contain a child <e164:infData> element that identifies the extension
   namespace and the location of the extension schema. The <e164:
   infData> element contains one or more <e164:naptr> elements that
   contain the following child elements:

   - An <e164:order> element that contains a NAPTR order value.

   - An <e164:pref> element that contains a NAPTR preference value.

   - An OPTIONAL <e164:flags> element that contains a NAPTR flags
      value.

   - An <e164:svc> element that contains a NAPTR service value.

   - An OPTIONAL <e164:regex> element that contains a NAPTR regular
      expression value.

   - An OPTIONAL <e164:replacement> element that contains a NAPTR
      replacement value.

   Example <info> response:

   S:<?xml version="1.0" encoding="UTF-8" standalone="no"?>
   S:<epp xmlns="urn:ietf:params:xml:ns:epp-1.0"
   S: xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   S: xsi:schemaLocation="urn:ietf:params:xml:ns:epp-1.0
   S: epp-1.0.xsd">
   S: <response>
   S: <result code="1000">
   S: <msg>Command completed successfully</msg>
   S: </result>
   S: <resData>
   S: <domain:infData
   S: xmlns:domain="urn:ietf:params:xml:ns:domain-1.0"
   S: xsi:schemaLocation="urn:ietf:params:xml:ns:domain-1.0
   S: domain-1.0.xsd">
   S: <domain:name>3.8.0.0.6.9.2.3.6.1.4.4.e164.arpa</domain:name>
   S: <domain:roid>EXAMPLE1-REP</domain:roid>
   S: <domain:status s="ok"/>
   S: <domain:registrant>jd1234</domain:registrant>
   S: <domain:contact type="admin">sh8013</domain:contact>
   S: <domain:contact type="tech">sh8013</domain:contact>
   S: <domain:ns>
   S: <domain:hostObj>ns1.example.com</domain:hostObj>
   S: <domain:hostObj>ns2.example.com</domain:hostObj>
   S: </domain:ns>
   S: <domain:host>ns1.example.com</domain:host>
   S: <domain:host>ns2.example.com</domain:host>
   S: <domain:clID>ClientX</domain:clID>
   S: <domain:crID>ClientY</domain:crID>
   S: <domain:crDate>1999-04-03T22:00:00.0Z</domain:crDate>
   S: <domain:upID>ClientX</domain:upID>
   S: <domain:upDate>1999-12-03T09:00:00.0Z</domain:upDate>
   S: <domain:exDate>2005-04-03T22:00:00.0Z</domain:exDate>
   S: <domain:trDate>2000-04-08T09:00:00.0Z</domain:trDate>
   S: <domain:authInfo>
   S: <domain:pw>2fooBAR</domain:pw>
   S: </domain:authInfo>
   S: </domain:infData>
   S: </resData>
   S: <extension>
   S: <e164:infData xmlns:e164="urn:ietf:params:xml:ns:e164epp-1.0"
   S: xsi:schemaLocation="urn:ietf:params:xml:ns:e164epp-1.0
   S: e164epp-1.0.xsd">
   S: <e164:naptr>
   S: <e164:order>10</e164:order>
   S: <e164:pref>100</e164:pref>
   S: <e164:flags>u</e164:flags>

```
S:       <e164:svc>E2U+sip</e164:svc>
S:       <e164:regex>"!^.*$!sip:info@example.com!"</e164:regex>
S:      </e164:naptr>
S:      <e164:naptr>
S:       <e164:order>10</e164:order>
S:       <e164:pref>102</e164:pref>
S:       <e164:flags>u</e164:flags>
S:       <e164:svc>E2U+msg</e164:svc>
S:       <e164:regex>"!^.*$!mailto:info@example.com!"</e164:regex>
S:      </e164:naptr>
S:     </e164:infData>
S:    </extension>
S:    <trID>
S:     <clTRID>ABC-12345</clTRID>
S:     <svTRID>54322-XYZ</svTRID>
S:    </trID>
S:   </response>
S:</epp>
```

An EPP error response MUST be returned if an extended <info> command
can not be processed for any reason.

3.1.3. EPP <transfer> Command

   This extension does not add any elements to the EPP <transfer>
   command or <transfer> response described in the EPP domain mapping
   [1].

3.2. EPP Transform Commands

   EPP provides five commands to transform objects: <create> to create
   an instance of an object, <delete> to delete an instance of an
   object, <renew> to extend the validity period of an object,
   <transfer> to manage object sponsorship changes, and <update> to
   change information associated with an object.

3.2.1. EPP <create> Command

   This extension defines additional elements for the EPP <create>
   command described in the EPP domain mapping [1]. No additional
   elements are defined for the EPP <create> response.

   The EPP <create> command provides a transform operation that allows a
   client to create a domain object. In addition to the EPP command
   elements described in the EPP domain mapping [1], the command MUST
   contain an <extension> element. The <extension> element MUST contain
   a child <e164:create> element that identifies the extension namespace
   and the location of the extension schema. The <e164:create> element

contains one or more <e164:naptr> elements that contain the following
child elements:

- An <e164:order> element that contains a NAPTR order value.

- An <e164:pref> element that contains a NAPTR preference value.

- An OPTIONAL <e164:flags> element that contains a NAPTR flags
   value.

- An <e164:svc> element that contains a NAPTR service value.

- An OPTIONAL <e164:regex> element that contains a NAPTR regular
   expression value.

- An OPTIONAL <e164:replacement> element that contains a NAPTR
   replacement value.

Example <create> command:

```
C:<?xml version="1.0" encoding="UTF-8" standalone="no"?>
C:<epp xmlns="urn:ietf:params:xml:ns:epp-1.0"
C:     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
C:     xsi:schemaLocation="urn:ietf:params:xml:ns:epp-1.0
C:     epp-1.0.xsd">
C: <command>
C:  <create>
C:   <domain:create
C:    xmlns:domain="urn:ietf:params:xml:ns:domain-1.0"
C:    xsi:schemaLocation="urn:ietf:params:xml:ns:domain-1.0
C:    domain-1.0.xsd">
C:     <domain:name>3.8.0.0.6.9.2.3.6.1.4.4.e164.arpa</domain:name>
C:     <domain:period unit="y">2</domain:period>
C:     <domain:ns>
C:      <domain:hostObj>ns1.example.com</domain:hostObj>
C:      <domain:hostObj>ns2.example.com</domain:hostObj>
C:     </domain:ns>
C:     <domain:registrant>jd1234</domain:registrant>
C:     <domain:contact type="admin">sh8013</domain:contact>
C:     <domain:contact type="tech">sh8013</domain:contact>
C:     <domain:authInfo>
C:      <domain:pw>2fooBAR</domain:pw>
C:     </domain:authInfo>
C:    </domain:create>
C:  </create>
C:  <extension>
C:   <e164:create
C:    xmlns:e164="urn:ietf:params:xml:ns:e164epp-1.0"
```

```
C:     xsi:schemaLocation="urn:ietf:params:xml:ns:e164epp-1.0
C:     e164epp-1.0.xsd">
C:     <e164:naptr>
C:      <e164:order>10</e164:order>
C:      <e164:pref>100</e164:pref>
C:      <e164:flags>u</e164:flags>
C:      <e164:svc>E2U+sip</e164:svc>
C:      <e164:regex>"!^.*$!sip:info@example.com!"</e164:regex>
C:     </e164:naptr>
C:     <e164:naptr>
C:      <e164:order>10</e164:order>
C:      <e164:pref>102</e164:pref>
C:      <e164:flags>u</e164:flags>
C:      <e164:svc>E2U+msg</e164:svc>
C:      <e164:regex>"!^.*$!mailto:info@example.com!"</e164:regex>
C:     </e164:naptr>
C:    </e164:create>
C:   </extension>
C:   <clTRID>ABC-12345</clTRID>
C:  </command>
C:</epp>
```

When an extended <create> command has been processed successfully,
the EPP response is as described in the EPP domain mapping [1].

3.2.2. EPP <delete> Command

   This extension does not add any elements to the EPP <delete> command
   or <delete> response described in the EPP domain mapping [1].

3.2.3. EPP <renew> Command

   This extension does not add any elements to the EPP <renew> command
   or <renew> response described in the EPP domain mapping [1].

3.2.4. EPP <transfer> Command

   This extension does not add any elements to the EPP <transfer>
   command or <transfer> response described in the EPP domain mapping
   [1].

3.2.5. EPP <update> Command

   This extension defines additional elements for the EPP <update>
   command described in the EPP domain mapping [1]. No additional
   elements are defined for the EPP <update> response.

   The EPP <update> command provides a transform operation that allows a
   client to change the state of a domain object. In addition to the
   EPP command elements described in the EPP domain mapping [1], the
   <update> command MUST contain an <extension> element. The
   <extension> element MUST contain a child <e164:update> element that
   identifies the extension namespace and the location of the extension
   schema. The <e164:update> element contains one or more <e164:add> or
   <e164:rem> elements. Each <e164:add> and <e164:rem> element contains
   an <e164:naptr> element that contains the following child elements:

   - An <e164:order> element that contains a NAPTR order value.

   - An <e164:pref> element that contains a NAPTR preference value.

   - An OPTIONAL <e164:flags> element that contains a NAPTR flags
      value.

   - An <e164:svc> element that contains a NAPTR service value.

   - An OPTIONAL <e164:regex> element that contains a NAPTR regular
      expression value.

   - An OPTIONAL <e164:replacement> element that contains a NAPTR
      replacement value.

   Example <update> command:

   C:<?xml version="1.0" encoding="UTF-8" standalone="no"?>
   C:<epp xmlns="urn:ietf:params:xml:ns:epp-1.0"
   C: xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   C: xsi:schemaLocation="urn:ietf:params:xml:ns:epp-1.0
   C: epp-1.0.xsd">
   C: <command>
   C: <update>
   C: <domain:update
   C: xmlns:domain="urn:ietf:params:xml:ns:domain-1.0"
   C: xsi:schemaLocation="urn:ietf:params:xml:ns:domain-1.0
   C: domain-1.0.xsd">
   C: <domain:name>3.8.0.0.6.9.2.3.6.1.4.4.e164.arpa</domain:name>
   C: </domain:update>
   C: </update>
   C: <extension>
   C: <e164:update xmlns:e164="urn:ietf:params:xml:ns:e164epp-1.0"
   C: xsi:schemaLocation="urn:ietf:params:xml:ns:e164epp-1.0
   C: e164epp-1.0.xsd">
   C: <e164:rem>
   C: <e164:naptr>
   C: <e164:order>10</e164:order>

```
C:          <e164:pref>102</e164:pref>
C:          <e164:flags>u</e164:flags>
C:          <e164:svc>E2U+msg</e164:svc>
C:          <e164:regex>"!^.*$!mailto:info@example.com!"</e164:regex>
C:        </e164:naptr>
C:      </e164:rem>
C:    </e164:update>
C:  </extension>
C:  <clTRID>ABC-12345</clTRID>
C: </command>
C:</epp>
```

When an extended <update> command has been processed successfully,
the EPP response is as described in the EPP domain mapping [1].

4. Formal Syntax

An EPP object mapping is specified in XML Schema notation. The
formal syntax presented here is a complete schema representation of
the object mapping suitable for automated validation of EPP XML
instances. The BEGIN and END tags are not part of the schema; they
are used to note the beginning and ending of the schema for URI
registration purposes.

```
BEGIN
<?xml version="1.0" encoding="UTF-8"?>

<schema targetNamespace="urn:ietf:params:xml:ns:e164epp-1.0"
        xmlns:e164="urn:ietf:params:xml:ns:e164epp-1.0"
        xmlns="http://www.w3.org/2001/XMLSchema"
        elementFormDefault="qualified">

  <annotation>
    <documentation>
      Extensible Provisioning Protocol v1.0
      domain name extension schema for E.164 number provisioning.
    </documentation>
  </annotation>

<!--
Child elements found in EPP commands.
-->
  <element name="create" type="e164:createType"/>
  <element name="update" type="e164:updateType"/>
```

```
    <!--
    Global elements.
    -->
      <element name="naptr" type="e164:naptrType"/>

    <!--
    Child elements of the <create> command.
    -->
      <complexType name="createType">
        <sequence>
          <element ref="e164:naptr" maxOccurs="unbounded"/>
        </sequence>
      </complexType>

      <complexType name="naptrType">
        <sequence>
          <element name="order" type="unsignedShort"/>
          <element name="pref" type="unsignedShort"/>
          <element name="flags" type="e164:flagsType"
           minOccurs="0"/>
          <element name="svc" type="e164:svcType"/>
          <element name="regex" type="e164:regexType"
           minOccurs="0"/>
          <element name="repl" type="e164:replType"
           minOccurs="0"/>
        </sequence>
      </complexType>

      <simpleType name="flagsType">
        <restriction base="token">
          <pattern value="[A-Z]|[a-z]|[0-9]"/>
          <length value="1"/>
        </restriction>
      </simpleType>

      <simpleType name="svcType">
        <restriction base="token">
          <minLength value="1"/>
        </restriction>
      </simpleType>

      <simpleType name="regexType">
        <restriction base="token">
          <minLength value="1"/>
        </restriction>
      </simpleType>
```

```
      <simpleType name="replType">
        <restriction base="token">
          <minLength value="1"/>
          <maxLength value="255"/>
        </restriction>
      </simpleType>

   <!--
   Child elements of the <update> command.
   -->
      <complexType name="updateType">
        <sequence>
          <element name="add" type="e164:addRemType"
           minOccurs="0"/>
          <element name="rem" type="e164:addRemType"
           minOccurs="0"/>
        </sequence>
      </complexType>

   <!--
   Data elements that can be added or removed.
   -->
      <complexType name="addRemType">
        <sequence>
          <element ref="e164:naptr" maxOccurs="unbounded"/>
        </sequence>
      </complexType>

   <!--
   Child response elements.
   -->
      <element name="infData" type="e164:infDataType"/>

   <!--
   <info> response elements.
   -->
      <complexType name="infDataType">
        <sequence>
          <element ref="e164:naptr" maxOccurs="unbounded"/>
        </sequence>
      </complexType>

   <!--
   End of schema.
   -->
      </schema>
      END
```

5. Internationalization Considerations

    EPP is represented in XML, which provides native support for encoding
    information using the Unicode character set and its more compact
    representations, including UTF-8 [10]. Conformant XML processors
    recognize both UTF-8 and UTF-16 [11]. Though XML includes provisions
    to identify and use other character encodings through use of an
    "encoding" attribute in an <?xml?> declaration, use of UTF-8 is
    RECOMMENDED in environments where parser encoding support
    incompatibility exists.

    As an extension of the EPP domain mapping [1], the elements, element
    content, attributes, and attribute values described in this document
    MUST inherit the internationalization conventions used to represent
    higher-layer domain and core protocol structures present in an XML
    instance that includes this extension.

6. IANA Considerations

    This document uses URNs to describe XML namespaces and XML schemas
    conforming to a registry mechanism described in RFC 3688 [9]. Two
    URI assignments have been completed by the IANA:

    Registration for the extension namespace:

        URI: urn:ietf:params:xml:ns:e164epp-1.0

        Registrant Contact: IESG

        XML: None. Namespace URIs do not represent an XML specification.

    Registration for the extension XML schema:

        URI: urn:ietf:params:xml:schema:e164epp-1.0

        Registrant Contact: IESG

        XML: See the "Formal Syntax" section of this document.

7. Security Considerations

    The mapping extensions described in this document do not provide any
    security services beyond those described by EPP [5], the EPP domain
    name mapping [1], and protocol layers used by EPP. Security
    considerations related to ENUM are described in the "Security
    Considerations" section of the ENUM specification [6]; security
    considerations related to the Dynamic Delegation Discovery System and
    NAPTR records are described in the "Security Considerations" section

of RFC 3403 [8]. The security considerations described in these
specifications apply to this specification as well.

As with other domain object transforms, the EPP transform operations
described in this document MUST be restricted to the sponsoring
client as authenticated using the mechanisms described in sections
2.9.1.1 and 7 of RFC 3730 [5]. Any attempt to perform a transform
operation on a domain object by any client other than the sponsoring
client MUST be rejected with an appropriate EPP authorization error.

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Lawrence Conroy, Edward Lewis, Michael Mealling, Allison Mankin, Chip
Sharp, and James Yu.

9. References

9.1. Normative References

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9.2. Informative References

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   ipr@ietf.org.

Acknowledgement