       Diameter Straightforward-Naming Authority Pointer (S-NAPTR) Usage

Abstract

   The Diameter base protocol specifies mechanisms whereby a given realm
   may advertise Diameter nodes and the supported transport protocol.
   However, these mechanisms do not reveal the Diameter applications
   that each node supports. A peer outside the realm would have to
   perform a Diameter capability exchange with every node until it
   discovers one that supports the required application. This document
   updates RFC 3588, "Diameter Base Protocol", and describes an
   improvement using an extended format for the Straightforward-Naming
   Authority Pointer (S-NAPTR) application service tag that allows for
   discovery of the supported applications without doing Diameter
   capability exchange beforehand.

Status of This Memo

   This is an Internet Standards Track document.

   This document is a product of the Internet Engineering Task Force
   (IETF). It represents the consensus of the IETF community. It has
   received public review and has been approved for publication by the
   Internet Engineering Steering Group (IESG). Further information on
   Internet Standards is available in Section 2 of RFC 5741.

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1. Introduction

   The Diameter base protocol [RFC3588] specifies three mechanisms for
   Diameter peer discovery. One of these involves the Diameter
   implementation performing a Naming Authority Pointer (NAPTR) query
   [RFC3403] for a server in a particular realm. These NAPTR records

provide a mapping from a domain to the DNS Service Locator (SRV)
record [RFC2782] or A/AAAA record [RFC1035] [RFC3596] for contacting
a server with the specific transport protocol in the NAPTR services
field.

The extended NAPTR usage for Diameter peer discovery defined by this
document is based on the Straightforward-NAPTR (S-NAPTR) Dynamic
Delegation Discovery System (DDDS) application defined in [RFC3958].
This document updates the Diameter peer discovery procedure described
in Section 5.2 of [RFC3588] and defines S-NAPTR application service
and application protocol tag values that permit the discovery of
Diameter peers that support a specific Diameter application and
transport protocol.

2. Terminology

   The Diameter base protocol specification (Section 1.3 of [RFC3588])
   and the Straightforward-NAPTR (S-NAPTR) DDDS application (Section 2.1
   of [RFC3958]) define the terminology used in this document.

2.1. Requirements Language

   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].

3. Extended NAPTR Service Field Format

   The NAPTR service field format defined by the S-NAPTR DDDS
   application in [RFC3958] follows this Augmented Backus-Naur Form
   (ABNF) [RFC5234]:

```
     service-parms = [ [app-service] *(":" app-protocol)]
     app-service  = experimental-service  / iana-registered-service
     app-protocol = experimental-protocol / iana-registered-protocol
     experimental-service     = "x-" 1*30ALPHANUMSYM
     experimental-protocol    = "x-" 1*30ALPHANUMSYM
     iana-registered-service  = ALPHA *31ALPHANUMSYM
     iana-registered-protocol = ALPHA *31ALPHANUMSYM
     ALPHA         =  %x41-5A / %x61-7A   ; A-Z / a-z
     DIGIT         =  %x30-39 ; 0-9
     SYM           =  %x2B / %x2D / %x2E  ; "+" / "-" / "."
     ALPHANUMSYM   =  ALPHA / DIGIT / SYM
     ; The app-service and app-protocol tags are limited to 32
     ; characters and must start with an alphabetic character.
     ; The service-parms are considered case-insensitive.
```

This specification refines the "iana-registered-service" tag
definition for the discovery of Diameter agents supporting a specific
Diameter application as defined below.

```
iana-registered-service =/ aaa-service
aaa-service              = "aaa+ap" appln-id
appln-id                 = 1*10DIGIT
                             ; Application Identifier expressed as
                             ; a decimal integer without leading
                             ; zeros.
```

The appln-id element is the Application Identifier used to identify a
specific Diameter application. The Diameter Application Identifier
is a 32-bit unsigned integer, and values are allocated by IANA as
defined in [RFC3588].

This specification also refines the "iana-registered-protocol" tag
definition for the discovery of Diameter agents supporting a specific
Diameter transport protocol as defined below.

```
iana-registered-protocol =/ aaa-protocol
aaa-protocol             = "diameter." aaa-transport
aaa-transport            = "tcp" / "sctp" / "tls.tcp"
```

The S-NAPTR application protocol tags defined by this specification
MUST NOT be parsed in any way by the querying application or
resolver. The delimiter (".") is present in the tag to improve
readability and does not imply a structure or namespace of any kind.
The choice of delimiter (".") for the application protocol tag
follows the format of existing S-NAPTR application protocol tag
registry entries, but this does not imply that it shares semantics
with any other specifications that create registry entries with the
same format.

The S-NAPTR application service and application protocol tags defined
by this specification are unrelated to the IANA "Service Name and
Transport Protocol Port Number Registry" (see [RFC6335]).

The maximum length of the NAPTR service field is 256 octets,
including a one-octet length field (see Section 4.1 of [RFC3403] and
Section 3.3 of [RFC1035]).

3.1. IETF Standards Track Diameter Applications

   A Diameter agent MUST be capable of using the extended S-NAPTR
   application service tag for dynamic discovery of a Diameter agent
   supporting Standards Track applications. Therefore, every IETF
   Standards Track Diameter application MUST be associated with a
   "aaa-service" tag formatted as defined in this specification and
   allocated in accordance with IANA policy (see Section 7).

   For example, a NAPTR service field value of:

      'aaa+ap6:diameter.sctp'

   means that the Diameter node in the SRV or A/AAAA record supports the
   Diameter Session Initiation Protocol (SIP) application ('6') and the
   Stream Control Transmission Protocol (SCTP) as the transport
   protocol.

3.2. Vendor-Specific Diameter Applications

   S-NAPTR application service and application protocol tag values can
   also be used to discover Diameter peers that support a vendor-
   specific Diameter application. In this case, the vendor-specific
   Diameter application MUST be associated with a "aaa-service" tag
   formatted as defined in this specification and allocated in
   accordance with IANA policy (see Section 7).

   For example, a NAPTR service field value of:

      'aaa+ap16777251:diameter.sctp'

   means that the Diameter node in the SRV or A/AAAA record supports the
   Diameter Third Generation Partnership Project (3GPP) S6a application
   ('16777251') and SCTP as the transport protocol.

4. Backwards Compatibility

   Domain Name System (DNS) administrators SHOULD also provision legacy
   NAPTR records [RFC3403] in the RFC 3588 style in order to guarantee
   backwards compatibility with legacy Diameter peers that are RFC 3588
   compliant. If the DNS administrator provisions both extended S-NAPTR
   records as defined in this specification and legacy RFC 3588 NAPTR
   records, then the extended S-NAPTR records MUST have higher priority
   (e.g., lower order and/or preference values) than legacy NAPTR
   records.

5. Extended NAPTR-Based Diameter Peer Discovery

   The Diameter Peer Discovery principles are described in Section 5.2
   of [RFC3588]. This specification updates the NAPTR query procedure
   in the Diameter peer discovery mechanism by allowing the querying
   node to determine which applications are supported by resolved
   Diameter peers.

   The extended-format NAPTR records provide a mapping from a domain to
   the SRV record or A/AAAA record for contacting a server supporting a
   specific transport protocol and Diameter application. The resource
   record will contain an empty regular expression and a replacement
   value, which is the SRV record or the A/AAAA record for that
   particular transport protocol.

   The assumption for this mechanism to work is that the DNS
   administrator of the queried domain has first provisioned the DNS
   with extended-format NAPTR entries. The steps below replace the
   NAPTR query procedure steps in Section 5.2 of [RFC3588].

   a. The Diameter implementation performs a NAPTR query for a server in
      a particular realm. The Diameter implementation has to know in
      advance in which realm to look for a Diameter agent, and in which
      Application Identifier it is interested. For example, the realm
      could be deduced from the Network Access Identifier (NAI) in the
      User-Name attribute-value pair (AVP) or extracted from the
      Destination-Realm AVP.

   b. If the returned NAPTR service fields contain entries formatted as
      "aaa+apX:Y" where "X" indicates the Application Identifier and "Y"
      indicates the supported transport protocol(s), the target realm
      supports the extended format for NAPTR-based Diameter peer
      discovery defined in this document.

         If "X" contains the required Application Identifier and "Y"
         matches a supported transport protocol, the Diameter
         implementation resolves the "replacement" field entry to a
         target host using the lookup method appropriate for the "flags"
         field.

         If "X" does not contain the required Application Identifier or
         "Y" does not match a supported transport protocol, the Diameter
         implementation abandons the peer discovery.

   c. If the returned NAPTR service fields contain entries formatted as
      "aaa+apX" where "X" indicates the Application Identifier, the
      target realm supports the extended format for NAPTR-based Diameter
      peer discovery defined in this document.

         If "X" contains the required Application Identifier, the
         Diameter implementation resolves the "replacement" field entry
         to a target host using the lookup method appropriate for the
         "flags" field and attempts to connect using all supported
         transport protocols following the order specified in
         Section 2.1 of [RFC3588].

         If "X" does not contain the required Application Identifier,
         the Diameter implementation abandons the peer discovery.

   d. If the returned NAPTR service fields contain entries formatted as
      "aaa:X" where "X" indicates the supported transport protocol(s),
      the target realm supports Diameter but does not support the
      extended format for NAPTR-based Diameter peer discovery defined in
      this document.

         If "X" matches a supported transport protocol, the Diameter
         implementation resolves the "replacement" field entry to a
         target host using the lookup method appropriate for the "flags"
         field.

   e. If the returned NAPTR service fields contain entries formatted as
      "aaa", the target realm supports Diameter but does not support the
      extended format for NAPTR-based Diameter peer discovery defined in
      this document. The Diameter implementation resolves the
      "replacement" field entry to a target host using the lookup method
      appropriate for the "flags" field and attempts to connect using
      all supported transport protocols following the order specified in
      Section 2.1 of [RFC3588].

   f. If the target realm does not support NAPTR-based Diameter peer
      discovery, the client proceeds with the next peer discovery
      mechanism described in Section 5.2 of [RFC3588].

5.1. Examples

   As an example, consider a client that wishes to discover a Diameter
   server in the ex1.example.com realm that supports the Credit Control
   application. The client performs a NAPTR query for that domain, and
   the following NAPTR records are returned:

```
           ;;          order pref flags service   regexp replacement
      IN NAPTR 50    50    "s"   "aaa:diameter.sctp" ""
                  _diameter._sctp.ex1.example.com
      IN NAPTR 50    50    "s"   "aaa+ap1:diameter.sctp" ""
                  _diameter._sctp.ex1.example.com
      IN NAPTR 50    50    "s"   "aaa+ap4:diameter.sctp" ""
                  _diameter._sctp.ex1.example.com
```

   This indicates that the server supports NASREQ (ID=1) and Credit
   Control (ID=4) applications over SCTP. If the client supports SCTP,
   it will be used, targeted to a host determined by an SRV lookup of
   _diameter._sctp.ex1.example.com.

   That SRV lookup would return:

```
      ;;          Priority  Weight  Port    Target
      IN SRV    0         1       3868    server1.ex1.example.com
      IN SRV    0         2       3868    server2.ex1.example.com
```

   As an alternative example, a client wishes to discover a Diameter
   server in the ex2.example.com realm that supports the NASREQ
   application over SCTP. The client performs a NAPTR query for that
   domain, and the following NAPTR records are returned:

```
      ;;          order pref flags service   regexp replacement
      IN NAPTR 150   50    "a"   "aaa:diameter.sctp"  ""
                  server1.ex2.example.com
      IN NAPTR 150   50    "a"   "aaa:diameter.tls.tcp"  ""
                  server2.ex2.example.com
      IN NAPTR 150   50    "a"   "aaa+ap1:diameter.sctp"  ""
                  server1.ex2.example.com
      IN NAPTR 150   50    "a"   "aaa+ap1:diameter.tls.tcp"  ""
                  server2.ex2.example.com
```

   This indicates that the server supports NASREQ (ID=1) over SCTP and
   Transport Layer Security (TLS)/TCP via hosts server1.ex2.example.com
   and server2.ex2.example.com, respectively.

6. Usage Guidelines

   Diameter is a peer-to-peer protocol, whereas most of the applications
   that extend the base protocol behave like client/server applications.
   The role of the peer is not advertised in the NAPTR tags and not even
   communicated during Diameter capability negotiation
   (Capabilities-Exchange-Request and Capabilities-Exchange-Answer
   message exchange). For this reason, NAPTR-based Diameter peer
   discovery for an application defining client/server roles should only
   be used by a client to discover servers.

7. IANA Considerations

7.1. IETF Diameter Application Service Tags

   IANA has reserved a value of "aaa" for Diameter in the "(S-NAPTR)
   Application Service Tag" registry created by [RFC3958]. IANA has
   also reserved the following S-NAPTR application service tags for
   existing IETF Diameter applications in the same registry.

```
       +-----------------+---------------------------+
       | Tag             | Diameter Application       |
       +-----------------+---------------------------+
       | aaa+ap1         | NASREQ [RFC3588]          |
       | aaa+ap2         | Mobile IPv4 [RFC4004]     |
       | aaa+ap3         | Base Accounting [RFC3588] |
       | aaa+ap4         | Credit Control [RFC4006]  |
       | aaa+ap5         | EAP [RFC4072]             |
       | aaa+ap6         | SIP [RFC4740]             |
       | aaa+ap7         | Mobile IPv6 IKE [RFC5778] |
       | aaa+ap8         | Mobile IPv6 Auth [RFC5778]|
       | aaa+ap9         | QoS [RFC5866]             |
       | aaa+ap4294967295 | Relay [RFC3588]          |
       +-----------------+---------------------------+
```

   Future IETF Diameter applications MUST reserve the S-NAPTR
   application service tag corresponding to the allocated Diameter
   Application ID as defined in Section 3.

7.2. 3GPP Diameter Application Service Tags

   IANA has reserved the following S-NAPTR application service tags for
   existing 3GPP Diameter applications in the "S-NAPTR Application
   Service Tag" registry created by [RFC3958].

```
       +---------------+---------------------+
       | Tag           | Diameter Application |
       +---------------+---------------------+
       | aaa+ap16777250 | 3GPP STa [TS29.273] |
       | aaa+ap16777251 | 3GPP S6a [TS29.272] |
       | aaa+ap16777264 | 3GPP SWm [TS29.273] |
       | aaa+ap16777267 | 3GPP S9 [TS29.215]  |
       +---------------+---------------------+
```

   Future 3GPP Diameter applications can reserve entries in the "S-NAPTR
   Application Service Tag" registry created by [RFC3958] that
   correspond to the allocated Diameter Application IDs as defined in
   Section 3.

7.3. WiMAX Forum Diameter Application Service Tags

   IANA has reserved the following S-NAPTR application service tags for
   existing Worldwide Interoperability for Microwave Access (WiMAX)
   Forum Diameter applications in the "S-NAPTR Application Service Tag"
   registry created by [RFC3958].

```
+----------------+---------------------------------------------------+
| Tag            | Diameter Application                              |
+----------------+---------------------------------------------------+
| aaa+ap16777281 | WiMAX Network Access Authentication and           |
|                | Authorization Diameter Application (WNAAADA)       |
|                | [WiMAX-BASE]                                       |
| aaa+ap16777282 | WiMAX Network Accounting Diameter Application      |
|                | (WNADA) [WiMAX-BASE]                               |
| aaa+ap16777283 | WiMAX MIP4 Diameter Application (WM4DA)            |
|                | [WiMAX-BASE]                                       |
| aaa+ap16777284 | WiMAX MIP6 Diameter Application (WM6DA)            |
|                | [WiMAX-BASE]                                       |
| aaa+ap16777285 | WiMAX DHCP Diameter Application (WDDA)             |
|                | [WiMAX-BASE]                                       |
| aaa+ap16777286 | WiMAX Location Authentication Authorization        |
|                | Diameter Application (WLAADA) [WiMAX-LBS]          |
| aaa+ap16777287 | WiMAX Policy and Charging Control R3 Policies      |
|                | Diameter Application (WiMAX PCC-R3-P)              |
|                | [WiMAX-PCC]                                        |
| aaa+ap16777288 | WiMAX Policy and Charging Control R3 Offline       |
|                | Charging Diameter Application (WiMAX PCC-R3-OFC)   |
|                | [WiMAX-PCC]                                        |
| aaa+ap16777289 | WiMAX Policy and Charging Control R3 Offline       |
|                | Charging Prime Diameter Application (WiMAX         |
|                | PCC-R3-OFC-PRIME) [WiMAX-PCC]                      |
| aaa+ap16777290 | WiMAX Policy and Charging Control R3 Online        |
|                | Charging Diameter Application (WiMAX PCC-R3-OC)    |
|                | [WiMAX-PCC]                                        |
+----------------+---------------------------------------------------+
```

   Future WiMAX Forum Diameter applications can reserve entries in the
   "S-NAPTR Application Service Tag" registry created by [RFC3958] that
   correspond to the allocated Diameter Application IDs as defined in
   Section 3.

7.4. Vendor-Specific Diameter Application Service Tags

   Vendor-Specific Diameter Application IDs are allocated by IANA
   according to the "First Come First Served" policy and do not require
   an IETF specification. However, the S-NAPTR application service tag
   registry created by [RFC3958] defines a registration policy of

"Specification Required" with a further stipulation that the
"specification" is an RFC (of any category). If a vendor-specific
Diameter application requires the functionality defined in this
document, an RFC of any category MUST be published that reserves the
S-NAPTR Application Service Tag corresponding to the Vendor-Specific
Diameter Application ID as defined in Section 3.

7.5. Diameter Application Protocol Tags

   IANA has reserved the following S-NAPTR Application Protocol Tags for
   the Diameter transport protocols in the "S-NAPTR Application Protocol
   Tag" registry created by [RFC3958].

```
               +------------------+----------+
               | Tag              | Protocol |
               +------------------+----------+
               | diameter.tcp     | TCP      |
               | diameter.sctp    | SCTP     |
               | diameter.tls.tcp | TLS/TCP  |
               +------------------+----------+
```

   Future Diameter versions that introduce new transport protocols MUST
   reserve an appropriate S-NAPTR Application Protocol Tag in the
   "S-NAPTR Application Protocol Tag" registry created by [RFC3958].

8. Security Considerations

   This document specifies an enhancement to the NAPTR service field
   format defined in RFC 3588 and also modifications to the NAPTR
   processing logic defined in RFC 3588. The enhancement and
   modifications are based on the S-NAPTR, which is actually a
   simplification of the NAPTR, and therefore the same security
   considerations described in RFC 3588 [RFC3588] are applicable to this
   document. No further extensions are required beyond the security
   mechanisms offered by RFC 3588. However, a malicious host doing
   S-NAPTR queries learns applications supported by Diameter agents in a
   certain realm faster, which might help the malicious host to scan
   potential targets for an attack more efficiently when some
   applications have known vulnerabilities.

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