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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.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc6408.

Table of Contents

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.

9. Acknowledgments

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10.1. Normative References

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