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Third-Party ALTO Server Discovery (3pdisc) draft-kist-alto-3pdisc-04

Abstract

The goal of Application-Layer Traffic Optimization (ALTO) is to provide guidance to applications that have to select one or several hosts from a set of candidates capable of providing a desired resource. ALTO is realized by a client-server protocol. Before an ALTO client can ask for guidance it needs to discover one or more ALTO servers that can provide suitable guidance.

This document specifies a procedure for third-party ALTO server discovery, which can be used if the ALTO client is not co-located with the actual resource consumer, but instead embedded in a third party such as a peer-to-peer tracker.

Technically, the algorithm specified in this document takes one IP address and a U-NAPTR Service Parameter (i.e., "ALTO:http" or "ALTO:https") as parameters. It performs several DNS lookups (for U-NAPTR and SOA resource records) and returns one or more URI(s) of information resources related to that IP address.

Terminology and Requirements Language

This document makes use of the ALTO terminology defined in RFC 5693 [RFC5693].

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 [RFC2119].

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

This Internet-Draft will expire on January 16, 2014.

Table of Contents

1. Introduction

The goal of Application-Layer Traffic Optimization (ALTO) is to provide guidance to applications that have to select one or several hosts from a set of candidates capable of providing a desired resource [RFC5693]. ALTO is realized by a client-server protocol; see requirement AR-1 in [RFC6708]. Before an ALTO client can ask for guidance it needs to discover one or more ALTO servers that can provide suitable guidance. For applications that use a centralized resource directory, such as tracker-based P2P applications, the efficiency of ALTO is significantly improved if the ALTO client is embedded in said resource directory instead of the resource consumer (see Section 4.1 of [I-D.ietf-alto-deployments]). The ALTO client embedded into the resource directory asks for guidance on behalf of the resource consumers. To that end, it needs to discover ALTO servers that can give guidance suitable for these resource consumers, respectively. This is called third-party party ALTO server discovery.

This document specifies a procedure for third-party ALTO server discovery. In other words, this document tries to meet requirement AR-33 in [RFC6708].

The ALTO protocol specification [I-D.ietf-alto-protocol] is based on HTTP and expects the discovery procedure to yield the HTTP(S) URI of an ALTO server's information resource directory. Therefore, this document specifies an algorithm that takes a resource consumer's IP address as argument, performs several DNS lookups (for U-NAPTR [RFC4848] and SOA resource records), and produces URIs of ALTO servers that are able to give reasonable ALTO guidance to a resource consumer willing to communicate using this IP address.

To some extent, AR-32, i.e., resource consumer initiated ALTO server discovery, can be seen as a special case of third-party ALTO server discovery. However, the considerations in Section 3.1.1 apply. Note that a less versatile yet simpler approach for resource consumer

initiated ALTO server discovery is specified in [I-D.ietf-alto-server-discovery].

A more detailed discussion of various options where to place the functional entities comprising the overall ALTO architecture can be found in [I-D.ietf-alto-deployments].

Comments and discussions about this memo should be directed to the ALTO working group: alto@ietf.org.

2. Third-party ALTO Server Discovery Procedure Specification

2.1. Interface

The algorithm specified in this document takes one IP address and a U-NAPTR Service Parameter (i.e., "ALTO:http" or "ALTO:https") as parameters. It performs several DNS lookups (for U-NAPTR and SOA resource records) and returns one or more URI(s) of information resources related to that IP address.

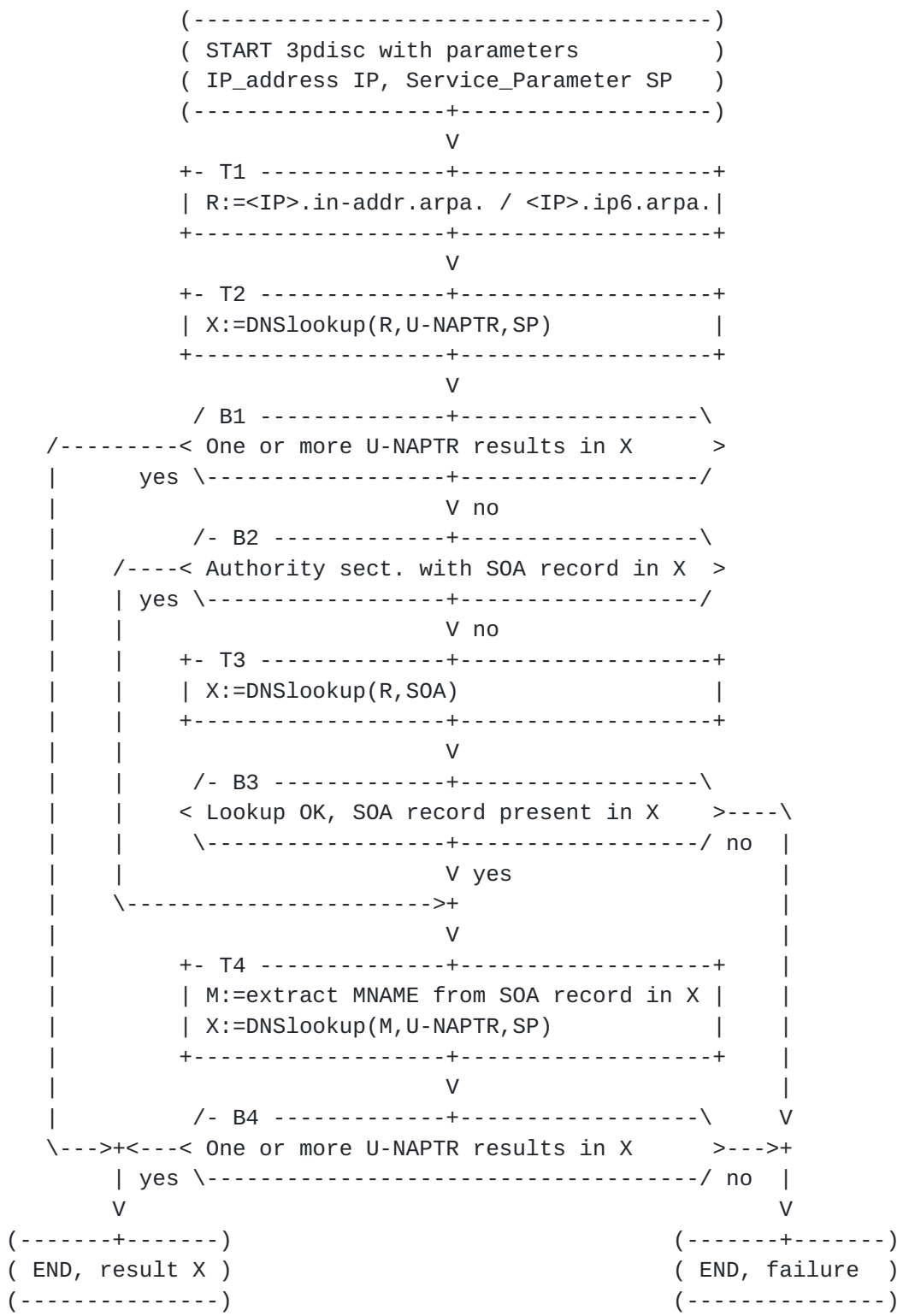
2.2. Basic Principle

The algorithm sequentially tries two different lookup strategies. First, an ALTO-specific U-NAPTR lookup is performed in the "reverse tree", i.e., in subdomains of in-addr.arpa. or ip6.arpa., respectively. If this lookup does not yield a usable result, the SOA record for the reverse zone is acquired, its master name server (MNAME) value is extracted and used for a further ALTO-specific U-NAPTR lookup.

The goal is to allow deployment scenarios that require fine-grained discovery on a per-IP basis, as well as large-scale scenarios where discovery is to be enabled for a large number of IP addresses with a small number of additional DNS resource records.

2.3. Overall Procedure

This figure gives an overview on the third-party discovery procedure. All tasks (T) and conditional branches (B) are specified below.



2.4. Specification of Tasks and Conditional Branches

2.4.1. T1: Prepare Domain Name for Reverse DNS Lookup

Task T1 takes the IP address parameter the 3pdisc procedure was called with and constructs a domain name, which is stored in variable "R" for use in subsequent tasks.

If the IP address given as a parameter to the 3pdisc procedure is an IPv4 address, the domain name is constructed according to the rules specified in Section 3.5 of [RFC1035] and it is rooted in the in the special domain "IN-ADDR.ARPA.". For IPv6 addresses, the construction rules in Section 2.5 of [RFC3596] apply and the special domain "IP6.ARPA." is used.

Example values for "R" for IPv4 and IPv6 addresses could be (Note: a line break was added in the IPv6 example):

```
R:="3.100.51.198.in-addr.arpa."

R:="0.2.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.8.B.D.0.
1.0.0.2.ip6.arpa."
```

2.4.2. T2/B1: U-NAPTR Lookup in Reverse Zone

Task T1 performs a U-NAPTR lookup as specified in [RFC4848] on "R", in order to get service-specific U-NAPTR resource records that are directly associated with the IP address in question.

The ALTO protocol specification defines HTTP and HTTPS as transport mechanisms and URI schemes for ALTO. Consequently, the U-NAPTR lookup is performed with the "ALTO" Application Service Tag and either the "http" or the "https" Application Protocol Tag. Application Service Tag and Application Protocol Tag are concatenated to form the Service Parameter SP, i.e., either "ALTO:http" or "ALTO:https".

The goal of said U-NAPTR lookup is to obtain one or more URIs for the ALTO server's Information Resource Directory. If two or more URIs are found they are sorted according to their order and preference fields as specified in [RFC4848] and [RFC3403].

The lookup result, including a SOA record that may or may not be present in the authority section, is stored in variable "X".

As an example, the following two U-NAPTR resource records can be used for mapping "3.100.51.198.in-addr.arpa." to the HTTPS URI https://altoserver.isp.example.net/secure/directory or the HTTP URI http://

altoserver.isp.example.net/directory, with the former being preferred.

```
3.100.51.198.in-addr.arpa.

IN NAPTR 100  10   "u"    "ALTO:https"
     "!.*!https://altoserver.isp.example.net/secure/directory!"  ""

IN NAPTR 200  10   "u"    "ALTO:http"
     "!.*!http://altoserver.isp.example.net/directory!"  ""
```

Conditional Branch B1 checks whether at least one U-NAPTR record matching the service parameter SP could be retrieved. If so, the procedure ends successfully and the sorted list of U-NAPTR records is the result. Otherwise, if no U-NAPTR records could be retrieved, we continue with B2.

Note: The U-NAPTR lookup in Task T2 is identical to Step 2 specified in [I-D.ietf-alto-server-discovery], which specifies with "manual input" and "DHCP" two alternatives for acquiring the name to be looked up. Therefore, it is possible to merge both documents into a common ALTO server discovery framework.

2.4.3. B2/T3/B3: Acquire SOA Record for Reverse Zone

The task of B2/T3/B3 is to acquire the SOA record for the "reverse zone", i.e., the zone in the in-addr.arpa. or ip6.arpa. domain that contains the IP address in question.

A sample SOA record could be:

```
100.51.198.in-addr.arpa
IN  SOA dns1.isp.example.net.   hostmaster.isp.example.net. (
                              1         ; Serial
                         604800         ; Refresh
                          86400         ; Retry
                        2419200         ; Expire
                         604800 )       ; Negative Cache TTL
```

Conditional Branch B2 checks whether the SOA record was present in the authority section of X, i.e., the result of Task T2. If not, an explicit lookup is done in Task T3. If Conditional Branch B3 determines that this explicit lookup failed, the discovery procedure is aborted without a result; otherwise we continue with T4.

2.4.4. T4/B4: U-NAPTR Lookup on SOA-MNAME

Now that the SOA record is available, Task T4 first extracts the MNAME field, i.e., the responsible master name server from the SOA record. An example MNAME could be:

dns1.isp.example.net.

Then, a U-NAPTR lookup as specified in Task T2 is performed on this MNAME and the result is stored in variable "X".

Conditional Branch B4 checks whether at least one U-NAPTR record matching the service parameter SP could be retrieved. If so, the procedure ends successfully and the sorted list of U-NAPTR records is the result. Otherwise, if no U-NAPTR records could be retrieved, the discovery procedure is aborted without a result.

3. Implementation, Deployment, and Operational Considerations

3.1. Considerations for ALTO Clients

3.1.1. Resource Consumer Initiated Discovery

To some extent, ALTO requirement AR-32 [RFC6708], i.e., resource consumer initiated ALTO server discovery, can be seen as a special case of third-party ALTO server discovery. To that end, an ALTO client embedded in a ressouce consumer would have to figure out its own "public" IP address and perform the procedures described in this document on that address. However, due to the widespread deployment of Network Address Translators (NAT), additional protocols and mechanisms such as STUN [RFC5389] would be needed and considerations for UNSAF [RFC3424] apply. Therefore, using the procedures specified in this document for resource consumer based ALTO server discovery is generally NOT RECOMMENDED. Note that a less versatile yet simpler approach for resource consumer initiated ALTO server discovery is specified in [I-D.ietf-alto-server-discovery].

3.1.2. IPv4/v6 Dual Stack, Multihoming, NAT, and Host Mobility

The algortihm specified in this document can discover ALTO server URIs for a given IP address. The intention is, that a third party (e.g., a resource directory) that receives query messages from a resource consumer can use the source address in these messages to discover suitable ALTO servers for this specific resource consumer.

However, resource consumers (as defined in Section 2 of [RFC5693]) may reside on hosts with more than one IP address, e.g., due to IPv4/

v6 dual stack operation and/or multihoming. IP packets sent with different source addresses may be subject to different routing policies and path costs. In some deployment scenarios, it may even be required to ask different sets of ALTO servers for guidance. Furthermore, source addresses in IP packets may be modified en-route by Network Address Translators (NAT).

If a resource consumer queries a resource directory for candidate resource providers, the locally selected (and possibly en-route translated) source address of the query message - as observed by the resource directory - will become the basis for the ALTO server discovery and the subsequent optimization of the resource directory's reply. If, however, the resource consumer then selects different source addresses to contact returned resource providers, the desired better-than-random "ALTO effect" may not occur.

Therefore, a dual stack or multihomed resource consumer SHOULD either always use the same address for contacting the resource directory and the resource providers, i.e., overriding the operating system's automatic source IP address selection, or use resource consumer based ALTO server discovery [I-D.ietf-alto-server-discovery] to discover suitable ALTO servers for every local address and then locally perform ALTO-influenced resource consumer selection and source address selection. Similarly, resource consumers on mobile hosts SHOULD query the resource directory again after a change of IP address, in order to get a list of candidate resource providers that is optimized for the new IP address.

3.2. Deployment Considerations for Network Operators

3.2.1. NAPTR in Reverse Tree vs. SOA-based discovery

As already outlined in Section 2.2, the third-party discovery procedure sequentially tries two different lookup strategies, thus giving network operators the choice of two different deployment options:

- Individual NAPTR records in the in-addr.arpa or ip6.arpa domains allow very fine-grained discovery of ALTO "entry point" URIs on a per-IP-address basis. This method also gives the fastest response times and causes a comparatively low load on the DNS, as the algorithm terminates successfully after the first DNS query. DNS operators that already maintain reverse zones (e.g., for PTR records) should prefer this option, possibly using DNS server implementation-specific methods for mass deployment (e.g., BIND9's $GENERATE statement).

- If a DNS operator considers the first option too cumbersome, or if IPv6 privacy extensions is to be used without dynamic PTR updates, setting up SOA records in the in-addr.arpa. or ip6.arpa. subdomains plus setting up corresponding ALTO-specific U-NAPTR records will also give reasonable, yet less fine-grained results at the cost of slightly higher delay and load on the DNS.

3.2.2. Separation of Interests

We assume that if two organizations share parts of their DNS infrastructure, i.e., have a common SOA record in their in-addr.arpa. or ip6.arpa. subdomain(s), they will also be able to operate a common ALTO server, which still may do redirections if desired or required by policies.

Note that the ALTO server discovery procedure is supposed to produce only a first URI of an ALTO server that can give reasonable guidance to the client. An ALTO server can still return different results based on the client's address (or other identifying properties) or redirect the client to another ALTO server using mechanisms of the ALTO protocol (see Sect. 6.7 of [I-D.ietf-alto-protocol]).

3.3. Impact on DNS

3.3.1. Non-PTR Resource Records in Reverse Tree

Installing NAPTR records, i.e., a record type other than PTR records, in the in-addr.arpa or ip6.arpa domain may seem uncommon, but it is not a new concept. Earlier documents that specify the usage of Non-PTR resource records in the reverse tree include RFC 4025 [RFC4025], RFC 4255 [RFC4255], and RFC 4322 [RFC4322].

3.3.2. Usage with DNS Hidden Master Servers

In some deployment scenarios, the Master DNS server for a in-addr.arpa. or ip6.arpa. subdomain, as indicated in the respective SOA record, may not be reachable due to traffic restrictions ("hidden master"). This does not cause any problems with the algorithm described here, as the MNAME is only used for further DNS lookups; but it is never attempted to contact this server directly.

3.3.3. Load on the DNS

The procedure described in this document features several nested conditional branches, but no loops. Each time being called it attempts one to three DNS lookups.

4. Security Considerations

A classification of the main security concerns related to ALTO can be found in the ALTO requirements document [RFC6708].

Using the procedure described in this document, any third party can discover a set of ALTO servers that can give ALTO guidance to a given IP address. However, this is generally not considered a security or privacy concern.

Forged DNS replies (e.g., due to a compromised name server or due to DNS message interception and modification) may cause the discovery algorithm to fail or produce undesirable results:

First, the third-party discovery procedure might not be able to discover an ALTO server, even if a suitable ALTO server exists. In that case, ALTO guidance will not be used. The resulting application performance and traffic distribution will subsequently correspond to a deployment scenario without ALTO guidance.

Second, the discovery procedure may discover a sub-optimal or wrong ALTO server. Such an ALTO server may either not be able to provide information for a given resource consumer, thus rendering the ALTO service useless. Alternatively, the ALTO server may provide suboptimal or forged information. In the latter case, attackers could try to use ALTO to affect the traffic distribution or the performance of applications. Users may then observe performance problems, and network operators could detect traffic anormalities. A potential counter-measure is to disable the use of the ALTO service if such anormalities are detected.

The application of DNS security (DNSSEC) [RFC4033] provides a means to limit attacks that rely on forging DNS messages. Security considerations specific to U-NAPTR are described in more detail in [RFC4848].

5. IANA Considerations

This document does not require any IANA action.

This document specifies an algorithm that uses U-NAPTR lookups [RFC4848] with the Application Service Tag "ALTO" and the Application Protocol Tags "http" and "https". These tags have already been registered with IANA. In particular, for the registration of the Application Service Tag "ALTO", see [I-D.ietf-alto-server-discovery].

6. References

6.1. Normative References

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[RFC5693] Seedorf, J. and E. Burger, "Application-Layer Traffic Optimization (ALTO) Problem Statement", RFC 5693, October 2009.

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Appendix A. Contributors List and Acknowledgments

The initial version of this document was co-authored by Marco Tomsu <marco.tomsu@alcatel-lucent.com>.

Hannes Tschofenig provided the initial input to the U-NAPTR solution part. Hannes and Martin Thomson provided excellent feedback and input to the server discovery.

This memo borrows some text from [I-D.ietf-alto-server-discovery], as the 3pdisc was historically part of that memo. Special thanks to Michael Scharf and Nico Schwan.

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