Third-party ALTO server discovery
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Abstract

The goal of Application-Layer Traffic Optimization (ALTO) is to provide guidance to applications, which have to select one or several hosts from a set of candidates, that are able to provide a desired resource.

This document describes why a third-party ALTO server discovery mechanism is required for an important class of applications, namely tracker-based P2P applications. Several solution approaches are classified and evaluated. The conclusion is that further work is required to standardize a protocol and procedures that follow one specific approach.

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1. Introduction

The goal of Application-Layer Traffic Optimization (ALTO) is to provide guidance to applications, which have to select one or several hosts from a set of candidates, that are able to provide a desired resource. ALTO is realized by a client-server protocol. ALTO clients send queries to ALTO servers, in order to solicit guidance. The ALTO client can be embedded in the resource consumer, which will eventually access the desired resource. As an alternative, the ALTO client can be embedded in a resource directory, which assists resource consumers in finding appropriate resource providers. ALTO queries in the latter case will be referred to as third-party ALTO queries.

The challenge for third-party ALTO queries is that they have to be answered by the "right" ALTO server, i.e., the ALTO server which has the knowledge to give guidance to the resource consumer on behalf of which the query is sent.

This document uses the terminology introduced in [I-D.ietf-alto-problem-statement] and it investigates solution approaches that fulfill the requirements for ALTO server discovery documented in [I-D.ietf-alto-reqs].

Comments and discussions about this document should be directed to the ALTO working group: alto@ietf.org.
2. Problem statement

2.1. The need for third-party ALTO queries

The scope of this document is the interaction of peer-to-peer applications, that use a centralized resource directory ("tracker"), with the ALTO service. In this scenario, the resource consumer asks the resource directory for a list of potential resource providers, which can provide the desired resource. Usually, only a subset of all resource providers known to the resource directory will eventually be contacted by the resource consumer for accessing the resource. The purpose of ALTO is giving guidance on this peer selection, which is supposed to yield better-than-random results.

There are two possibilities where to apply the ALTO guidance, in the resource consumer or in the resource directory:

In the first scenario, the resource directory returns a list of potential resource providers without considering ALTO. It is then the duty of the resource consumer to invoke ALTO, in order to solicit guidance regarding this list. The problem with this approach is, that while the resource directory might know thousands of peers taking part in a swarm, the list returned to the resource consumer is usually shortened for efficiency reasons. Therefore, the "best" (in the sense of ALTO) potential resource providers might not be contained in that list anymore, even before ALTO can consider them.

In the second scenario, the resource directory has an embedded ALTO client, which we will refer to as RDAC in this document. The resource directory invokes the RDAC to evaluate all resource providers it knows. Then it returns a, possibly shortened, list containing the "best" resource providers to the resource consumer. From an overall optimization perspective, this scenario is advantageous, because it is ensured that the addresses of the "best" resource providers are actually delivered to the resource consumer.

2.2. The need for third-party ALTO server discovery

The previous section has shown why it is advantageous that entities such as resource directories can perform ALTO queries on behalf of resource consumers. We will refer to this kind of ALTO query as "third-party ALTO query".

ALTO queries are sent to ALTO servers, which have knowledge of network topology and other information on which the ALTO guidance is based. One deployment scenario for ALTO is to establish a group of centralized ALTO servers which have complete knowledge and therefore can evaluate any pair of resource consumers and providers,
respectively.

However, it is likely that there will be deployment scenarios with many ALTO servers, each having only partial knowledge and therefore being able to give guidance regarding only a defined group of resource consumers (e.g., those in its topological vicinity, or those connected to the same network operator). The reasons for partitioning the overall knowledge include scalability and separate administrative responsibilities. For the remainder of this document, we assume that the second scenario has to be supported. The first scenario can be seen as special case of it, i.e., a solution that supports the second scenario will support the first scenario as well.

The challenge for third-party ALTO queries is that they have to be answered by the "right" ALTO server, i.e., the ALTO server which has the knowledge to give guidance to the resource consumer on behalf of which the query is sent.
3. Classification of solution approaches

There are several approaches for directing a third-party ALTO query from the RDAC to the "right" ALTO server. The selection of the "right" ALTO server needs to consider the resource consumer, on behalf of which the query will be performed. The set of available options therefore depends on the available information about the resource consumer.

The primary criterion in the following classification is whether ALTO must work together with all existing (P2P) application protocols, or whether we can assume that these protocols can be augmented with new ALTO-specific information fields.

3.1. Solutions that do not require an update of the application protocol

If we do not want to make specific assumptions on the (P2P) application protocol, we cannot assume that there are any other peer identifiers apart from IP addresses. Therefore, we assume that the only information identifying the resource consumer is the source IP address of messages sent from the resource consumer to the resource directory. This address may be the (public) IP address of the resource consumer, or it may be the external address of the last NAT on the path between resource consumer and resource directory.

The RDAC that wants to perform the third-party ALTO query has two options:

- Approach #1: The RDAC invokes a discovery mechanism external to the ALTO client protocol, in order to map from the resource consumer’s IP address to the "right" ALTO server. The ALTO query will then be sent there directly.

- Approach #2: Independent of the resource consumer’s identity, the RDAC uses the ALTO client protocol to send the ALTO query to one preconfigured ALTO server. The resource consumer’s IP address is included in the query message. Based on this IP address and using mechanisms of the ALTO client protocol the first ALTO server redirects or forwards the query to the "right" ALTO server. This implies that ALTO servers must know each other, based on some discovery mechanism or manual configuration.

3.2. Solutions that do require an update of the application protocol

If we assume that applications can be upgraded in order to support ALTO, the resource consumer can provide additional information to the RDAC in order to assist the process of ALTO server discovery.
o Approach #3: Using the extended application protocol, the resource consumer sends an additional peer-ID, which can be understood by ALTO, to the resource directory. This peer-ID could be used to uniquely identify resource consumers and providers located behind NATs. The RDAC uses this peer-ID instead of the resource consumer’s IP address. In all other aspects this approach is identical to approach #1.

o Approach #4: This approach is identical to approach #2, except that the peer-ID is used instead of the IP address, as described in approach #3.

o Approach #5: The resource consumer discovers its ALTO server on its own (i.e., not a third-party discovery). Using the extended application protocol it sends the ALTO server’s address to the RDAC. The RDAC can use it for sending third-party ALTO queries there.
4. Discussion

This section assesses and compares the different approaches introduced above, regarding trust, scalability, integration into existing ISP infrastructure and management processes, modification of existing applications, and ongoing ALTO architecture specification works.

4.1. Approach #1

The existence of a mechanism according to approach #1 is assumed by [I-D.penno-alto-protocol].

This approach does not require any changes of existing (P2P) application protocols. However, the RDAC needs to implement an additional protocol for performing third-party ALTO server discovery.

One possible way of implementing this approach would be based on DNS, providing a mapping from the resource consumer’s IP address to the IP address of the corresponding "right" ALTO server. DNS is proven to be scalable and has well-understood mechanisms for delegating authority. Network operators are used to DNS management.

This approach does not support intra-domain traffic optimization for large domains behind a NAT.

4.2. Approach #2

This approach does not require any changes of existing (P2P) application protocols.

Furthermore, the RDAC does not need to implement an additional protocol besides the ALTO client protocol. However, this approach relocates the discovery problem from the RDAC to the first ALTO server.

This first ALTO server, when preconfigured in the RDAC of a large resource directory, would raise serious concerns about scalability and trust/security issues.

This approach does not support intra-domain traffic optimization for large domains behind a NAT.

4.3. Approach #3

This approach requires changes to all existing (P2P) application protocols that want to benefit from ALTO.
This approach supports intra-domain traffic optimization for large domains behind a NAT.

Except for the abovementioned statements, the same results as for approach #1 apply.

4.4. Approach #4

This approach requires changes to all existing (P2P) application protocols that want to benefit from ALTO.

This approach supports intra-domain traffic optimization for large domains behind a NAT.

Except for the abovementioned statements, the same results as for approach #2 apply.

4.5. Approach #5

This approach requires changes to all existing (P2P) application protocols that want to benefit from ALTO.

This approach does not need a mechanism for third-party ALTO server discovery, as the ALTO server is discovered by the resource consumer. However, a mechanism for this kind of discovery is needed, see, e.g., [I-D.song-alto-server-discovery].
5. Conclusion

This document describes why a third-party ALTO server discovery mechanism is required for an important class of applications, namely tracker-based P2P applications. Several solution approaches are classified and evaluated. Assuming that ALTO should work together with already deployed application protocols, "Approach #1" seems to be most promising. In this approach, the resource directory invokes a discovery mechanism external to the ALTO client protocol, in order to map from the resource consumer’s IP address to the "right" ALTO server.

The existence of such a mechanism according to "Approach #1" is assumed by [I-D.penno-alto-protocol].

Further action is required to standardize a protocol and procedures according to "Approach #1".
6. IANA Considerations

This document does not mandate any immediate IANA actions. However, such IANA considerations may arise from future ALTO discovery specification documents which try to meet the requirements given here.
7. Security Considerations

This initial version of this memo does not yet have any security considerations, but they will be added in future revision.
8. Informative References

[I-D.ietf-alto-problem-statement]

[I-D.ietf-alto-reqs]

[I-D.penno-alto-protocol]
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Appendix A. Acknowledgments

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