XEP-0495: Happy Eyeballs

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When a server's IPv4 path and protocol are working, but the server's IPv6 path and protocol are not working, a dual-stack application that initiates a connect experiences significant connection delay compared to an IPv4-only application. This is undesirable because it causes the dual-stack initiating entity to have a worse user experience. This XEP defines how IETF's 'Happy Eyeballs' algorithm requirements that reduce this user-visible delay are applied to XMPP.

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1 Introduction

In context of establishing TCP connections between XMPP entities, RFC 6120 [1] defines the resolution of Fully Qualified Domain Names of the receiving entity (server) by an initiating entity (client or server). The described Preferred Process uses SRV lookup, based on RFC 2782 [2], and a Fallback Process using A or AAAA record resolution.
The Preferred Process definition explicitly states that resolved addresses are tried in a particular sequence, progressing to the next address only after a preceding connection attempt has failed. As specific addresses or entire address families (IPv4 vs IPv6) may perform suboptimal on a network, or may be blocked, or broken completely, this can lead to user-visible delay.
Requirements for algorithms that reduce such delay are specified in RFC 8305 [3]. This XEP defines how this 'Happy Eyeballs' technique can be applied to XMPP, thus reducing the aforementioned user-visible delays.

2 Glossary

This document mostly uses terminology borrowed from RFC 2782 [4], RFC 6724 [5] and RFC 8305 [6].

Dual Stacked (hosts) (from RFC 2782) Hosts that support both the IPv4 and IPv6 address families.

Target host (from RFC 2782) A host (typically represented by a domain name) that is announced in the Target attribute of an SRV resource record. Used to identify service that provide an (XMPP) service.

Priority group Target hosts in an SRV response that share the same 'priority' value

Resolution Delay The time to wait for an AAAA response after receiving an A response (from RFC 8305) and to wait for a response to the request made against the first (by SRV 'weight' ordering) target after receiving a response for a later target.

3 Requirements

The primary goal of 'Happy Eyeballs' is to reduce user-visible delays when connections are established, notably on dual-stacked hosts.

[1] RFC 6120: Extensible Messaging and Presence Protocol (XMPP): Core <http://tools.ietf.org/html/rfc6120>.
[2] RFC 2782: A DNS RR for specifying the location of services (DNS SRV) <http://tools.ietf.org/html/rfc2782>.
[3] RFC 8305: Happy Eyeballs Version 2: Better Connectivity Using Concurrency <http://tools.ietf.org/html/rfc8305>.
[4] RFC 2782: A DNS RR for specifying the location of services (DNS SRV) <http://tools.ietf.org/html/rfc2782>.
[5] RFC 6724: Default Address Selection for Internet Protocol Version 6 (IPv6) <http://tools.ietf.org/html/rfc6724>.
[6] RFC 8305: Happy Eyeballs Version 2: Better Connectivity Using Concurrency <http://tools.ietf.org/html/rfc8305>.

The 'Happy Eyeballs' algorithm as defined in RFC 8305 [7] does not take into account the SRV lookup that is defined to be XMPP's Preferred Process for the resolution of Fully Qualified Domain Names. SRV defines attributes that are used for target host priority and server selection.
By deploying multiple SRV Resource Records (RR) that contain 'weight' and 'priority' attributes that are unequal to that of other RRs, the administrator explicitly defines that certain servers are more preferable than others. As this is a deliberate act, such information SHOULD NOT be discarded. This XEP describes how these attributes are best applied in a 'Happy Eyeballs' algorithm.

4 Algorithm

The 'Happy Eyeballs' algorithm described in this section applies primarily to the Preferred Process of resolution of fully qualified domain names as described in RFC 6120 [8], section 3.2.1, as it largely focuses on the incorporation of address characteristics discovered through SRV lookups.
When an initiation entity makes use of the Fallback Process defined in RFC 6120 [9], Section 3.2.2, then the 'Happy Eyeballs' algorithm defined in this XEP is essentially the same as the algorithm that is specified in RFC 8305 [10].

4.1 Service Resolution

The initiating entity preforms an SRV lookup, sorts and orders the resulting list of target hosts, as defined in the 'Usage rules' section of RFC 2782 [11]. This results in a complete, ordered list of target hosts.
To maintain strict ordering as defined by the 'priority' attribute of SRV, the remainder of the algorithm is applied iteratively for each group of target hosts that shares the same SRV 'priority' value ('priority groups'), in priority order (lowest first, as specified in RFC 2782 [12]). Only after all connection attempts (as described in section 4.4) for all target hosts in the first priority group are exhausted, target hosts for the subsequent priority group are processed. This is repeated for all priority groups.

[7] RFC 8305: Happy Eyeballs Version 2: Better Connectivity Using Concurrency <http://tools.ietf.org/html/rfc8305>.
[8] RFC 6120: Extensible Messaging and Presence Protocol (XMPP): Core <http://tools.ietf.org/html/rfc6120>.
[9] RFC 6120: Extensible Messaging and Presence Protocol (XMPP): Core <http://tools.ietf.org/html/rfc6120>.
[10] RFC 8305: Happy Eyeballs Version 2: Better Connectivity Using Concurrency <http://tools.ietf.org/html/rfc8305>.
[11] RFC 2782: A DNS RR for specifying the location of services (DNS SRV) <http://tools.ietf.org/html/rfc2782>.
[12] RFC 2782: A DNS RR for specifying the location of services (DNS SRV) <http://tools.ietf.org/html/rfc2782>.

4.2 Hostname Resolution

The initiating entity sends out both AAAA and A DNS queries, largely following the process as defined in section 3 'Hostname Resolution Query Handling' of RFC 8305 [13]. The process defined therein, which is based on resolution of one hostname, is adjusted as follows to accommodate the lookup of more than one hostname (each of the target hosts returned by the SRV lookup): An AAAA and A query is sent out for each host in the priority group, starting with an AAAA query for the first host, immediately followed by an A query for the first host. This is immediately followed by an AAAA query, and then an A query, for the second host. This is repeated for all hosts in the priority group.
In line with section 3 of RFC 8305 [14], a connection attempt is immediately started if a positive AAAA response for the first host is received first, and the 'Resolution Delay' is applied when the A response for that host is received first due to reordering. As stated in RFC 8305 [15], this is done to give preference to IPv6. In addition to the specification in RFC 8305 [16], the 'Resolution Delay' is *also* applied when responses for hosts other than the first target are received prior to receiving responses for the first target. This helps maintain the preference order that is derived from SRV's 'weight' attribute.

4.3 Sorting Addresses

RFC 8305 [17], Section 4 describes how resolved addresses are sorted before attempts are mode to connect to them, which is a slightly modified version fo the Destination Address Selection as defined in RFC 6724 [18], Section 6.
An additional Destination Selection rule that prefers an addresses by their SRV-defined Weight attribute SHOULD be added before rule 9 of RFC 6724 [19] (but after the two rules added by RFC 8305 [20]).

[13] RFC 8305: Happy Eyeballs Version 2: Better Connectivity Using Concurrency <http://tools.ietf.org/html/rfc8305>.
[14] RFC 8305: Happy Eyeballs Version 2: Better Connectivity Using Concurrency <http://tools.ietf.org/html/rfc8305>.
[15] RFC 8305: Happy Eyeballs Version 2: Better Connectivity Using Concurrency <http://tools.ietf.org/html/rfc8305>.
[16] RFC 8305: Happy Eyeballs Version 2: Better Connectivity Using Concurrency <http://tools.ietf.org/html/rfc8305>.
[17] RFC 8305: Happy Eyeballs Version 2: Better Connectivity Using Concurrency <http://tools.ietf.org/html/rfc8305>.
[18] RFC 6724: Default Address Selection for Internet Protocol Version 6 (IPv6) <http://tools.ietf.org/html/rfc6724>.
[19] RFC 6724: Default Address Selection for Internet Protocol Version 6 (IPv6) <http://tools.ietf.org/html/rfc6724>.
[20] RFC 8305: Happy Eyeballs Version 2: Better Connectivity Using Concurrency <http://tools.ietf.org/html/rfc8305>.

4.4 Connection Attempts

Connection attempts are made as described in RFC 8305 [21], Section 5. If no successful connection has been established after the entire sorted list of addresses has been processed, the initiating client can restart the algorithm with Hostname Resolution of the next priority group.
When all priority groups are exhausted and no connection has been successfully established, the initiating entity MAY attempt to establish connections using Fallback Process defined in RFC 6120 [22], Section 3.2.2. If it does, it SHOULD implement this in accordance with the 'Happy Eyeballs' algorithm as defined in RFC 8305 [23].

5 Implementation Notes

This XEP, similar to RFC 8305 [24], assumes that the preference policy for the host destination address favors IPv6 over IPv4, as it has many desirable properties designed to be improvements over IPv4. If so desired, the recommendations in this document can easily be adapted to change to reflect a different preference policy.

6 Accessibility Considerations

This document does not require any Accessibility Considerations.

7 Security Considerations

This document does not define Security Considerations in addition to those defined in RFC 2782 [25], RFC 6724 [26] and RFC 8305 [27]

[21] RFC 8305: Happy Eyeballs Version 2: Better Connectivity Using Concurrency <http://tools.ietf.org/html/rfc8305>.
[22] RFC 6120: Extensible Messaging and Presence Protocol (XMPP): Core <http://tools.ietf.org/html/rfc6120>.
[23] RFC 8305: Happy Eyeballs Version 2: Better Connectivity Using Concurrency <http://tools.ietf.org/html/rfc8305>.
[24] RFC 8305: Happy Eyeballs Version 2: Better Connectivity Using Concurrency <http://tools.ietf.org/html/rfc8305>.
[25] RFC 2782: A DNS RR for specifying the location of services (DNS SRV) <http://tools.ietf.org/html/rfc2782>.
[26] RFC 6724: Default Address Selection for Internet Protocol Version 6 (IPv6) <http://tools.ietf.org/html/rfc6724>.
[27] RFC 8305: Happy Eyeballs Version 2: Better Connectivity Using Concurrency <http://tools.ietf.org/html/rfc8305>.

8 Privacy Considerations

This document does not define Privacy Considerations in addition to those defined in RFC 2782 [28], RFC 6724 [29] and RFC 8305 [30]

9 IANA Considerations

This document does not require any IANA actions.

10 XMPP Registrar Considerations

This document does not require any XMPP Registrar actions.

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[28] RFC 2782: A DNS RR for specifying the location of services (DNS SRV) <http://tools.ietf.org/html/rfc2782>.
[29] RFC 6724: Default Address Selection for Internet Protocol Version 6 (IPv6) <http://tools.ietf.org/html/rfc6724>.
[30] RFC 8305: Happy Eyeballs Version 2: Better Connectivity Using Concurrency <http://tools.ietf.org/html/rfc8305>.