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Moving A6 to Historic Status

Abstract

This document provides a summary of issues related to the use of A6 records, discusses the current status, and moves RFC 2874 to Historic status, providing clarity to implementers and operators.

Status of This Memo

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1. Introduction and Background

The IETF began standardizing two different DNS protocol enhancements for IPv6 addresses in DNS records: AAAA was specified in 1995 as a Proposed Standard [RFC1886] and later in 2003 as a Draft Standard [RFC3596], and A6 appeared in 2000 as a Proposed Standard [RFC2874].

The existence of multiple ways to represent an IPv6 address in the DNS has led to confusion and conflicts about which of these protocol enhancements should be implemented and/or deployed. Having more than one choice of how IPv6 addresses are to be represented within the DNS can be argued to have led to delays in the deployment of IPv6. In 2002, "Representing Internet Protocol version 6 (IPv6) Addresses in the Domain Name System (DNS)" [RFC3363] moved A6 to Experimental status, with an aim of clearing up any confusion in this area. [RFC3363] and [RFC3364] compared AAAA and A6, and examined many of the issues in the A6 standard; these issues are summarized in this document.

After ten years, the Experimental status of A6 continues to result in confusion and parallel deployment of both A6 and AAAA, albeit AAAA predominates by a large degree. In recent IPv6 transition tests and deployments, some providers informally mentioned A6 support as a possible future choice.

This document provides a brief summary of the issues related to the use of A6 records and discusses the current usage status of A6. Given the implications of A6 on the DNS architecture and the state of A6 deployment, this document moves RFC 2874 [RFC2874] to Historic status, thereby clarifying that implementers and operators should represent IPv6 addresses in the DNS by using AAAA records only.

1.1. Standards Action Taken

Per this document, the status of RFC 2874 has been changed from Experimental to Historic.

2. A6 Issues

This section summarizes the known issues associated with the use of A6 resource records (RRs), including the analyses explored in [RFC3363]. The reader is encouraged to review that document to fully understand the issues relating to A6.

2.1. Resolution Latency

Resolving an A6 record chain can involve resolving a series of subqueries that are likely to be independent of each other. Each of these subqueries takes a non-negligible amount of time unless the answer already happens to be in the resolver's cache. In the worst-case scenario, the time spent resolving an N-link chain A6 record would be the sum of the latency resulting from each of the N resolutions. As a result, long A6 chains would likely increase user frustration due to an excessive wait time for domain names to resolve.

In practice, it is very hard to derive a reasonable timeout-handling strategy for the reassembly of all the results from A6 subqueries. It has proved difficult to decide multiple timeout parameters, including: (1) the communication timeout for a single A6 fragment, (2) the communication timeout for the IPv6 address itself (total time needed for reassembly), and (3) the Time to Live (TTL) timeout for A6 fragment records.

2.2. Resolution Failure

The probability of A6 resolution failure during the process of resolving an N-link A6 chain is the sum of the probabilities of failure of each subquery, since each of the queries involved in resolving an A6 chain has a nonzero probability of failure, and an A6 resolution cannot complete until all subqueries have succeeded.

Furthermore, the failure may happen at any link among 1~N of an N-Link A6 chain. Therefore, it would take an indeterminate time to return a failure result.

2.3. Cross Administrative Domains

One of the primary motivations for the A6 RR is to facilitate renumbering and multihoming, where the prefix name field in the A6 RR points to a target that is not only outside the DNS zone containing the A6 RR, but is administered by a different organization entirely.

While pointers out-of-zone are not a problem per se, experience both with glue RRs and with PTR RRs in the IN-ADDR.ARPA tree suggests that pointers to other organizations are often not maintained properly, perhaps because they're less amenable to automation than pointers within a single organization would be.

2.4. Difficult Maintenance

In A6, changes to components of an RR are not isolated from the use of the composite IPv6 address. Any change to a non-128-bit component of an A6 RR may cause change to a large number of IPv6 addresses. The relationship dependency actually makes the maintenance of addresses much more complicated and difficult. Without understanding these complicated relationships, any arbitrary change for a non-128-bit A6 RR component may result in undesired consequences.

Multiple correlative subcomponents of A6 records may have different TTLs, which can make cache maintenance very complicated.

2.5. Existence of Multiple RR Types for One Purpose Is Harmful

If both AAAA and A6 records were widely deployed in the global DNS, it would impose more query delays to the client resolvers. DNS clients have insufficient knowledge to choose between AAAA and A6 queries, requiring local policy to determine which record type to query. If local policy dictates parallel queries for both AAAA and A6 records, and if those queries returned different results for any reason, the clients would have no knowledge about which address to choose.

2.6. Higher Security Risks

The dependency relationships inherent in A6 chains increase security risks. An attacker may successfully attack a single subcomponent of an A6 record, which would then influence many query results, and possibly every host on a large site. There is also the danger of unintentionally or maliciously creating a resolution loop -- an A6 chain may create an infinite loop because an out of zone pointer may point back to another component farther down the A6 chain.

3. Current Usage of A6

Full support for IPv6 in the global DNS can be argued to have started when the first IPv6 records were associated with root servers in early 2008.

One of the major DNS server software packages, BIND9 [BIND], supports both A6 and AAAA, and is unique among the major DNS resolvers in that certain versions of the BIND9 resolver will attempt to query for A6 records and follow A6 chains.

According to published statistics for two root DNS servers (the "K" root server [KROOT] and the "L" root server [LROOT]), there are between 9,000 and 14,000 DNS queries per second on the "K" root server and between 13,000 to 19,000 queries per second on the "L" root server. The distributions of those queries by RR type are similar: roughly 60% A queries, 20˜25% AAAA queries, and less than 1% A6 queries.

3.1. Reasons for Current A6 Usage

That there is A6 query traffic does not mean that A6 is actually in use; it is likely the result of some recursive servers that issue internally generated A6 queries when looking up missing name server addresses, in addition to issuing A and AAAA queries.

BIND versions 9.0 through 9.2 could be configured to make A6 queries, and it is possible that some active name servers running those versions have not yet been upgraded.

In the late 1990s, A6 was considered to be the future in preference to AAAA [RFC2874]. As a result, A6 queries were tried by default in BINDv9 versions. When it was pointed out that A6 had some fundamental issues (discussed in [A6DISC] with the deprecation codified in RFC 3363), A6 was abandoned in favor of AAAA and BINDv9 no longer tried A6 records by default. A6 was removed from the query order in the BIND distribution in 2004 or 2005.

Some Linux/glibc versions may have had A6 query implementations in gethostbyname() 8-10 years ago. These operating systems/libraries may not have been replaced or upgraded everywhere yet.

4. Moving A6 to Historic Status

This document moves the A6 specification to Historic status. This move provides a clear signal to implementers and/or operators that A6 should NOT be implemented or deployed.

4.1. Impact on Current A6 Usage

If A6 were in use and it were to be treated as an 'unknown record' (RFC3597) as discussed below, it might lead to some interoperability issues since resolvers that support A6 are required to do additional section processing for these records on the wire. However, as there are no known production uses of A6, the impact is considered negligible.

4.2. Transition Phase for Current A6 Usage

Since there is no known A6-only client in production use, the transition phase may not be strictly necessary. However, clients that attempt to resolve A6 before AAAA will suffer a performance penalty. Therefore, we recommend that:

* A6 handling from all new or updated host stacks be removed;

* All existing A6 records be removed; and,

* All resolver and server implementations to return the same response as for any unknown or deprecated RR type for all A6 queries. If a AAAA record exists for the name being resolved, a suitable response would be 'no answers/no error', i.e., the response packet has an answer count of 0 but no error is indicated.

5. Security Considerations

Removing A6 records will eliminate any security exposure related to that RR type, and should introduce no new vulnerabilities.

6. IANA Considerations

IANA has updated the annotation of the A6 RR type (code 38) from "Experimental" to "Obsolete" in the DNS Parameters registry.

7. Acknowledgments

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