

Network Working Group  
Internet-Draft  
Updates: [6376](#) (if approved)  
Intended status: Standards Track  
Expires: November 30, 2018

J. Levine  
Taughannock Networks  
May 29, 2018

A new cryptographic signature method for DKIM  
draft-ietf-dcrup-dkim-crypto-10

## Abstract

This document adds a new signing algorithm to DKIM, ed25519-sha256. DKIM verifiers are required to implement this algorithm.

## Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of [BCP 78](#) and [BCP 79](#).

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at <https://datatracker.ietf.org/drafts/current/>.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on November 30, 2018.

## Copyright Notice

Copyright (c) 2018 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to [BCP 78](#) and the IETF Trust's Legal Provisions Relating to IETF Documents (<https://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Internet-Draft

DKIM Crypto Update

May 2018

## Table of Contents

<a href="#">1.</a>	Introduction . . . . .	<a href="#">2</a>
<a href="#">2.</a>	Conventions Used in This Document . . . . .	<a href="#">2</a>
<a href="#">3.</a>	Ed25519-SHA256 Signing Algorithm . . . . .	<a href="#">3</a>
<a href="#">4.</a>	Signature and key syntax . . . . .	<a href="#">3</a>
<a href="#">4.1.</a>	Signature syntax . . . . .	<a href="#">3</a>
<a href="#">4.2.</a>	Key syntax . . . . .	<a href="#">3</a>
<a href="#">5.</a>	Key and algorithm choice and strength . . . . .	<a href="#">4</a>
<a href="#">6.</a>	Transition Considerations . . . . .	<a href="#">4</a>
<a href="#">7.</a>	Security Considerations . . . . .	<a href="#">4</a>
<a href="#">8.</a>	IANA Considerations . . . . .	<a href="#">4</a>
<a href="#">8.1.</a>	DKIM Key Type registry . . . . .	<a href="#">4</a>
<a href="#">9.</a>	References . . . . .	<a href="#">4</a>
<a href="#">9.1.</a>	Normative References . . . . .	<a href="#">5</a>
<a href="#">9.2.</a>	Informative References . . . . .	<a href="#">5</a>
<a href="#">9.3.</a>	URIs . . . . .	<a href="#">5</a>
<a href="#">Appendix A.</a>	Example of a signed message . . . . .	<a href="#">5</a>
<a href="#">A.1.</a>	Secret key . . . . .	<a href="#">5</a>
<a href="#">A.2.</a>	Public key DNS record . . . . .	<a href="#">6</a>
<a href="#">A.3.</a>	Signed Message . . . . .	<a href="#">6</a>
<a href="#">Appendix B.</a>	Change log . . . . .	<a href="#">6</a>
	Author's Address . . . . .	<a href="#">7</a>

[1.](#) Introduction

Discussion Venue: Discussion about this draft is directed to the [dcrup@ietf.org](mailto:dcrup@ietf.org) [\[1\]](#) mailing list.

DKIM [\[RFC6376\]](#) signs e-mail messages, by creating hashes of the message headers and body and signing the header hash with a digital signature. Message recipients fetch the signature verification key from the DNS. The defining documents specify a single signing algorithm, RSA [\[RFC3447\]](#).

This document adds a new stronger signing algorithm, Edwards-Curve Digital Signature Algorithm using the Curve25519 curve (ed25519), which has much shorter keys than RSA for similar levels of security.

[2.](#) Conventions Used in This Document

The capitalized 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 [\[RFC2119\]](#).

Syntax descriptions use Augmented BNF (ABNF) [\[RFC5234\]](#). The ABNF tokens sig-a-tag-k and key-k-tag-type are imported from [\[RFC6376\]](#).

Levine

Expires November 30, 2018

[Page 2]

---

Internet-Draft

DKIM Crypto Update

May 2018

### [3.](#) Ed25519-SHA256 Signing Algorithm

The ed25519-sha256 signing algorithm computes a message hash as defined in [section 3 of \[RFC6376\]](#) using SHA-256 [\[FIPS-180-4-2015\]](#) as the hash-alg, and signs it with the PureEDdSA variant Ed25519, as defined in [RFC 8032 section 5.1 \[RFC8032\]](#). Example keys and signatures in [Appendix A](#) below are based on the test vectors in [RFC 8032 section 7.1 \[RFC8032\]](#).

The DNS record for the verification public key has a "k=ed25519" tag to indicate that the key is an Ed25519 rather than RSA key.

This is an additional DKIM signature algorithm added to [Section 3.3 of \[RFC6376\]](#) as envisioned in [Section 3.3.4 of \[RFC6376\]](#).

Note: since Ed25519 keys are 256 bits long, the base64 encoded key is only 44 octets, so DNS key record data will generally fit in a single 255 byte TXT string, and will work even with DNS provisioning software that doesn't handle multi-string TXT records.

### [4.](#) Signature and key syntax

The syntax of DKIM signatures and DKIM keys are updated as follows.

#### [4.1.](#) Signature syntax

The syntax of DKIM algorithm tags in [section 3.5 of \[RFC6376\]](#) is updated by adding this rule to the existing rule for sig-a-tag-k:

ABNF:

```
sig-a-tag-k =/ "ed25519"
```

#### [4.2.](#) Key syntax

The syntax of DKIM key tags in [section 3.6.1 of \[RFC6376\]](#) is updated

by adding this rule to the existing rule for key-k-tag-type:

ABNF:

```
key-k-tag-type  =/ "ed25519"
```

The p= value in the key record is the ed25519 public key encoded in base64. Since the key is 256 bits long, the base64 text is 44 octets long. For example, a key record using the public key in [\[RFC8032\]](#) [Section 7.1](#), Test 1, might be:

Levine

Expires November 30, 2018

[Page 3]

---

Internet-Draft

DKIM Crypto Update

May 2018

```
s._domainkey.example TXT (  
  "v=DKIM1; k=ed25519; p=11qYAYKxCrfVS/7TyWQH0g7hcvPapiMlrwIaaPcHURo="  
  )
```

## [5.](#) Key and algorithm choice and strength

[Section 3.3 of \[RFC6376\]](#) describes DKIM's hash and signature algorithms. It is updated as follows:

Signers SHOULD implement and verifiers MUST implement the ed25519-sha256 algorithm.

## [6.](#) Transition Considerations

For backward compatibility, signers MAY add multiple signatures that use old and new signing algorithms. Since there can only be a single key record in the DNS for each selector, the signatures will have to use different selectors, although they can use the same d= and i= identifiers.

## [7.](#) Security Considerations

Ed25519 is a widely used cryptographic technique, so the security of DKIM signatures using new signing algorithms should be at least as good as those using old algorithms.

## [8.](#) IANA Considerations

IANA is requested to update registries as follows.

## 8.1. DKIM Key Type registry

The following value is added to the DKIM Key Type Registry

TYPE	REFERENCE	STATUS
ed25519	[RFC8032]	active

Table 1: DKIM Key Type Registry Added Values

## 9. References

Levine Expires November 30, 2018 [Page 4]

---

Internet-Draft DKIM Crypto Update May 2018

### 9.1. Normative References

- [FIPS-180-4-2015] U.S. Department of Commerce, "Secure Hash Standard", FIPS PUB 180-4, August 2015, <<http://nvlpubs.nist.gov/nistpubs/FIPS/NIST.FIPS.180-4.pdf>>.
- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <<https://www.rfc-editor.org/info/rfc2119>>.
- [RFC5234] Crocker, D., Ed. and P. Overell, "Augmented BNF for Syntax Specifications: ABNF", STD 68, RFC 5234, DOI 10.17487/RFC5234, January 2008, <<https://www.rfc-editor.org/info/rfc5234>>.
- [RFC6376] Crocker, D., Ed., Hansen, T., Ed., and M. Kucherawy, Ed., "DomainKeys Identified Mail (DKIM) Signatures", STD 76, RFC 6376, DOI 10.17487/RFC6376, September 2011, <<https://www.rfc-editor.org/info/rfc6376>>.

[RFC8032] Josefsson, S. and I. Liusvaara, "Edwards-Curve Digital Signature Algorithm (EdDSA)", [RFC 8032](#), DOI 10.17487/RFC8032, January 2017, <<https://www.rfc-editor.org/info/rfc8032>>.

## [9.2.](#) Informative References

[RFC3447] Jonsson, J. and B. Kaliski, "Public-Key Cryptography Standards (PKCS) #1: RSA Cryptography Specifications Version 2.1", [RFC 3447](#), DOI 10.17487/RFC3447, February 2003, <<https://www.rfc-editor.org/info/rfc3447>>.

## [9.3.](#) URIs

[1] <mailto:dcrup@ietf.org>

## [Appendix A.](#) Example of a signed message

This is a small message with an ed25519-rsa DKIM signature.

### [A.1.](#) Secret key

Ed25519 secret key in base64.

```
fL+5V9EquCZAovKik3pA6Lk9zwCzoEtjIuIqK9ZXHHA=
```

Levine

Expires November 30, 2018

[Page 5]

---

Internet-Draft

DKIM Crypto Update

May 2018

### [A.2.](#) Public key DNS record

```
test._domainkey.example.com IN TXT
```

```
"k=ed25519; p=yi50DjK509pqbFpNHklsv9lqaS0ArSYu02qp1S0DW1Y="
```

### [A.3.](#) Signed Message

The text in each line of the message start at the first position except for the five continuation lines on the DKIM-Signature which start with a single space.

```
DKIM-Signature: v=1; a=ed25519; c=relaxed/simple; d=example.com;
 i=@example.com; q=dns/txt; s=test; t=5; h=message-id :
 date : from : to : subject : date : from : subject;
 bh=wE7NXSkgnx9PGiavN40ZhJztkqPDlemV30GuEnLwNo=;
```

b=wt7P+9DoBwcln1RKE3LN7069ZEEiSyVE/NH1YXnqnJy4JcrSCZUbeIEh  
vXssPHeLX4yNSXG9eTGTwwk5NxYqBw==  
Received: from localhost  
Message-ID: <example@example.com>  
Date: Mon, 01 Jan 2011 01:02:03 +0400  
From: Test User <test@example.com>  
To: somebody@example.com  
Subject: Testing

This is a test message.

## [Appendix B](#). Change log

- 09 to 10 Improve abstract, minor nits.
- 08 to 09 Specify sha-256 for the extremely literal minded. Take out the prehash stuff. Add example.
- 07 to 08 Specify base64 key records. Style edits per Dave C.
- 06 to 07: Remove RSA fingerprints. Change Pure to hashed eddsa.
- 05 to 06: Editorial changes only.
- 04 to 05: Remove deprecation cruft and inconsistent key advice. Fix p= and k= text.
- 03 to 04: Change eddsa to ed25519. Add Martin's key regeneration issue. Remove hashed ed25519 keys. Fix typos and clarify text. Move syntax updates to separate section. Take out SHA-1 stuff.
- 01 to 02: Clarify EdDSA algorithm is ed25519 with Pure version of the signing. Make references to tags and fields consistent.

Levine

Expires November 30, 2018

[Page 6]

---

Internet-Draft

DKIM Crypto Update

May 2018

### Author's Address

John Levine  
Taughannock Networks  
PO Box 727  
Trumansburg, NY 14886

Phone: +883.5100.01196712

Email: [standards@taugh.com](mailto:standards@taugh.com)