

Internet Engineering Task Force (IETF)  
Request for Comments: 8080  
Category: Standards Track  
ISSN: 2070-1721

O. Sury  
CZ.NIC  
R. Edmonds  
Fastly  
February 2017

## Edwards-Curve Digital Security Algorithm (EdDSA) for DNSSEC

### Abstract

This document describes how to specify Edwards-curve Digital Security Algorithm (EdDSA) keys and signatures in DNS Security (DNSSEC). It uses EdDSA with the choice of two curves: Ed25519 and Ed448.

### Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at <http://www.rfc-editor.org/info/rfc8080>.

### Copyright Notice

Copyright (c) 2017 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 (<http://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.

## Table of Contents

1. Introduction . . . . .	2
2. Requirements Language . . . . .	2
3. DNSKEY Resource Records . . . . .	2
4. RRSIG Resource Records . . . . .	3
5. Algorithm Number for DS, DNSKEY, and RRSIG Resource Records .	3
6. Examples . . . . .	3
6.1. Ed25519 Examples . . . . .	3
6.2. Ed448 Examples . . . . .	4
7. IANA Considerations . . . . .	5
8. Security Considerations . . . . .	5
9. References . . . . .	6
9.1. Normative References . . . . .	6
9.2. Informative References . . . . .	7
Acknowledgements . . . . .	7
Authors' Addresses . . . . .	7

## 1. Introduction

DNSSEC, which is broadly defined in [RFC4033], [RFC4034], and [RFC4035], uses cryptographic keys and digital signatures to provide authentication of DNS data. Currently, the most popular signature algorithm in use is RSA. GOST [RFC5933] and NIST-specified elliptic curve cryptography [RFC6605] are also standardized.

[RFC8032] describes the elliptic curve signature system Edwards-curve Digital Signature Algorithm (EdDSA) and recommends two curves, Ed25519 and Ed448.

This document defines the use of DNSSEC's DS, DNSKEY, and RRSIG resource records (RRs) with a new signing algorithm, EdDSA, using a choice of two curves: Ed25519 and Ed448.

## 2. Requirements Language

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 [RFC2119].

## 3. DNSKEY Resource Records

An Ed25519 public key consists of a 32-octet value, which is encoded into the Public Key field of a DNSKEY resource record as a simple bit string. The generation of a public key is defined in Section 5.1.5 of [RFC8032].

An Ed448 public key consists of a 57-octet value, which is encoded into the Public Key field of a DNSKEY resource record as a simple bit string. The generation of a public key is defined in Section 5.2.5 of [RFC8032].

#### 4. RRSIG Resource Records

An Ed25519 signature consists of a 64-octet value, which is encoded into the Signature field of an RRSIG resource record as a simple bit string. The Ed25519 signature algorithm and verification of the Ed25519 signature are described in Sections 5.1.6 and 5.1.7 of [RFC8032], respectively.

An Ed448 signature consists of a 114-octet value, which is encoded into the Signature field of an RRSIG resource record as a simple bit string. The Ed448 signature algorithm and verification of the Ed448 signature are described in Sections 5.2.6 and 5.2.7 of [RFC8032], respectively.

#### 5. Algorithm Number for DS, DNSKEY, and RRSIG Resource Records

The algorithm number associated with the use of Ed25519 in DS, DNSKEY, and RRSIG resource records is 15. The algorithm number associated with the use of Ed448 in DS, DNSKEY, and RRSIG resource records is 16. This registration is fully defined in the IANA Considerations section.

#### 6. Examples

##### 6.1. Ed25519 Examples

Private-key-format: v1.2

Algorithm: 15 (ED25519)

PrivateKey: ODIyNjAzODQ2MjgwODAxMjI2NDUxOTAYMDQxNDIyNjI=

```
example.com. 3600 IN DNSKEY 257 3 15 (
    102Woi0iS8Aa25FQkUd9RMzZHJpBoRQwAQEX1SxZJA4= )
```

```
example.com. 3600 IN DS 3613 15 2 (
    3aa5ab37efce57f737fc1627013fee07bdf241bd10f3b1964ab55c78e79
    a304b )
```

```
example.com. 3600 IN MX 10 mail.example.com.
```

```
example.com. 3600 IN RRSIG MX 3 3600 (
    1440021600 1438207200 3613 example.com. (
    Edk+IB9KNNWg0HAjm7FazXyrd5m3Rk8zNZbvNpAcM+eysqcUOMIjWoevFkj
    H5GaMWeG96GUVZu6ECKOQmemHDg== )
```

```
Private-key-format: v1.2
Algorithm: 15 (ED25519)
PrivateKey: DSSF3o0s0f+ElWzj9E/Osxxw8hLpk55chkmx0LYN5WiY=
```

```
example.com. 3600 IN DNSKEY 257 3 15 (
    zPnZ/QwEe7S8C5SPz2OfS5RR40Atk2/rYnE9xHIEijs= )
```

```
example.com. 3600 IN DS 35217 15 2 (
    401781b934e392de492ec77ae2e15d70f6575a1c0bc59c5275c04ebe80c
    6614c )
```

```
example.com. 3600 IN MX 10 mail.example.com.
```

```
example.com. 3600 IN RRSIG MX 3 3600 (
    1440021600 1438207200 35217 example.com. (
    5LL2obmzdqjWI+Xto5eP5adXt/T5tMhasWvwcyW4L3SzfcRawOle9bodhC+
    oip9ayUGjY9T/rL4rN3bOuESGDA== )
```

## 6.2. Ed448 Examples

```
Private-key-format: v1.2
Algorithm: 16 (ED448)
PrivateKey: xZ+5Cgm463xugtkY5B0Jx6erFTXpl3rYegst0qRtNsOYnaVpMx0Z/c5EiA9x
    8wWbDDct/U3FhYWA
```

```
example.com. 3600 IN DNSKEY 257 3 16 (
    3kgROaDjrh0H2iuixWBrc8g2EpBBLCdGzHmn+G2MpTPhpj/OiBVHHSfPodx
    1FYUcJKmlMDpJtIA )
```

```
example.com. 3600 IN DS 9713 16 2 (
    6ccf18d5bc5d7fc2fceb1d59d17321402f2aa8d368048db93dd811f5cb2
    b19c7 )
```

```
example.com. 3600 IN MX 10 mail.example.com.
```

```
example.com. 3600 IN RRSIG MX 3 3600 (
    1440021600 1438207200 9713 example.com. (
    Nmc0rgGKpr3GKYXcBlJmqqs4NYwhmechvJTqVzt3jR+Qy/1SLFoIk1L+9e3
    9GPL+5tVzDPN3f9kAwu8KCUPPjt1227ayaCZtRKZuJax7n9NuYlZJIusX0
    SOIOKBGzG+yWYtz1/jjbzl5GGkWvREUCUA )
```

```
Private-key-format: v1.2
Algorithm: 16 (ED448)
PrivateKey: WEyKD3ht3MHkU8iH4uVOLz8JLwtRBSqiBoM6fF72+Mrp/u5gjxuB1DV6NnPO
          2BlZdz4hdSTkOdOA
```

```
example.com. 3600 IN DNSKEY 257 3 16 (
          kkreGWoccsDmUBGAe7+zsbG6ZAFQp+syPmYUurBRQc3tDjeMCJcVMRDmgcN
          Lp5HlHAMy12VoISsa )
```

```
example.com. 3600 IN DS 38353 16 2 (
          645ff078b3568f5852b70cb60e8e696cc77b75bfaaffc118cf79cbdalba
          28af4 )
```

```
example.com. 3600 IN MX 10 mail.example.com.
```

```
example.com. 3600 IN RRSIG MX 3 3600 (
          1440021600 1438207200 38353 example.com. (
          +JjANio/LIzp7osmMYE5XD3H/YES8kXs5Vb9H8MjPS8OAGZMD37+LsCIcJg
          5ivt0d4Om/UaqETEAsJjaYe56CEQP5lhrWuD2ivBqE0zfwJTyp4WqvpULbp
          vaukswwv/WNEFxzEYQEIm9+xDlXj4pMAMA )
```

## 7. IANA Considerations

This document updates the IANA registry "Domain Name System Security (DNSSEC) Algorithm Numbers". The following entries have been added to the registry:

Number	15	16
Description	Ed25519	Ed448
Mnemonic	ED25519	ED448
Zone Signing	Y	Y
Trans. Sec.	*	*
Reference	RFC 8080	RFC 8080

- \* There has been no determination of standardization of the use of this algorithm with Transaction Security.

## 8. Security Considerations

The security considerations of [RFC8032] and [RFC7748] are inherited in the usage of Ed25519 and Ed448 in DNSSEC.

Ed25519 is intended to operate at around the 128-bit security level and Ed448 at around the 224-bit security level. A sufficiently large quantum computer would be able to break both. Reasonable projections of the abilities of classical computers conclude that Ed25519 is

perfectly safe. Ed448 is provided for those applications with relaxed performance requirements and where there is a desire to hedge against analytical attacks on elliptic curves.

These assessments could, of course, change in the future if new attacks that work better than the ones known today are found.

A private key used for a DNSSEC zone MUST NOT be used for any other purpose than for that zone. Otherwise, cross-protocol or cross-application attacks are possible.

## 9. References

### 9.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <<http://www.rfc-editor.org/info/rfc2119>>.
- [RFC4033] Arends, R., Austein, R., Larson, M., Massey, D., and S. Rose, "DNS Security Introduction and Requirements", RFC 4033, DOI 10.17487/RFC4033, March 2005, <<http://www.rfc-editor.org/info/rfc4033>>.
- [RFC4034] Arends, R., Austein, R., Larson, M., Massey, D., and S. Rose, "Resource Records for the DNS Security Extensions", RFC 4034, DOI 10.17487/RFC4034, March 2005, <<http://www.rfc-editor.org/info/rfc4034>>.
- [RFC4035] Arends, R., Austein, R., Larson, M., Massey, D., and S. Rose, "Protocol Modifications for the DNS Security Extensions", RFC 4035, DOI 10.17487/RFC4035, March 2005, <<http://www.rfc-editor.org/info/rfc4035>>.
- [RFC7748] Langley, A., Hamburg, M., and S. Turner, "Elliptic Curves for Security", RFC 7748, DOI 10.17487/RFC7748, January 2016, <<http://www.rfc-editor.org/info/rfc7748>>.
- [RFC8032] Josefsson, S. and I. Liusvaara, "Edwards-Curve Digital Signature Algorithm (EdDSA)", RFC 8032, DOI 10.17487/RFC8032, January 2017, <<http://www.rfc-editor.org/info/rfc8032>>.

## 9.2. Informative References

- [RFC5933] Dolmatov, V., Ed., Chuprina, A., and I. Ustinov, "Use of GOST Signature Algorithms in DNSKEY and RRSIG Resource Records for DNSSEC", RFC 5933, DOI 10.17487/RFC5933, July 2010, <<http://www.rfc-editor.org/info/rfc5933>>.
- [RFC6605] Hoffman, P. and W. Wijngaards, "Elliptic Curve Digital Signature Algorithm (DSA) for DNSSEC", RFC 6605, DOI 10.17487/RFC6605, April 2012, <<http://www.rfc-editor.org/info/rfc6605>>.

## Acknowledgements

Some of the material in this document is copied liberally from [RFC6605].

The authors of this document wish to thank Jan Vcelak, Pieter Lexis, Kees Monshouwer, Simon Josefsson, Paul Hoffman, and others for a review of this document.

## Authors' Addresses

Ondrej Sury  
CZ.NIC  
Milesovska 1136/5  
Praha 130 00  
Czech Republic

Email: [ondrej.sury@nic.cz](mailto:ondrej.sury@nic.cz)

Robert Edmonds  
Fastly  
Atlanta, Georgia  
United States of America

Email: [edmonds@mycre.ws](mailto:edmonds@mycre.ws)

