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Use of GOST signature algorithms in DNSKEY and RRSIG Resource Records for DNSSEC
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Abstract

This document describes how to produce signature and hash using GOST (R 34.10-2001, R 34.11-94) algorithms foor DNSKEY, RRSIG and DS

resource records for use in the Domain Name System Security Extensions (DNSSEC).

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1. Introduction

The Domain Name System (DNS) is the global hierarchical distributed database for Internet Naming. The DNS has been extended to use cryptographic keys and digital signatures for the verification of the authenticity and integrity of its data. RFC 4033 [RFC4033], RFC 4034 [RFC4034], and RFC 4035 [RFC4035] describe these DNS Security Extensions, called DNSSEC.

RFC 4034 describes how to store DNSKEY and RRSIG resource records, and specifies a list of cryptographic algorithms to use. This document extends that list with the signature and hash algorithms GOST [GOST3410, GOST3411],
and specifies how to store DNSKEY data and how to produce RRSIG resource records with these hash algorithms.

Familiarity with DNSSEC and GOST signature and hash algorithms is assumed in this document.

The term "GOST" is not officially defined, but is usually used to refer to the collection of the Russian cryptographic algorithms GOST R 34.10-2001[DRAFT1], GOST R 34.11-94[DRAFT2], GOST 28147-89[DRAFT3].
Since GOST 28147-89 is not used in DNSSEC, "GOST" will only refer to the GOST R 34.10-2001 and GOST R 34.11-94 in this document.

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].

2. DNSKEY Resource Records

The format of the DNSKEY RR can be found in RFC 4034 [RFC4034].

GOST R 34.10-2001 public keys are stored with the algorithm number {TBA1}.

The wire format of the public key is compatible with RFC 4491 [RFC4491]:

According to [GOST3410], a public key is a point on the elliptic curve Q = (x,y).

The wire representation of a public key MUST contain 64 octets, where the first 32 octets contain the little-endian representation of x and the second 32 octets contain the little-endian representation of y.
This corresponds to the binary representation of (<y>256||<x>256) from [GOST3410], ch. 5.3.

Corresponding public key parameters are those identified by id-GostR3410-2001-CryptoPro-A-ParamSet (1.2.643.2.2.35.1) [RFC4357], and the digest parameters are those identified by id-GostR3411-94-CryptoProParamSet (1.2.643.2.2.30.1) [RFC4357].

2.1. Using a public key with existing cryptographic libraries

Existing GOST-aware cryptographic libraries at the time of this document writing are capable to read GOST public keys via a generic X509 API if the key is encoded according to RFC 4491 [RFC4491], section 2.3.2.

To make this encoding from the wire format of a GOST public key with the parameters used in this document, prepend the 64 octets of key data with the following 37-byte sequence:

```
0x30 0x63 0x30 0x1c 0x06 0x06 0x2a 0x85 0x03 0x02 0x02 0x13 0x30
0x12 0x06 0x07 0x2a 0x85 0x03 0x02 0x02 0x23 0x01 0x06 0x07 0x2a
0x85 0x03 0x02 0x02 0x1e 0x01 0x03 0x43 0x00 0x04 0x40
```

2.2. GOST DNSKEY RR Example

Given a private key with the following value (the value of GostAsn1 field is split here into two lines to simplify reading; in the private key file it must be in one line):

```
Private-key-format: v1.2
Algorithm: {TBA1} (ECC-GOST)
GostAsn1: MEUCAQAwHAYGKoUDAgITMBIGByqFAwICIwEGByqFAwICHgEEIgQgp9c
          t2LQaNS1vMKPLEN9zHYjLPNMIQN6QB9vt3AghZFA=
```

The following DNSKEY RR stores a DNS zone key for example.net

```
example.net. 86400 IN DNSKEY 256 3 {TBA1} (
                            GtTJjmZKUXV+lHLG/6crB6RCR+EJR51Islpa
                            6FqfT0MUfKhSn1yAo92+LJ0GDssTiAnj0H0I
                            9Jrfial/yyc5Og==
                            ) ; key id = 10805
```

3. RRSIG Resource Records

The value of the signature field in the RRSIG RR follows RFC 4490 [RFC4490] and is calculated as follows. The values for the RDATA fields that precede the signature data are specified in RFC 4034 [RFC4034].

```
hash = GOSTR3411(data)
```

where "data" is the wire format data of the resource record set that is signed, as specified in RFC 4034 [RFC4034].

Hash MUST be calculated with GOST R 34.11-94 parameters identified by id-GostR3411-94-CryptoProParamSet [RFC4357].

Signature is calculated from the hash according to the GOST R 34.10-2001 standard and its wire format is compatible with RFC 4490 [RFC4490].

Quoting RFC 4490:

"The signature algorithm GOST R 34.10-2001 generates a digital signature in the form of two 256-bit numbers, r and s. Its octet string representation consists of 64 octets, where the first 32 octets contain the big-endian representation of s and the second 32 octets contain the big-endian representation of r."

3.1. RRSIG RR Example

With the private key from section 2.2 sign the following RRSet, consisting of one A record:

```
www.example.net. 3600 IN A 192.0.2.1
```

Setting the inception date to 2000-01-01 00:00:00 UTC and the expiration date to 2030-01-01 00:00:00 UTC, the following signature should be created (assuming {TBA1}==249 until proper code is assigned by IANA)

```
www.example.net. 3600 IN RRSIG A {TBA1} 3 3600 20300101000000 (
                              20000101000000 10805 example.net.
                              k3m0r5bm6kFQmcRlHshY3jIj7KL6KTUsPIAp
                              Vy466khKuWEUoVvSkqI+9tvMQySQgZcEmS0W
                              HRFSm0XS5YST5g== )
```

Note: Several ECC-GOST signatures calculated for the same message text will differ because of using of a random element is used in signature generation process.

4. DS Resource Records

GOST R 34.11-94 digest algorithm is denoted in DS RRs by the digest type {TBA2}.The wire format of a digest value is compatible with RFC4490 [RFC4490], that is digest is in little-endian representation.

The digest MUST always be calculated with GOST R 34.11-94 parameters identified by id-GostR3411-94-CryptoProParamSet [RFC4357].

4.1. DS RR Example

For key signing key (assuming {TBA1}==249 until proper code is assigned by IANA)

```
example.net. 86400   DNSKEY  257 3 {TBA1} (
                              1aYdqrVz3JJXEURLMdmeI7H1CyTFfPVFBIGA
                              EabZFP+7NT5KPYXzjDkRbPWleEFbBilDNQNi
                              q/q4CwA4WR+ovg==
                              ) ; key id = 6204
```

The DS RR will be

```
example.net. 3600 IN DS 6204 {TBA1} {TBA2} (
          0E6D6CB303F89DBCF614DA6E21984F7A62D08BDD0A05B3A22CC63D1B
          553BC61E )
```

5. Deployment Considerations

5.1. Key Sizes

According to RFC4357 [RFC4357], the key size of GOST public keys MUST be 512 bits.

5.2. Signature Sizes

According to the GOST signature algorithm specification [GOST3410], the size of a GOST signature is 512 bits.

5.3. Digest Sizes

According to the GOST R 34.11-94 [GOST3411], the size of a GOST digest is 256 bits.

6. Implementation Considerations

6.1. Support for GOST signatures

DNSSEC aware implementations MAY be able to support RRSIG and DNSKEY resource records created with the GOST algorithms as defined in this document.

6.2. Support for NSEC3 Denial of Existence

Any DNSSEC-GOST implementation MUST support both NSEC[RFC4035] and NSEC3 [RFC5155]

6.3 Byte order

Due to the fact that all existing industry implementations of GOST cryptographic libraries are returning GOST blobs without transformation from little-endian format and in order to avoid the necessity for DNSSEC developers to handle different cryptographic algorithms differently, it was chosen to send these blobs on the wire "as is" without transformation of endianness.

7. Security considerations

Currently, the cryptographic resistance of the GOST 34.10-2001 digital signature algorithm is estimated as 2**128 operations of multiple elliptic curve point computations on prime modulus of order 2**256.

Currently, the cryptographic resistance of GOST 34.11-94 hash algorithm is estimated as 2**128 operations of computations of a step hash function. (There is known method to reduce this estimate to 2**105 operations, but it demands padding the colliding message with 1024 random bit blocks each of 256 bit length, thus it cannot be used in any practical implementation).

8. IANA Considerations

This document updates the IANA registry "DNS Security Algorithm Numbers" [RFC4034]
(http://www.iana.org/assignments/dns-sec-alg-numbers).
The following entries are added to the registry:

Value	Algorithm	Mnemonic	Zone Signing	Trans. Sec.	References	Status
{TBA1}	GOST R 34.10-2001	ECC-GOST	Y	*	(this memo)	OPTIONAL

This document updates the RFC 4034 Digest Types assignment (section A.2)by adding the value and status for the GOST R 34.11-94 algorithm:

Value	Algorithm	Status
{TBA2}	GOST R 34.11-94	OPTIONAL

9. Acknowledgments

This document is a minor extension to RFC 4034 [RFC4034]. Also, we tried to follow the documents RFC 3110 [RFC3110], RFC 4509 [RFC4509], and RFC 4357 [RFC4357] for consistency. The authors of and contributors to these documents are gratefully acknowledged for

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