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Network Working Group  
Request for Comments: 2535  
Obsoletes: 2065  
Updates: 2181, 1035, 1034  
Category: Standards Track

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March 1999

## Domain Name System Security Extensions

### Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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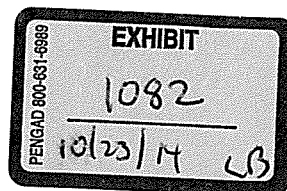
### Abstract

Extensions to the Domain Name System (DNS) are described that provide data integrity and authentication to security aware resolvers and applications through the use of cryptographic digital signatures. These digital signatures are included in secured zones as resource records. Security can also be provided through non-security aware DNS servers in some cases.

The extensions provide for the storage of authenticated public keys in the DNS. This storage of keys can support general public key distribution services as well as DNS security. The stored keys enable security aware resolvers to learn the authenticating key of zones in addition to those for which they are initially configured. Keys associated with DNS names can be retrieved to support other protocols. Provision is made for a variety of key types and algorithms.

In addition, the security extensions provide for the optional authentication of DNS protocol transactions and requests.

This document incorporates feedback on RFC 2065 from early implementers and potential users.



Acknowledgments

The significant contributions and suggestions of the following persons (in alphabetic order) to DNS security are gratefully acknowledged:

- James M. Galvin
- John Gilmore
- Olafur Gudmundsson
- Charlie Kaufman
- Edward Lewis
- Thomas Narten
- Radia J. Perlman
- Jeffrey I. Schiller
- Steven (Xunhua) Wang
- Brian Wellington

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## 1. Overview of Contents

This document standardizes extensions of the Domain Name System (DNS) protocol to support DNS security and public key distribution. It assumes that the reader is familiar with the Domain Name System,

particularly as described in RFCs 1033, 1034, 1035 and later RFCs. An earlier version of these extensions appears in RFC 2065. This replacement for that RFC incorporates early implementation experience and requests from potential users.

Section 2 provides an overview of the extensions and the key distribution, data origin authentication, and transaction and request security they provide.

Section 3 discusses the KEY resource record, its structure, and use in DNS responses. These resource records represent the public keys of entities named in the DNS and are used for key distribution.

Section 4 discusses the SIG digital signature resource record, its structure, and use in DNS responses. These resource records are used to authenticate other resource records in the DNS and optionally to authenticate DNS transactions and requests.

Section 5 discusses the NXT resource record (RR) and its use in DNS responses including full and incremental zone transfers. The NXT RR permits authenticated denial of the existence of a name or of an RR type for an existing name.

Section 6 discusses how a resolver can be configured with a starting key or keys and proceed to securely resolve DNS requests. Interactions between resolvers and servers are discussed for various combinations of security aware and security non-aware. Two additional DNS header bits are defined for signaling between resolvers and servers.

Section 7 describes the ASCII representation of the security resource records for use in master files and elsewhere.

Section 8 defines the canonical form and order of RRs for DNS security purposes.

Section 9 defines levels of conformance for resolvers and servers.

Section 10 provides a few paragraphs on overall security considerations.

Section 11 specified IANA considerations for allocation of additional values of parameters defined in this document.

Appendix A gives details of base 64 encoding which is used in the file representation of some RRs defined in this document.

Appendix B summarizes changes between this memo and RFC 2065.

Appendix C specified how to calculate the simple checksum used as a key tag in most SIG RRs.

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. Overview of the DNS Extensions

The Domain Name System (DNS) protocol security extensions provide three distinct services: key distribution as described in Section 2.2 below, data origin authentication as described in Section 2.3 below, and transaction and request authentication, described in Section 2.4 below.

Special considerations related to "time to live", CNAMEs, and delegation points are also discussed in Section 2.3.

### 2.1 Services Not Provided

It is part of the design philosophy of the DNS that the data in it is public and that the DNS gives the same answers to all inquirers. Following this philosophy, no attempt has been made to include any sort of access control lists or other means to differentiate inquirers.

No effort has been made to provide for any confidentiality for queries or responses. (This service may be available via IPSEC [RFC 2401], TLS, or other security protocols.)

Protection is not provided against denial of service.

### 2.2 Key Distribution

A resource record format is defined to associate keys with DNS names. This permits the DNS to be used as a public key distribution mechanism in support of DNS security itself and other protocols.

The syntax of a KEY resource record (RR) is described in Section 3. It includes an algorithm identifier, the actual public key parameter(s), and a variety of flags including those indicating the type of entity the key is associated with and/or asserting that there is no key associated with that entity.

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Under conditions described in Section 3.5, security aware DNS servers will automatically attempt to return KEY resources as additional information, along with those resource records actually requested, to minimize the number of queries needed.

### 2.3 Data Origin Authentication and Integrity

Authentication is provided by associating with resource record sets (RRsets [RFC 2181]) in the DNS cryptographically generated digital signatures. Commonly, there will be a single private key that authenticates an entire zone but there might be multiple keys for different algorithms, signers, etc. If a security aware resolver reliably learns a public key of the zone, it can authenticate, for

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