

TLS Working Group  
Internet-Draft  
Expires: February 22, 2003

N. Mavroyanopoulos  
August 23, 2002

## Using OpenPGP keys for TLS authentication

[<draft-ietf-tls-openpgp-keys-02.txt>](#)

### Status of this Memo

This document is an Internet-Draft and is in full conformance with all provisions of [Section 10 of RFC2026](#).

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF), its areas, and its working groups. Note that other groups may also distribute working documents as Internet-Drafts.

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."

The list of current Internet-Drafts can be accessed at <http://www.ietf.org/ietf/1id-abstracts.txt>

The list of Internet-Draft Shadow Directories can be accessed at <http://www.ietf.org/shadow.html>.

### Abstract

This document proposes extensions to the TLS protocol to support the OpenPGP trust model and keys. The extensions discussed here include a certificate type negotiation mechanism, and the required modifications to the TLS Handshake Protocol.

This document uses the same notation used in the TLS Protocol draft.

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 [RFC 2119](#).

---

Internet-Draft Using OpenPGP keys for TLS Authentication January 2002

## 1. Introduction

At the time of writing, TLS [[TLS](#)] uses the PKIX [[PKIX](#)] infrastructure, to provide certificate services. Currently the PKIX protocols are limited to a hierarchical key management. As a result, applications which follow different - non hierarchical - trust models, like the "web of trust" model, could not be benefited by TLS.

OpenPGP keys (sometimes called OpenPGP certificates), provide security services for electronic communications. They are widely deployed, especially in electronic mail applications, provide public key authentication services, and allow distributed key management. This document will update the TLS protocol to support OpenPGP trust model and keys using the existing TLS cipher suites.

## 2. OpenPGP keys for TLS authentication

The X.509 [[X509](#)] certificates recommended for use with TLS will not be used in conjunction with OpenPGP keys. An implementation SHOULD be able to support both TLS with X.509 certificates and TLS with OpenPGP keys. Implementations are not required to support both. The "peer certificate" in the session state of TLS MAY refer to either X.509 or OpenPGP.

### 2.1 Changes to the Handshake Message Contents

This section describes the changes to the TLS handshake message contents when OpenPGP keys are to be used for authentication.

#### 2.1.1 Hello Messages

##### 2.1.1.1 Extension Type

A new value, "cert\_type(7)", is added to the enumerated ExtensionType, defined in [[TLSEXT](#)]. This value is used as the extension number for the extensions in both the client hello message and the server hello message. The new extension type will be used for certificate type negotiation.

##### 2.1.1.2 Client Hello

In order to indicate the support of multiple certificate types clients will include an extension of type "cert\_type" to the extended client hello message. The the hello extension mechanism is described in [[TLSEXT](#)].

This extension carries a list of supported certificate types the client can use, sorted by client preference. This extension SHOULD be omitted if the client supports only X.509 certificates.

The "extension\_data" field of this extension will contain a CertificateTypeExtension structure.

```
enum { client, server } ClientOrServerExtension;

enum { X.509(0), OpenPGP(1), (255) } CertificateType;

struct {
    select(ClientOrServerExtension) {
        case client:
            CertificateType certificate_types<1..2^8-1>;
        case server:
            CertificateType certificate_type;
    }
} CertificateTypeExtension;
```

### [2.1.1.3](#) Server Hello

Servers that receive an extended client hello containing the "cert\_type" extension MUST select a certificate type from the certificate\_types field in the extended client hello, or terminate the connection with a fatal alert of type "unsupported\_certificate".

The certificate type selected by the server, is encoded in a CertificateTypeExtension structure, which is included in the extended server hello message, using an extension of type "cert\_type".

Servers that only support X.509 certificates MAY omit including the "cert\_type" extension in the extended server hello.

### [2.1.2](#) Server certificate

The contents of the certificate message sent from server to client and vice versa are determined by the negotiated certificate type and the selected cipher suite's key exchange algorithm.

If the OpenPGP certificate type is negotiated then it is required to present an OpenPGP key in the Certificate message. The OpenPGP key must contain a public key that matches the selected key exchange algorithm, as shown below.

Key Exchange Algorithm	OpenPGP Key Type
RSA	RSA public key which can be used for encryption.
DHE_DSS	DSS public key.
DHE_RSA	RSA public key which can be used for signing.

N. Mavroyanopoulos

Expires February 22, 2003

[Page 3]

---

Internet-Draft Using OpenPGP keys for TLS Authentication January 2002

An OpenPGP key appearing in the Certificate message will be sent in binary OpenPGP format. The option is also available to send an OpenPGP fingerprint, instead of sending the entire key. The process of fingerprint generation is described in [[OpenPGP](#)]. The peer shall respond with a "certificate\_unobtainable" fatal alert if the key with the given key fingerprint cannot be found. The "certificate\_unobtainable" fatal alert is defined in section 4 of [[TLSEXT](#)].

If the key is not valid, expired, revoked, corrupt, the appropriate fatal alert message is sent from section A.3 of the TLS specification. If a key is valid and neither expired nor revoked, it is accepted by the protocol. The key validation procedure is a local matter outside the scope of this document.

```
enum {
    key_fingerprint (0), key (1), (255)
} PGPKKeyDescriptorType;

opaque PGPKKeyFingerprint<16..20>;

opaque PGPKKey<0..2^24-1>;

struct {
    PGPKKeyDescriptorType descriptorType;
```

```

        select (descriptorType) {
            case key_fingerprint: PGPFingerprint;
            case key: PGFKey;
        }
    } Certificate;

```

### [2.1.3 Certificate request](#)

The semantics of this message remain the same as in the TLS specification. However the structure of this message has been modified for OpenPGP keys. the PGPCertificateRequest structure will only be used if the negotiated certificate type is OpenPGP.

```

enum {
    rsa_sign(1), dss_sign(2), (255)
} ClientCertificateParamsType;

struct {
    ClientCertificateParamsType certificate_params_types<1..2^8-1>;
} PGPCertificateRequest;

```

certificate\_params\_types is a list of accepted client certificate parameter types, sorted in order of the server's preference.

### [2.1.4 Client certificate](#)

The client certificate message is sent using the same formatting as the server certificate message. This message is only sent in response to the certificate request message. If no OpenPGP key is available from the client, then a certificate that contains an empty PGFKey is sent. The server may respond with a "handshake\_failure" fatal alert if client authentication is required. This transaction follows the TLS specification.

### [2.1.5 Server key exchange](#)

The server key exchange message for OpenPGP keys is identical to the TLS specification.

### [2.1.6 Certificate verify](#)

The certificate verify message for OpenPGP keys is identical to the TLS specification.

### [2.1.7](#) Finished

The finished message for OpenPGP keys is identical to the description in the specification.

## 3. Cipher suites

No new cipher suites are required to use OpenPGP keys. OpenPGP keys can be combined with existing cipher suites defined in [\[TLS\]](#), except the ones marked as "Exportable". Exportable cipher suites SHOULD NOT be used with OpenPGP keys.

### [3.1](#) New cipher suites

Some additional cipher suites are defined here in order to support algorithms which are defined in [\[OpenPGP\]](#) but are not present in [\[TLS\]](#).

```
CipherSuite TLS_DHE_DSS_WITH_CAST_128_CBC_SHA      = { 0x00, 0x70 };
CipherSuite TLS_DHE_DSS_WITH_CAST_128_CBC_RMD      = { 0x00, 0x71 };
CipherSuite TLS_DHE_DSS_WITH_3DES_EDE_CBC_RMD     = { 0x00, 0x72 };
CipherSuite TLS_DHE_DSS_WITH_AES_128_CBC_RMD      = { 0x00, 0x73 };
CipherSuite TLS_DHE_DSS_WITH_AES_256_CBC_RMD      = { 0x00, 0x74 };

CipherSuite TLS_DHE_RSA_WITH_CAST_128_CBC_SHA     = { 0x00, 0x75 };
CipherSuite TLS_DHE_RSA_WITH_CAST_128_CBC_RMD     = { 0x00, 0x76 };
CipherSuite TLS_DHE_RSA_WITH_3DES_EDE_CBC_RMD     = { 0x00, 0x77 };
CipherSuite TLS_DHE_RSA_WITH_AES_128_CBC_RMD      = { 0x00, 0x78 };
CipherSuite TLS_DHE_RSA_WITH_AES_256_CBC_RMD      = { 0x00, 0x79 };
```

```
CipherSuite TLS_RSA_WITH_CAST_128_CBC_SHA        = { 0x00, 0x7A };
CipherSuite TLS_RSA_WITH_CAST_128_CBC_RMD        = { 0x00, 0x7B };
CipherSuite TLS_RSA_WITH_3DES_EDE_CBC_RMD        = { 0x00, 0x7C };
CipherSuite TLS_RSA_WITH_AES_128_CBC_RMD         = { 0x00, 0x7D };
CipherSuite TLS_RSA_WITH_AES_256_CBC_RMD         = { 0x00, 0x7E };
```

All of the above cipher suites use either the CAST [\[CAST\]](#), AES [\[AES\]](#), or 3DES block ciphers in CBC mode. The choice of hash is either SHA-1 or RIPEMD-160. Implementations are not required

to support the above cipher suites.

#### 4. Acknowledgments

The author wishes to thank Werner Koch for his suggestions on improving this document.

#### 5. References

- [TLS] T. Dierks, and C. Allen, "The TLS Protocol Version 1.0", [RFC 2246](#), January 1999.
- [OpenPGP] Callas, J., Donnerhackle, L., Finney, H., Thayer, R., "OpenPGP Message Format", [RFC 2440](#), November 1998.
- [TLSEXT] Blake-Wilson, S., Nystrom, M., Hopwood, D., Mikkelsen, J. and Wright, T., "TLS Extensions", work in progress, December 2001.
- [X509] CCITT. Recommendation X.509: "The Directory - Authentication Framework". 1988.
- [PKIX] Housley, R., Ford, W., Polk, W., Solo, D., "Internet X.509 Public Key Infrastructure Certificate and CRL Profile", [RFC 2459](#), January 1999.
- [CAST] Adams, C., "The CAST-128 Encryption Algorithm", [RFC 2144](#), May 1997.
- [AES] Daemen, J., Rijmen, V., "The Rijndael Block Cipher" <http://csrc.nist.gov/encryption/aes/rijndael/Rijndael.pdf> 3rd September 1999.

Nikos Mavroyanopoulos  
8 Arkadias Street  
Chalandri 15234  
Greece

Email: nmav@gnutls.org

## Full Copyright Statement

Copyright (C) The Internet Society (2002). All Rights Reserved.

This document and translations of it may be copied and furnished to others, and derivative works that comment on or otherwise explain it or assist in its implementation may be prepared, copied, published and distributed, in whole or in part, without restriction of any kind, provided that the above copyright notice and this paragraph are included on all such copies and derivative works. However, this document itself may not be modified in any way, such as by removing the copyright notice or references to the Internet Society or other Internet organizations, except as needed for the purpose of developing Internet standards in which case the procedures for copyrights defined in the Internet Standards process must be followed, or as required to translate it into languages other than English.

The limited permissions granted above are perpetual and will not be revoked by the Internet Society or its successors or assigns.

This document and the information contained herein is provided on an "AS IS" basis and THE INTERNET SOCIETY AND THE INTERNET ENGINEERING TASK FORCE DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY THAT THE USE OF THE INFORMATION HEREIN WILL NOT INFRINGE ANY RIGHTS OR ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

## Acknowledgement

Funding for the RFC Editor function is currently provided by the Internet Society.



