

TLS Working Group
Internet Draft
Intended status: Informational
Expires: April 2009

Mohamad Badra
LIMOS Laboratory
October 17, 2008

ECDHE_PSK Ciphersuites for Transport Layer Security (TLS)
draft-ietf-tls-ecdhe-psk-04.txt

Status of this Memo

By submitting this Internet-Draft, each author represents that any applicable patent or other IPR claims of which he or she is aware have been or will be disclosed, and any of which he or she becomes aware will be disclosed, in accordance with [Section 6 of BCP 79](#).

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>

This Internet-Draft will expire on April 17, 2009.

Copyright Notice

Copyright (C) The IETF Trust (2008).

Abstract

This document extends [RFC 4279](#), [RFC 4492](#) and [RFC 4785](#), and specifies a set of ciphersuites that use a pre-shared key (PSK) to authenticate an Elliptic Curve Diffie-Hellman exchange (ECDH). These ciphersuites provide Perfect Forward Secrecy (PFS).

Table of Contents

1.	Introduction.....	3
1.1.	Applicability Statement.....	3
1.2.	Conventions used in this document.....	3
2.	ECDHE_PSK Key Exchange Algorithm.....	3
3.	ECDHE_PSK Based Cipher Suites.....	5
3.1.	ECDHE_PSK Cipher Suites Using the SHA-1 Hash.....	5
3.2.	ECDHE_PSK Cipher Suites Using SHA-2 Hashes.....	5
4.	ECDHE_PSK Based Cipher Suites with NULL Encryption.....	5
4.1.	ECDHE_PSK Cipher Suites Using the SHA-1 Hash with NULL Encryption.....	5
4.2.	ECDHE_PSK Cipher Suites Using SHA-2 Hashes with NULL Encryption.....	6
5.	Security Considerations.....	6
6.	IANA Considerations.....	6
7.	Acknowledgments.....	6
8.	References.....	7
8.1.	Normative References.....	7
	Author's Addresses.....	7
	Intellectual Property Statement.....	7
	Disclaimer of Validity.....	8

1. Introduction

[RFC 4279](#) specifies cipher suites for supporting TLS using pre-shared symmetric keys which (a) use only symmetric key operations for authentication, (b) use a Diffie-Hellman exchange authenticated with a pre-shared key, or (c) combine public key authentication of the server with pre-shared key authentication of the client.

[RFC 4785](#) specifies authentication-only cipher suites (with no encryption). These cipher suites are useful when authentication and integrity protection is desired, but confidentiality is not needed or not permitted.

[RFC 4492](#) defines a set of ECC-based cipher suites for TLS and describes the use of ECC certificates for client authentication. In particular, it specifies the use of Elliptic Curve Diffie-Hellman (ECDH) key agreement in a TLS handshake and the use of Elliptic Curve Digital Signature Algorithm (ECDSA) as a new authentication mechanism.

This document specifies a set of cipher suites that use a PSK to authenticate an ECDH exchange. These cipher suites provide Perfect Forward Secrecy. One of these ciphersuites provides authentication-only.

The reader is expected to become familiar with [RFC 4279](#), [RFC 4492](#), and [RFC 4785](#) prior to studying this document.

1.1. Applicability Statement

The ciphersuites defined in Sections [3.1](#) and [4.1](#) can be negotiated, whatever the negotiated TLS version is.

The ciphersuites defined in Sections [3.2](#) and [4.2](#) can be negotiated in TLS version 1.2 or higher.

1.2. Conventions used 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. ECDHE_PSK Key Exchange Algorithm

The ciphersuites described in this document make use of the EC parameter negotiation mechanism defined in [RFC 4492](#). When the ciphersuites defined in this document are used, the

'ec_diffie_hellman_psk' case inside the ServerKeyExchange and ClientKeyExchange structure MUST be used instead of the 'psk' case defined in [\[RFC4279\]](#) (i.e., the ServerKeyExchange and ClientKeyExchange messages include the Diffie-Hellman parameters). The PSK identity and identity hint fields have the same meaning and encoding as specified in [\[RFC4279\]](#) (note that the ServerKeyExchange message is always sent, even if no PSK identity hint is provided).

The format of the ServerKeyExchange and ClientKeyExchange messages is shown below.

```
struct {
    select (KeyExchangeAlgorithm) {
        /* other cases for rsa, diffie_hellman, etc. */
        case ec_diffie_hellman_psk: /* NEW */
            opaque psk_identity_hint<0..2^16-1>;
            ServerECDHParams params;
    };
} ServerKeyExchange;

struct {
    select (KeyExchangeAlgorithm) {
        /* other cases for rsa, diffie_hellman, etc. */
        case ec_diffie_hellman_psk: /* NEW */
            opaque psk_identity<0..2^16-1>;
            ClientECDiffieHellmanPublic public;
    } exchange_keys;
} ClientKeyExchange;
```

The premaster secret is formed as follows. First, perform the ECDH computation as described in [Section 5.10 of \[RFC4492\]](#). Let Z be the octet string produced by this computation. Next, concatenate a uint16 containing the length of Z (in octets), Z itself, a uint16 containing the length of the PSK (in octets), and the PSK itself.

This corresponds to the general structure for the premaster secrets (see Note 1 in [Section 2 of \[RFC4279\]](#)), with "other_secret" containing Z.

```
struct {
    opaque other_secret<0..2^16-1>;
    opaque psk<0..2^16-1>;
};
```


3. ECDHE_PSK Based Cipher Suites

3.1. ECDHE_PSK Cipher Suites Using the SHA-1 Hash

```
CipherSuite TLS_ECDHE_PSK_WITH_RC4_128_SHA      = {0xXX,0xXX};
CipherSuite TLS_ECDHE_PSK_WITH_3DES_EDE_CBC_SHA  = {0xXX,0xXX};
CipherSuite TLS_ECDHE_PSK_WITH_AES_128_CBC_SHA   = {0xXX,0xXX};
CipherSuite TLS_ECDHE_PSK_WITH_AES_256_CBC_SHA   = {0xXX,0xXX};
```

The above four cipher suites match the cipher suites defined in [\[RFC4279\]](#), except that they use an Elliptic Curve Diffie-Hellman exchange [\[RFC4492\]](#) authenticated with a PSK and that:

- o when negotiated in a version of TLS prior to 1.2, they use the Pseudo Random Function (PRF) from that version;
- o when negotiated in TLS version 1.2, they use the PRF with the SHA-256 hash function defined in TLS version 1.2.

3.2. ECDHE_PSK Cipher Suites Using SHA-2 Hashes

```
CipherSuite TLS_ECDHE_PSK_WITH_AES_128_CBC_SHA256 = {0xXX,0xXX};
CipherSuite TLS_ECDHE_PSK_WITH_AES_256_CBC_SHA384 = {0xXX,0xXX};
```

The above two cipher suites are the same as the corresponding AES cipher suites in [section 3.1](#) above, except for the hash and PRF algorithms, which SHALL be as follows:

For TLS_ECDHE_PSK_WITH_AES_128_CBC_SHA256, the PRF is the TLS PRF [\[RFC5246\]](#) with SHA-256 as the hash function, and the MAC is HMAC [\[RFC2104\]](#) with SHA-256 as the hash function.

For TLS_ECDHE_PSK_WITH_AES_256_CBC_SHA384, the PRF is the TLS PRF [\[RFC5246\]](#) with SHA-384 as the hash function, and the MAC is HMAC [\[RFC2104\]](#) with SHA-384 as the hash function.

4. ECDHE_PSK Based Cipher Suites with NULL Encryption

4.1. ECDHE_PSK Cipher Suites Using the SHA-1 Hash with NULL Encryption

The following cipher suite matches the cipher suites defined in [section 3.1](#), except that we define a suite with null encryption.

```
CipherSuite TLS_ECDHE_PSK_WITH_NULL_SHA          = {0xXX,0xXX};
```

4.2. ECDHE_PSK Cipher Suites Using SHA-2 Hashes with NULL Encryption

```
CipherSuite TLS_ECDHE_PSK_WITH_NULL_SHA256      = {0xxx,0xxx};  
CipherSuite TLS_ECDHE_PSK_WITH_NULL_SHA384      = {0xxx,0xxx};
```

These two cipher suites are the same as the corresponding cipher suites in [section 3.2](#), but with NULL encryption (instead of AES).

5. Security Considerations

The security considerations described throughout [\[RFC5246\]](#), [\[RFC4785\]](#), [\[RFC4492\]](#), and [\[RFC4279\]](#) apply here as well. In particular, as authentication-only cipher suites (with no encryption) defined here do not support confidentiality, care should be taken not to send sensitive information (such as passwords) over connections protected with one of the cipher suites with NULL encryption defined in this document.

Given the current state of published to date crypto attacks, HMAC-SHA1 apparently is not (yet) so bad that we need to risk breaking interoperability with previous versions of TLS. However, implementers and administrators should monitor the general statements on recommended cryptographic algorithms published from time to time by various forums including the IETF, as a base for the portfolio they support and the policies for strength of function acceptable for the cipher suites they set.

6. IANA Considerations

This document defines the following new cipher suites, whose values are to be assigned from the TLS Cipher Suite registry defined in [\[RFC5246\]](#).

```
CipherSuite TLS_ECDHE_PSK_WITH_RC4_128_SHA      = {0xxx,0xxx};  
CipherSuite TLS_ECDHE_PSK_WITH_3DES_EDE_CBC_SHA = {0xxx,0xxx};  
CipherSuite TLS_ECDHE_PSK_WITH_AES_128_CBC_SHA   = {0xxx,0xxx};  
CipherSuite TLS_ECDHE_PSK_WITH_AES_256_CBC_SHA   = {0xxx,0xxx};  
CipherSuite TLS_ECDHE_PSK_WITH_AES_128_CBC_SHA256 = {0xxx,0xxx};  
CipherSuite TLS_ECDHE_PSK_WITH_AES_256_CBC_SHA384 = {0xxx,0xxx};  
CipherSuite TLS_ECDHE_PSK_WITH_NULL_SHA         = {0xxx,0xxx};  
CipherSuite TLS_ECDHE_PSK_WITH_NULL_SHA256      = {0xxx,0xxx};  
CipherSuite TLS_ECDHE_PSK_WITH_NULL_SHA384      = {0xxx,0xxx};
```

7. Acknowledgments

The author appreciates Alfred Hoenes for his detailed review and effort on issues resolving discussion. The author would like to

acknowledge Bodo Moeller, Simon Josefsson, Uri Blumenthal, Pasi Eronen, Paul Hoffman, Joseph Salowey, Mark Tillinghast, and the TLS mailing list members for their comments on the document.

8. References

8.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [RFC4279] Eronen, P. and H. Tschofenig, "Pre-Shared Key Ciphersuites for Transport Layer Security (TLS)", [RFC 4279](#), December 2005.
- [RFC4492] Blake-Wilson, S., Bolyard, N., Gupta, V., Hawk, C. and B. Moeller, "Elliptic Curve Cryptography (ECC) Cipher Suites for Transport Layer Security (TLS)", [RFC 4492](#), May 2006.
- [RFC4785] Blumenthal, U. and P. Goel, "Pre-Shared Key (PSK) Ciphersuites with NULL Encryption for Transport Layer Security (TLS)", [RFC 4785](#), January 2007.
- [RFC5246] Dierks, T. and E. Rescorla, "The Transport Layer Security (TLS) Protocol Version 1.2", [RFC 5246](#), August 2008.

Author's Addresses

Mohamad Badra
LIMOS Laboratory - UMR6158, CNRS
France

Email: badra@isima.fr

Intellectual Property Statement

The IETF takes no position regarding the validity or scope of any Intellectual Property Rights or other rights that might be claimed to pertain to the implementation or use of the technology described in this document or the extent to which any license under such rights might or might not be available; nor does it represent that it has made any independent effort to identify any such rights. Information on the procedures with respect to rights in RFC documents can be found in [BCP 78](#) and [BCP 79](#).

Copies of IPR disclosures made to the IETF Secretariat and any assurances of licenses to be made available, or the result of an attempt made to obtain a general license or permission for the use of such proprietary rights by implementers or users of this specification can be obtained from the IETF on-line IPR repository at <http://www.ietf.org/ipr>.

The IETF invites any interested party to bring to its attention any copyrights, patents or patent applications, or other proprietary rights that may cover technology that may be required to implement this standard. Please address the information to the IETF at ietf-ipr@ietf.org.

Disclaimer of Validity

This document and the information contained herein are provided on an "AS IS" basis and THE CONTRIBUTOR, THE ORGANIZATION HE/SHE REPRESENTS OR IS SPONSORED BY (IF ANY), THE INTERNET SOCIETY, THE IETF TRUST AND THE INTERNET ENGINEERING TASK FORCE DISCLAIM 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.

Copyright Statement

Copyright (C) The IETF Trust (2008).

This document is subject to the rights, licenses and restrictions contained in [BCP 78](#), and except as set forth therein, the authors retain all their rights.

Acknowledgment

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