TLS Working Group
Internet Draft
Intended status: Standards Track
Expires: February 2009

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September 23, 2008

Pre-Shared Key Cipher Suites for Transport Layer Security (TLS) with SHA-256/384 and AES Galois Counter Mode
draft-ietf-tls-psk-new-mac-aes-gcm-02.txt

Status of this Memo

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Abstract

RFC 4279 and RFC 4785 describe pre-shared key cipher suites for Transport Layer Security (TLS). However, all those cipher suites use SHA-1 as their MAC algorithm. This document describes a set of cipher suites for TLS/DTLS which uses stronger digest algorithms (i.e., SHA-256 or SHA-384) and another which uses the Advanced Encryption Standard (AES) in Galois Counter Mode (GCM).

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1. Introduction

TLS 1.2 [RFC5246] adds support for authenticated encryption with additional data (AEAD) cipher modes [RFC5116]. This document describes the use of Advanced Encryption Standard (AES) [AES] in Galois Counter Mode (GCM) [GCM] (AES-GCM) with various pre-shared key (PSK) key exchange mechanisms ([RFC4279] and [RFC4785]) as a cipher suite for Transport Layer Security (TLS).

This document also specifies PSK cipher suites for TLS which replace SHA-1 by SHA-256 or SHA-384 [SHS]. RFC 4279 [RFC4279] and RFC 4785 [RFC4785] describe PSK cipher suites for TLS. However, all of the RFC 4279 and the RFC 4785 cipher suites use HMAC-SHA1 as their MAC algorithm. Due to recent analytic work on SHA-1 [Wang05], the IETF is gradually moving away from SHA-1 and towards stronger hash algorithms.

ECC based cipher suites with SHA-256/384 and AES-GCM are defined in [RFC5289]; RSA, DSS and Diffie-Hellman based cipher suites are specified in [RFC5288]. The reader is expected to become familiar with these two memos prior to studying this document.

1.1. 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. PSK, DHE_PSK and RSA_PSK Key Exchange Algorithms with AES-GCM

The following six cipher suites use the new authenticated encryption modes defined in TLS 1.2 with AES in Galois Counter Mode (GCM) [GCM]. The cipher suites with DHE_PSK key exchange algorithm (TLS_DHE_PSK_WITH_AES_128_GCM_SHA256 and TLS_DHE_PSK_WITH_AES_256_GCM_SHA348) provide Perfect Forward Secrecy (PFS).

```
   CipherSuite TLS_PSK_WITH_AES_128_GCM_SHA256        = {0xXX,0xXX};
```

```
   CipherSuite TLS_PSK_WITH_AES_256_GCM_SHA384         = {0xXX,0xXX};
   CipherSuite TLS_DHE_PSK_WITH_AES_128_GCM_SHA256     = {0xXX,0xXX};
   CipherSuite TLS_DHE_PSK_WITH_AES_256_GCM_SHA384     = {0xXX,0xXX};
   CipherSuite TLS_RSA_PSK_WITH_AES_128_GCM_SHA256     = {0xXX,0xXX};
   CipherSuite TLS_RSA_PSK_WITH_AES_256_GCM_SHA384     = {0xXX,0xXX};
```

These cipher suites use authenticated encryption with additional data (AEAD) algorithms AEAD_AES_128_GCM and AEAD_AES_256_GCM described in RFC 5116. GCM is used as described in [RFC5288].

The PSK, DHE_PSK and RSA_PSK key exchanges are performed as defined in [RFC4279].

The PRFs SHALL be as follows:

For cipher suites ending with _SHA256, the PRF is the TLS PRF [RFC5246] with SHA-256 as the hash function.

For cipher suites ending with _SHA384, the PRF is the TLS PRF [RFC5246] with SHA-384 as the hash function.

Implementations MUST send TLS Alert bad_record_mac for all types of failures encountered in processing the AES-GCM algorithm.

3. PSK, DHE_PSK and RSA_PSK Key Exchange with SHA-256/384

The cipher suites described in this section use AES [AES] in CBC [CBC] mode with an HMAC-based MAC.

3.1. PSK Key Exchange Algorithm with SHA-256/384

```
   CipherSuite TLS_PSK_WITH_AES_128_CBC_SHA256         = {0xXX,0xXX};
   CipherSuite TLS_PSK_WITH_AES_256_CBC_SHA384         = {0xXX,0xXX};
   CipherSuite TLS_PSK_WITH_NULL_SHA256                = {0xXX,0xXX};
   CipherSuite TLS_PSK_WITH_NULL_SHA384                = {0xXX,0xXX};
```

The above four cipher suites are the same as the corresponding cipher suites in RFC 4279 and RFC 4785 (with names ending in "_SHA" in place of "_SHA256" or "_SHA384"), except for the hash and PRF algorithms.

The PRF and MAC algorithms SHALL be as follows:

For cipher suites ending with _SHA256, the PRF is the TLS PRF [RFC5246] with SHA-256 as the hash function.
The MAC is HMAC [RFC2104] with SHA-256 as the hash function.

For cipher suites ending with _SHA384, the PRF is the TLS PRF [RFC5246] with SHA-384 as the hash function.
The MAC is HMAC [RFC2104] with SHA-384 as the hash function.

3.2. DHE_PSK Key Exchange Algorithm with SHA-256/384

```
CipherSuite TLS_DHE_PSK_WITH_AES_128_CBC_SHA256    = {0xXX,0xXX};
CipherSuite TLS_DHE_PSK_WITH_AES_256_CBC_SHA384    = {0xXX,0xXX};
CipherSuite TLS_DHE_PSK_WITH_NULL_SHA256           = {0xXX,0xXX};
CipherSuite TLS_DHE_PSK_WITH_NULL_SHA384           = {0xXX,0xXX};
```


The above four cipher suites are the same as the corresponding cipher suites in RFC 4279 and RFC 4785 (with names ending in "_SHA" in place of "_SHA256" or "_SHA384"), except for the hash and PRF algorithms, as explained in section 3.1.

3.3. RSA_PSK Key Exchange Algorithm with SHA-256/384

```
CipherSuite TLS_RSA_PSK_WITH_AES_128_CBC_SHA256    = {0xXX,0xXX};
CipherSuite TLS_RSA_PSK_WITH_AES_256_CBC_SHA384    = {0xXX,0xXX};
```

The above two cipher suites are the same as the corresponding cipher suites in RFC 4279 and RFC 4785 (with names ending in "_SHA" in place of "_SHA256" or "_SHA384"), except for the hash and PRF algorithms, as explained in section 3.1.

4. Security Considerations

The security considerations in RFC 4279, RFC 4758, and [RFC5288] apply to this document as well. In addition, as described in [RFC5288], these cipher suites may only be used with TLS 1.2 or greater.

5. IANA Considerations

IANA has assigned the following values for the cipher suites defined in this document:

```
CipherSuite TLS_PSK_WITH_AES_128_GCM_SHA256        = {0xXX,0xXX};
```

```
   CipherSuite TLS_PSK_WITH_AES_256_GCM_SHA384         = {0xXX,0xXX};
   CipherSuite TLS_DHE_PSK_WITH_AES_128_GCM_SHA256     = {0xXX,0xXX};
   CipherSuite TLS_DHE_PSK_WITH_AES_256_GCM_SHA384     = {0xXX,0xXX};
   CipherSuite TLS_RSA_PSK_WITH_AES_128_GCM_SHA256     = {0xXX,0xXX};
   CipherSuite TLS_RSA_PSK_WITH_AES_256_GCM_SHA384     = {0xXX,0xXX};
   CipherSuite TLS_PSK_WITH_AES_128_CBC_SHA256         = {0xXX,0xXX};
   CipherSuite TLS_PSK_WITH_AES_256_CBC_SHA384         = {0xXX,0xXX};
   CipherSuite TLS_PSK_WITH_NULL_SHA256                = {0xXX,0xXX};
   CipherSuite TLS_PSK_WITH_NULL_SHA384                = {0xXX,0xXX};
   CipherSuite TLS_DHE_PSK_WITH_AES_128_CBC_SHA256     = {0xXX,0xXX};
   CipherSuite TLS_DHE_PSK_WITH_AES_256_CBC_SHA384     = {0xXX,0xXX};
   CipherSuite TLS_DHE_PSK_WITH_NULL_SHA256            = {0xXX,0xXX};
   CipherSuite TLS_DHE_PSK_WITH_NULL_SHA384            = {0xXX,0xXX};
   CipherSuite TLS_RSA_PSK_WITH_AES_128_CBC_SHA256     = {0xXX,0xXX};
   CipherSuite TLS_RSA_PSK_WITH_AES_256_CBC_SHA384     = {0xXX,0xXX};
```

6. Acknowledgments

This draft borrows heavily from [RFC5289] and [RFC5288].

The author appreciates Alfred Hoenes for his detailed review and effort on issues resolving discussion. The author would like also to acknowledge Ibrahim Hajjeh, Simon Josefsson, Hassnaa Moustafa, Joseph Salowey and Pascal Urien for their reviews of the content of the document.

7. References

7.1. Normative References

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[AES] National Institute of Standards and Technology, "Specification for the Advanced Encryption Standard (AES)", FIPS 197, November 2001.

[SHS] National Institute of Standards and Technology, "Secure Hash Standard", FIPS 180-2, August 2002.

[CBC] National Institute of Standards and Technology, "Recommendation for Block Cipher Modes of Operation - Methods and Techniques", SP 800-38A, December 2001.

[GCM] National Institute of Standards and Technology, "Recommendation for Block Cipher Modes of Operation: Galois/Counter Mode (GCM) for Confidentiality and Authentication", SP 800-38D, November 2007.

[RFC5288] Salowey, J., A. Choudhury, and C. McGrew, "RSA based AES-GCM Cipher Suites for TLS", RFC 5288, August 2008.

7.2. Informative References

[Wang05] Wang, X., Yin, Y., and H. Yu, "Finding Collisions in the Full SHA-1", CRYPTO 2005, August 2005.

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