           ECDHE_PSK with AES-GCM and AES-CCM Cipher Suites
                     for TLS 1.2 and DTLS 1.2

Abstract

   This document defines several new cipher suites for version 1.2 of
   the Transport Layer Security (TLS) protocol and version 1.2 of the
   Datagram Transport Layer Security (DTLS) protocol. These cipher
   suites are based on the Ephemeral Elliptic Curve Diffie-Hellman with
   Pre-Shared Key (ECDHE_PSK) key exchange together with the
   Authenticated Encryption with Associated Data (AEAD) algorithms
   AES-GCM and AES-CCM. PSK provides light and efficient
   authentication, ECDHE provides forward secrecy, and AES-GCM and
   AES-CCM provide encryption and integrity protection.

Status of This Memo

   This is an Internet Standards Track document.

   This document is a product of the Internet Engineering Task Force
   (IETF). It represents the consensus of the IETF community. It has
   received public review and has been approved for publication by the
   Internet Engineering Steering Group (IESG). Further information on
   Internet Standards is available in Section 2 of RFC 7841.

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   and how to provide feedback on it may be obtained at
   https://www.rfc-editor.org/info/rfc8442.

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1. Introduction

This document defines new cipher suites that provide Pre-Shared Key (PSK) authentication, Perfect Forward Secrecy (PFS), and Authenticated Encryption with Associated Data (AEAD). The cipher suites are defined for version 1.2 of the Transport Layer Security (TLS) protocol [RFC5246] and version 1.2 of the Datagram Transport Layer Security (DTLS) protocol [RFC6347].

PSK authentication is widely used in many scenarios. One deployment is 3GPP networks where pre-shared keys are used to authenticate both subscriber and network. Another deployment is Internet of Things where PSK authentication is often preferred for performance and energy efficiency reasons. In both scenarios, the endpoints are owned and/or controlled by a party that provisions the pre-shared keys and makes sure that they provide a high level of entropy.

Perfect Forward Secrecy (PFS) is a strongly recommended feature in security protocol design and can be accomplished by using an ephemeral Diffie-Hellman key exchange method. Ephemeral Elliptic

Curve Diffie-Hellman (ECDHE) provides PFS with excellent performance
and small key sizes. ECDHE is mandatory to implement in both HTTP/2
[RFC7540] and the Constrained Application Protocol (CoAP) [RFC7252].

AEAD algorithms that combine encryption and integrity protection are
strongly recommended for (D)TLS [RFC7525], and TLS 1.3 [RFC8446]
forbids the use of non-AEAD algorithms. The AEAD algorithms
considered in this document are AES-GCM and AES-CCM. The use of
AES-GCM in TLS is defined in [RFC5288], and the use of AES-CCM is
defined in [RFC6655].

[RFC4279] defines PSK cipher suites for TLS but does not consider
elliptic curve cryptography. [RFC8422] introduces elliptic curve
cryptography for TLS but does not consider PSK authentication.
[RFC5487] describes the use of AES-GCM in combination with PSK
authentication but does not consider ECDHE. [RFC5489] describes the
use of PSK in combination with ECDHE but does not consider AES-GCM or
AES-CCM.

2. Requirements Notation

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
"SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and
"OPTIONAL" in this document are to be interpreted as described in
BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all
capitals, as shown here.

3. ECDHE_PSK with AES-GCM and AES-CCM Cipher Suites

The cipher suites defined in this document are based on the following
AES-GCM and AES-CCM AEAD algorithms: AEAD_AES_128_GCM [RFC5116],
AEAD_AES_256_GCM [RFC5116], AEAD_AES_128_CCM [RFC5116], and
AEAD_AES_128_CCM_8 [RFC6655].

Messages and premaster secret construction in this document are
defined in [RFC5489]. The ServerKeyExchange and ClientKeyExchange
messages are used, and the premaster secret is computed as for the
ECDHE_PSK key exchange. The elliptic curve parameters used in the
Diffie-Hellman parameters are negotiated using extensions defined in
[RFC8422].

For TLS 1.2 and DTLS 1.2, the following cipher suites are defined:

```
TLS_ECDHE_PSK_WITH_AES_128_GCM_SHA256   = {0xD0,0x01}
TLS_ECDHE_PSK_WITH_AES_256_GCM_SHA384   = {0xD0,0x02}
TLS_ECDHE_PSK_WITH_AES_128_CCM_8_SHA256 = {0xD0,0x03}
TLS_ECDHE_PSK_WITH_AES_128_CCM_SHA256   = {0xD0,0x05}
```

The assigned code points can only be used for TLS 1.2 and DTLS 1.2.

The cipher suites defined in this document MUST NOT be negotiated for any version of (D)TLS other than version 1.2. Servers MUST NOT select one of these cipher suites when selecting a (D)TLS version other than version 1.2. A client MUST treat the selection of these cipher suites in combination with a different version of (D)TLS as an error and generate a fatal 'illegal_parameter' TLS alert.

Cipher suites TLS_AES_128_GCM_SHA256, TLS_AES_256_GCM_SHA384, TLS_AES_128_CCM_8_SHA256, and TLS_AES_128_CCM_SHA256 are used to support equivalent functionality in TLS 1.3 [RFC8446].

4. IANA Considerations

This document defines the following new cipher suites for TLS 1.2 and DTLS 1.2. The values have been assigned in the "TLS Cipher Suites" registry defined by [RFC8446] and [RFC8447].

Value	Description	DTLS-OK	Recommended
{0xD0,0x01}	TLS_ECDHE_PSK_WITH_AES_128_GCM_SHA256	Y	Y
{0xD0,0x02}	TLS_ECDHE_PSK_WITH_AES_256_GCM_SHA384	Y	Y
{0xD0,0x03}	TLS_ECDHE_PSK_WITH_AES_128_CCM_8_SHA256	Y	N
{0xD0,0x05}	TLS_ECDHE_PSK_WITH_AES_128_CCM_SHA256	Y	Y

5. Security Considerations

The security considerations in TLS 1.2 [RFC5246], DTLS 1.2 [RFC6347], PSK Ciphersuites for TLS [RFC4279], ECDHE_PSK [RFC5489], AES-GCM [RFC5288], and AES-CCM [RFC6655] apply to this document as well.

All the cipher suites defined in this document provide confidentiality, mutual authentication, and forward secrecy. The AES-128 cipher suites provide 128-bit security, and the AES-256 cipher suites provide at least 192-bit security. However, AES_128_CCM_8 only provides 64-bit security against message forgery.

The pre-shared keys used for authentication MUST have a security level equal to or higher than the cipher suite used, i.e., at least 128-bit security for the AES-128 cipher suites and at least 192-bit security for the AES-256 cipher suites.

GCM or CCM encryption that reuses a nonce with a same key undermines the security of GCM and CCM. As a result, GCM and CCM MUST only be used with a system guaranteeing nonce uniqueness [RFC5116].

6. References

6.1. Normative References

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