

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

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September 29, 2008

**ECDHE\_PSK Ciphersuites for Transport Layer Security (TLS)**  
**draft-ietf-tls-ecdhe-psk-03.txt**

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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).

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## **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**

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

```
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};
```

For all four cipher suites, the PRF is the TLS PRF [\[RFC5246\]](#) with SHA-1 as the hash function, and the MAC is HMAC [\[RFC2104\]](#) with SHA-1 as the hash function.

#### **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.

## 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, Alfred Hoenes, Paul Hoffman, Joseph Salowey, and the TLS mailing list members for their comments on the document.

## 8. References

### 8.1. Normative References

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- [RFC4279] Eronen, P. and H. Tschofenig, "Pre-Shared Key Ciphersuites for Transport Layer Security (TLS)", [RFC 4279](#), December 2005.



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- [RFC4785] Blumenthal, U. and P. Goel, "Pre-Shared Key (PSK) Ciphersuites with NULL Encryption for Transport Layer Security (TLS)", [RFC 4785](#), January 2007.
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#### Acknowledgment

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