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RSA based AES-GCM Cipher Suites for TLS
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Status of this Memo

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Abstract

This memo describes the use of the Advanced Encryption Standard (AES) in Galois/Counter Mode (GCM) as a Transport Layer Security (TLS) authenticated encryption operation. GCM provides both confidentiality and data origin authentication, can be efficiently implemented in hardware for speeds of 10 gigabits per second and above, and is also well-suited to software implementations. This memo defines TLS ciphersuites that use AES-GCM with RSA.

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1. Introduction

This document describes the use of AES [AES]in Galois Counter Mode (GCM) [GCM] (AES-GCM) with RSA based key exchange as a ciphersuite for TLS. This mechanism is not only efficient and secure, hardware implementations can achieve high speeds with low cost and low latency, because the mode can be pipelined. Applications like CAPWAP, which uses DTLS, can benefit from the high-speed implementations when wireless termination points (WTPs) and controllers (ACs) have to meet requirements to support higher throughputs in the future. AES-GCM has been specified as a mode that can be used with IPsec ESP [RFC4106] and 802.1AE MAC Security [IEEE8021AE]. It also is part of the NSA suite B ciphersuites for TLS [I-D.rescorla-tls-suiteb]; however in order to meet Suite B requirements these ciphersuites require ECC base key exchange and TLS 1.2. The ciphersuites defined in this document are based on RSA which allows the use of AES-GCM in environments that have not deployed ECC algorithms and do not need to meet NSA Suite B requirements. AES-GCM is an authenticated encryption with associated data (AEAD) operation, as used in TLS 1.2[I-D.ietf-tls-rfc4346-bis]. The ciphersuites defined in this draft may be used with DTLS defined in [RFC4347] and [I-D.ietf-tls-ctr]. This memo uses GCM in a way similar to [I-D.rescorla-tls-suiteb].

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]

3. RSA Based AES-GCM Cipher Suites

The ciphersuites defined in this document are based on the the AES-GCM authenticated encryption with associated data (AEAD) algorithms AEAD_AES_128_GCM and AEAD_AES_256_GCM described in [I-D.mcgrew-auth-enc]. Note that this specification uses a 128-bit authentication tag with GCM. The following ciphersuites are defined:

```
CipherSuite TLS_RSA_WITH_AES_128_GCM_SHA256 = {TBD1,TBD1}
CipherSuite TLS_RSA_WITH_AES_256_GCM_SHA384 = {TBD2,TBD2}
CipherSuite TLS_RSA_DHE_WITH_AES_128_GCM_SHA256 = {TBD3,TBD3}
CipherSuite TLS_RSA_DHE_WITH_AES_256_GCM_SHA384 = {TBD4,TBD4}
```

These ciphersuites make use of the AEAD capability in TLS 1.2 [I-D.ietf-tls-rfc4346-bis]. The "nonce" SHALL be 12 bytes long and constructed from a salt and a counter as follows:

```
             Struct{
                uint32 salt;
                uint64 counter;
             } GCMNonce
```

The salt is derived form the TLS key block as follows:

```
            struct {
               case client:
                  uint32 client_write_IV;  // low order 32-bits
               case server:
                  uint32 server_write_IV;  // low order 32-bits
            } salt
```

In the case of TLS the counter is the 64 bit sequence number. In the case of DTLS the counter is formed from the concatenation of the 16-bit epoch with the 48-bit sequence number.

The RSA and RSA-DHE key exchange is performed as defined in [I-D.ietf-tls-rfc4346-bis].

Recall that an AEAD operation replaces the use of HMAC as a MAC, but not as a PRF for the purposes of key derivation. Consequently, the hash function for the TLS PRF must be explicitly specified by the ciphersuite. For TLS_RSA_WITH_AES_128_GCM_SHA256 and TLS_RSA_DHE_WITH_AES_128_GCM_SHA256 the hash function is SHA256. For TLS_RSA_WITH_AES_256_GCM_SHA384 and TLS_RSA_DHE_WITH_AES_256_GCM_SHA384 the hash function is SHA384.

4. TLS Versions

These ciphersuites make use of the authenticated encryption with additional data defined in TLS 1.2 [I-D.ietf-tls-rfc4346-bis]. They MUST NOT be negotiated in older versions of TLS. Clients MUST NOT offer these cipher suites if they do not offer TLS 1.2 or later. Servers which select an earlier version of TLS MUST NOT select one of these cipher suites. Because TLS has no way for the client to indicate that it supports TLS 1.2 but not earlier, a non-compliant server might potentially negotiate TLS 1.1 or earlier and select one of the cipher suites in this document. Clients MUST check the TLS version and generate a fatal "illegal_parameter" alert if they detect an incorrect version.

5. IANA Considerations

IANA has assigned the following values for the ciphersuites defined in this draft:

```
CipherSuite TLS_RSA_WITH_AES_128_GCM_SHA256 = {TBD1,TBD1}
CipherSuite TLS_RSA_WITH_AES_256_GCM_SHA384 = {TBD2,TBD2}
CipherSuite TLS_RSA_DHE_WITH_AES_128_GCM_SHA256 = {TBD3,TBD3}
CipherSuite TLS_RSA_DHE_WITH_AES_256_GCM_SHA384 = {TBD4,TBD4}
```

6. Security Considerations

6.1. Perfect Forward Secrecy

The perfect forward secrecy properties of RSA based TLS ciphersuites are discussed in the security analysis of [RFC4346]. It should be noted that only the ephemeral Diffie-Hellman based ciphersuites are capable of providing perfect forward secrecy.

6.2. Counter Reuse

AES-GCM security requires that the counter is never reused. The IV construction in Section 3 is designed to prevent counter reuse.

7. Acknowledgements

This draft borrows heavily from [I-D.ietf-tls-ctr] and [I-D.rescorla-tls-suiteb]

8. References

8.1. Normative References

[AES] National Institute of Standards and Technology, "Specification for the Advanced Encryption Standard (AES)", FIPS 197, November 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, April 2006.

[I-D.ietf-tls-rfc4346-bis]
Dierks, T. and E. Rescorla, "The TLS Protocol Version 1.2", draft-ietf-tls-rfc4346-bis-02 (work in progress),

October 2006.

[I-D.mcgrew-auth-enc]
McGrew, D., "An Interface and Algorithms for Authenticated Encryption", draft-mcgrew-auth-enc-01 (work in progress), October 2006.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC4346] Dierks, T. and E. Rescorla, "The Transport Layer Security (TLS) Protocol Version 1.1", RFC 4346, April 2006.

[RFC4347] Rescorla, E. and N. Modadugu, "Datagram Transport Layer Security", RFC 4347, April 2006.

8.2. Informative References

[I-D.ietf-tls-ctr]
Modadugu, N. and E. Rescorla, "AES Counter Mode Cipher Suites for TLS and DTLS", draft-ietf-tls-ctr-01 (work in progress), June 2006.

[I-D.rescorla-tls-suiteb]
Salter, M. and E. Rescorla, "SuiteB CipherSuites for TLS", draft-rescorla-tls-suiteb-00 (work in progress), December 2006.

[IEEE8021AE]
Institute of Electrical and Electronics Engineers, "Media Access Control Security", IEEE Standard 802.1AE, August 2006.

[RFC2246] Dierks, T. and C. Allen, "The TLS Protocol Version 1.0", RFC 2246, January 1999.

[RFC4106] Viega, J. and D. McGrew, "The Use of Galois/Counter Mode (GCM) in IPsec Encapsulating Security Payload (ESP)", RFC 4106, June 2005.

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