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P. Eronen, Ed.
Nokia

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DES and IDEA Cipher Suites for Transport Layer Security (TLS)

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Abstract

Transport Layer Security (TLS) versions 1.0 (RFC 2246) and 1.1 (RFC 4346) include cipher suites based on DES (Data Encryption Standard) and IDEA (International Data Encryption Algorithm) algorithms. DES (when used in single-DES mode) and IDEA are no longer recommended for general use in TLS, and have been removed from TLS version 1.2 (RFC 5246). This document specifies these cipher suites for completeness and discusses reasons why their use is no longer recommended.

1. Introduction

TLS versions 1.0 [TLS10] and 1.1 [TLS11] include cipher suites based on DES (Data Encryption Standard) and IDEA (International Data Encryption Algorithm) algorithms. DES (when used in single-DES mode) and IDEA are no longer recommended for general use in TLS, and have been removed from TLS version 1.2 [TLS12].

This document specifies these cipher suites for completeness and discusses reasons why their use is no longer recommended.

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 [REQ].

2. DES Cipher Suites

DES (Data Encryption Standard) is a block cipher that was originally approved as a US federal standard in 1976, and is specified in [DES].

For TLS key generation purposes, DES is treated as having a 64-bit key, but it still provides only 56 bits of protection, as 8 of the 64 bits are not used by the algorithm. DES uses a 64-bit block size.

The following cipher suites have been defined for using DES in Cipher Block Chaining (CBC) mode in TLS:

```
CipherSuite TLS_RSA_WITH_DES_CBC_SHA            = { 0x00,0x09 };
CipherSuite TLS_DH_DSS_WITH_DES_CBC_SHA         = { 0x00,0x0C };
CipherSuite TLS_DH_RSA_WITH_DES_CBC_SHA         = { 0x00,0x0F };
CipherSuite TLS_DHE_DSS_WITH_DES_CBC_SHA        = { 0x00,0x12 };
CipherSuite TLS_DHE_RSA_WITH_DES_CBC_SHA        = { 0x00,0x15 };
CipherSuite TLS_DH_anon_WITH_DES_CBC_SHA        = { 0x00,0x1A };
```

The key exchange algorithms (RSA, DH_DSS, DH_RSA, DHE_DSS, DHE_RSA, and DH_anon) and the MAC (Message Authentication Code) algorithm (SHA) are defined in the base TLS specification.

3. IDEA Cipher Suite

IDEA (International Data Encryption Algorithm) is a block cipher designed by Xuejia Lai and James Massey [IDEA] [SCH]. IDEA uses a 128-bit key and operates on 64-bit blocks.

The following cipher suite has been defined for using IDEA in CBC mode in TLS:

```
CipherSuite TLS_RSA_WITH_IDEA_CBC_SHA           = { 0x00,0x07 };
```

The key exchange algorithm (RSA) and the MAC algorithm (SHA) are defined in the base TLS specification.

4. Security Considerations

4.1. DES Cipher Suites

DES has an effective key strength of 56 bits, which has been known to be vulnerable to practical brute force attacks for over 20 years [DH]. A relatively recent 2006 paper by Kumar, et al. [COPA] describes a system that performs an exhaustive key search in less than nine days on average, and costs less than 10,000 USD to build.

Given this, the single-DES cipher suites SHOULD NOT be implemented by TLS libraries. If a TLS library implements these cipher suites, it SHOULD NOT enable them by default. Experience has also shown that rarely used code is a source of security and interoperability problems, so existing implementations SHOULD consider removing these cipher suites.

4.2. IDEA Cipher Suite

IDEA has a 128-bit key, and thus is not vulnerable to an exhaustive key search. However, the IDEA cipher suite for TLS has not seen widespread use: most implementations either do not support it, do not enable it by default, or do not negotiate it when other algorithms (such as AES, 3DES, or RC4) are available.

Experience has shown that rarely used code is a source of security and interoperability problems; given this, the IDEA cipher suite SHOULD NOT be implemented by TLS libraries and SHOULD be removed from existing implementations.

5. IANA Considerations

IANA has already allocated values for the cipher suites described in this document in the TLS Cipher Suite Registry, defined in [TLS11]. IANA has updated the references of these cipher suites to point to this document:

Value	Description	Reference
0x00,0x07	TLS_RSA_WITH_IDEA_CBC_SHA	[RFC5469]
0x00,0x09	TLS_RSA_WITH_DES_CBC_SHA	[RFC5469]
0x00,0x0C	TLS_DH_DSS_WITH_DES_CBC_SHA	[RFC5469]
0x00,0x0F	TLS_DH_RSA_WITH_DES_CBC_SHA	[RFC5469]
0x00,0x12	TLS_DHE_DSS_WITH_DES_CBC_SHA	[RFC5469]
0x00,0x15	TLS_DHE_RSA_WITH_DES_CBC_SHA	[RFC5469]
0x00,0x1A	TLS_DH_anon_WITH_DES_CBC_SHA	[RFC5469]

This document does not create any new registries to be maintained by IANA, and does not require any new assignments from existing registries.

6. Acknowledgments

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7. References

7.1. Normative References

[DES] National Institute of Standards and Technology, "Data Encryption Standard (DES)", FIPS PUB 46-3, October 1999.

[IDEA] Lai, X., "On the Design and Security of Block Ciphers", ETH Series in Information Processing, v. 1, Konstanz: Hartung-Gorre Verlag, 1992.

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

[SCH] Schneier, B., "Applied Cryptography: Protocols, Algorithms, and Source Code in C", 2nd ed., John Wiley & Sons, Inc., 1996.

[TLS10] Dierks, T. and C. Allen, "The TLS Protocol Version 1.0", RFC 2246, January 1999.

[TLS11] Dierks, T. and E. Rescorla, "The Transport Layer Security (TLS) Protocol Version 1.1", RFC 4346, April 2006.

[TLS12] Dierks, T. and E. Rescorla, "The Transport Layer Security (TLS) Protocol Version 1.2", RFC 5246, August 2008.

7.2. Informative References

[COPA] Kumar, S., Paar, C., Pelzl, J., Pfeiffer, G., and M. Schimmler, "Breaking Ciphers with COPACOBANA - A Cost-Optimized Parallel Code Breaker", Workshop on Cryptographic Hardware and Embedded Systems (CHES 2006), Yokohama, Japan, October 2006.

[DH] Diffie, W. and M. Hellman, "Exhaustive Cryptanalysis of the NBS Data Encryption Standard", IEEE Computer, Volume 10, Issue 6, June 1977.

Author's Address

Pasi Eronen (editor)
Nokia Research Center
P.O. Box 407
FIN-00045 Nokia Group
Finland

EMail: pasi.eronen@nokia.com