Internet Engineering Task Force
Internet-Draft
Updates: 8465 8422 7568 7562 7507 7465
6367
6176 6042 5878 5734 5469 5422
5364 5281 5263 5238 5216 5158
5091 5054 5049 5024 5023 5019
5018 4992 4976 4975 4964 4851
4823 4791 4785 4744 4743 4732
4712 4681 4680 4642 4616 4582
4540 4531 4513 4497 4279 4261
4235 4217 4168 4162 4111 4097
3983 3943 3903 3887 3871 3856
3767 3749 3656 3568 3552 3501
3470 3436 3329 3261 (if
approved)
Intended status: Standards Track
Expires: May 12, 2019

K. Moriarty
Dell EMC
S. Farrell
Trinity College Dublin

November 8, 2018

Deprecating TLSv1.0 and TLSv1.1
draft-ietf-tls-oldversions-deprecate-01

Abstract

This document, if approved, formally deprecates Transport Layer Security (TLS) versions 1.0 [RFC2246] and 1.1 [RFC4346] and moves these documents to the historic state. These versions lack support for current and recommended cipher suites, and various government and industry profiles of applications using TLS now mandate avoiding these old TLS versions. TLSv1.2 has been the recommended version for IETF protocols since 2008, providing sufficient time to transition away from older versions. Products having to support older versions increase the attack surface unnecessarily and increase opportunities for misconfigurations. Supporting these older versions also requires additional effort for library and product maintenance.

This document updates many RFCs that normatively refer to TLS1.0 or TLS1.1 as described herein. This document also updates RFC 7525 and hence is part of BCP195.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute

working documents as Internet-Drafts. The list of current Internet-Drafts is at https://datatracker.ietf.org/drafts/current/.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on May 12, 2019.

Copyright Notice

Copyright (c) 2018 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents (https://trustee.ietf.org/license-info) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Table of Contents

1. Introduction 3
  1.1. Updates 3
  1.2. Terminology 4
2. Support for Deprecation 4
3. SHA-1 5
4. Do Not Use TLSv1.0 6
5. Do Not Use TLSv1.1 6
6. Updates to RFC7525 7
7. Security Considerations 7
8. Acknowledgements 7
9. IANA Considerations 8
10. References 8
  10.1. Normative References 8
  10.2. Informative References 16
Appendix A. Change Log 20
Authors' Addresses 20

1. Introduction

Transport Layer Security (TLS) versions 1.0 [RFC2246] and 1.1 [RFC4346] were superceded by TLSv1.2 [RFC5246] in 2008, which has now itself been superceded by TLSv1.3 [RFC8446]. It is therefore timely to further deprecate these old versions. The expectation is that TLSv1.2 will continue to be used for many years alongside TLSv1.3.

TLSv1.1 and TLSv1.0 are also actively being deprecated in accordance with guidance from government agencies (e.g. NIST SP 80052r2 [NIST800-52r2]) and industry consortia such as the Payment Card Industry Association (PCI) [PCI-TLS1].

The primary technical reasons for deprecating these versions include:

- o They require implementation of older cipher suites that are no longer desirable for cryptographic reasons, e.g. TLSv1.0 makes TLS_DHE_DSS_WITH_3DES_EDE_CBC_SHA mandatory to implement
- o Lack of support for current recommended cipher suites, especially using AEAD ciphers which are not supported prior to TLS 1.2. Note: registry entries for no-longer-desirable ciphersuites remain in the registries, but many TLS registries are being updated through [RFC8447] which denotes such entries as "not recommended."
- o Integrity of the handshake depends on SHA-1 hash
- o Authentication of the peers depends on SHA-1 signatures
- o Support for four protocol versions increases the likelihood of misconfiguration
- o At least one widely-used library has plans to drop TLSv1.1 and TLSv1.0 support in upcoming releases; products using such libraries would need to use older versions of the libraries to support TLSv1.0 and TLSv1.1, which is clearly undesirable

Deprecation of these versions is intended to assist developers as additional justification to no longer support older TLS versions and to migrate to a minimum of TLSv1.2. Deprecation also assists product teams with phasing out support for the older versions to reduce the attack surface and the scope of maintenance for protocols in their offerings.

1.1. Updates

This document updates these RFCs that normatively reference TLS1.0 or TLS1.1 and have not been obsoleted: [RFC8465] [RFC8422] [RFC7568] [RFC7562] [RFC7507] [RFC7465] [RFC7255] [RFC7030] [RFC6750] [RFC6749] [RFC6739] [RFC6367] [RFC6176] [RFC6042] [RFC5878] [RFC5734] [RFC5469] [RFC5422] [RFC5364] [RFC5281] [RFC5263] [RFC5238] [RFC5216] [RFC5158] [RFC5091] [RFC5054] [RFC5049] [RFC5024] [RFC5023] [RFC5019] [RFC5018] [RFC4992] [RFC4976] [RFC4975] [RFC4964] [RFC4851] [RFC4823] [RFC4791]

[RFC4785] [RFC4744] [RFC4743] [RFC4732] [RFC4712] [RFC4681] [RFC4680] [RFC4642] [RFC4616] [RFC4582] [RFC4540] [RFC4531] [RFC4513] [RFC4497] [RFC4279] [RFC4261] [RFC4235] [RFC4217] [RFC4168] [RFC4162] [RFC4111] [RFC4097] [RFC3983] [RFC3943] [RFC3903] [RFC3887] [RFC3871] [RFC3856] [RFC3767] [RFC3749] [RFC3656] [RFC3568] [RFC3552] [RFC3501] [RFC3470] [RFC3436] [RFC3329] [RFC3261]

In addition these RFCs normatively refer to TLS1.0 or TLS1.1 and have been obsoleted, or informatively refer to TLS1.0 or TLS1.1: [RFC5101] [RFC5081] [RFC5077] [RFC4934] [RFC4572] [RFC4507] [RFC4492] [RFC4366] [RFC4347] [RFC4244] [RFC4132] [RFC3920] [RFC3734] [RFC3588] [RFC3546] [RFC3489] [RFC3316]

1.2. Terminology

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.

2. Support for Deprecation

Industry has actively followed guidance provided by NIST and the PCI Council to deprecate TLSv1.0 and TLSv1.1 by June 30, 2018. TLSv1.2 should remain a minimum baseline for TLS support at this time.

Specific details on attacks against TLSv1.0 and TLSv1.1 as well as their mitigations are provided in NIST SP800-52r2 [NIST800-52r2], RFC 7457 [RFC7457] and other referenced RFCs. Although the attacks have been mitigated, if support is dropped for future library releases for these versions, it is unlikely attacks found going forward will be mitigated in older library releases.

NIST for example have provided the following rationale, copied with permission from NIST SP800-52r2 [NIST800-52r2], section 1.2 "History of TLS" (with references changed for RFC formatting).

> TLS 1.1, specified in [RFC4346], was developed to address weaknesses discovered in TLS 1.0, primarily in the areas of initialization vector selection and padding error processing. Initialization vectors were made explicit to prevent a certain class of attacks on the Cipher Block Chaining (CBC) mode of operation used by TLS. The handling of padding errors was altered to treat a padding error as a bad message authentication code, rather than a decryption failure. In addition, the TLS 1.1 RFC acknowledges attacks on CBC mode that rely on the time to compute the message authentication code (MAC). The TLS 1.1 specification

states that to defend against such attacks, an implementation must process records in the same manner regardless of whether padding errors exist. Further implementation considerations for CBC modes (which were not included in RFC4346 [RFC4346]) are discussed in Section 3.3.2.

TLS 1.2, specified in RFC5246 [RFC5246], made several cryptographic enhancements, particularly in the area of hash functions, with the ability to use or specify the SHA-2 family algorithms for hash, MAC, and Pseudorandom Function (PRF) computations. TLS 1.2 also adds authenticated encryption with associated data (AEAD) cipher suites.

TLS 1.3, specified in TLSv1.3 [RFC8446], represents a significant change to TLS that aims to address threats that have arisen over the years. Among the changes are a new handshake protocol, a new key derivation process that uses the HMAC-based Extract-and-Expand Key Derivation Function (HKDF), and the removal of cipher suites that use static RSA or DH key exchanges, the CBC mode of operation, or SHA-1. The list of extensions that can be used with TLS 1.3 has been reduced considerably.

The Canadian government treasury board have also mandated that these old versions of TLS not be used. [Canada]

Various companies and web sites have announced plans to deprecate these old versions of TLS.

3. SHA-1

The integrity of both TLSv1.0 and TLSv1.1 depends on a running SHA-1 hash of the exchanged messages. This makes it possible to perform a downgrade attack on the handshake by an attacker able to perform 2^77 operations, well below the acceptable modern security margin.

Similarly, the authentication of the handshake depends on signatures made using SHA-1 hash or a not stronger concatenation of MD-5 and SHA-1 hashes, allowing the attacker to impersonate a server when it is able to break the severely weakened SHA-1 hash.

Neither TLSv1.0 nor TLSv1.1 allow the peers to select a stronger hash for signatures in the ServerKeyExchange or CertificateVerify messages, making the only upgrade path the use of a newer protocol version.

See [Bhargavan2016] for additional detail.

4. Do Not Use TLSv1.0

TLSv1.0 MUST NOT be used. Negotiation of TLSv1.0 from any version of TLS MUST NOT be permitted.

Any other version of TLS is more secure than TLSv1.0. TLSv1.0 can be configured to prevent interception, though using the highest version available is preferable.

Pragmatically, clients MUST NOT send a ClientHello with ClientHello.client_version set to {03,01}. Similarly, servers MUST NOT send a ServerHello with ServerHello.server_version set to {03,01}. Any party receiving a Hello message with the protocol version set to {03,01} MUST respond with a "protocol_version" alert message and close the connection.

Historically, TLS specifications were not clear on what the record layer version number (TLSPlaintext.version) could contain when sending ClientHello. Appendix E of [RFC5246] notes that TLSPlaintext.version could be selected to maximize interoperability, though no definitive value is identified as ideal. That guidance is still applicable; therefore, TLS servers MUST accept any value {03,XX} (including {03,00}) as the record layer version number for ClientHello, but they MUST NOT negotiate TLSv1.0.

5. Do Not Use TLSv1.1

TLSv1.1 MUST NOT be used. Negotiation of TLSv1.1 from any version of TLS MUST NOT be permitted.

Pragmatically, clients MUST NOT send a ClientHello with ClientHello.client_version set to {03,02}. Similarly, servers MUST NOT send a ServerHello with ServerHello.server_version set to {03,02}. Any party receiving a Hello message with the protocol version set to {03,02} MUST respond with a "protocol_version" alert message and close the connection.

Any newer version of TLS is more secure than TLSv1.1. TLSv1.1 can be configured to prevent interception, though using the highest version available is preferable. Support for TLSv1.1 is dwindling in libraries and will impact security going forward if mitigations for attacks cannot be easily addressed and supported in older libraries.

Historically, TLS specifications were not clear on what the record layer version number (TLSPlaintext.version) could contain when sending ClientHello. Appendix E of [RFC5246] notes that TLSPlaintext.version could be selected to maximize interoperability, though no definitive value is identified as ideal. That guidance is

still applicable; therefore, TLS servers MUST accept any value {03,XX} (including {03,00}) as the record layer version number for ClientHello, but they MUST NOT negotiate TLSv1.1.

6. Updates to RFC7525

This documents updates [RFC7525] Section 3.1.1 changing SHOULD NOT to MUST NOT as follows:

o Implementations MUST NOT negotiate TLS version 1.0 [RFC2246].

  Rationale: TLS 1.0 (published in 1999) does not support many modern, strong cipher suites. In addition, TLS 1.0 lacks a per-record Initialization Vector (IV) for CBC-based cipher suites and does not warn against common padding errors.

o Implementations MUST NOT negotiate TLS version 1.1 [RFC4346].

  Rationale: TLS 1.1 (published in 2006) is a security improvement over TLS 1.0 but still does not support certain stronger cipher suites.

This documents updates [RFC7525] Section 3.1.2 changing SHOULD NOT to MUST NOT as follows:

o Implementations MUST NOT negotiate DTLS version 1.0 [RFC4347].

  Version 1.0 of DTLS correlates to version 1.1 of TLS (see above).

7. Security Considerations

This document deprecates two older protocol versions for security reasons already described. The attack surface is reduced when there are a smaller number of supported protocols and fallback options are removed.

8. Acknowledgements

Thanks to those that provided usage data, reviewed and/or improved this document, including: David Benjamin, David Black, Viktor Dukhovni, Alessandro Ghedini, Jeremy Harris, Russ Housley, Hubert Kario, Loganaden Velvindron, Eric Mill, Yoav Nir, Andrei Popov, Eric Rescorla, Yaron Sheffer, https://github.com/yaleman, and Jakub Wilk.

9. IANA Considerations

[[This memo includes no request to IANA.]]

10. References

10.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

[RFC2246] Dierks, T. and C. Allen, "The TLS Protocol Version 1.0", RFC 2246, DOI 10.17487/RFC2246, January 1999, <https://www.rfc-editor.org/info/rfc2246>.

[RFC3261] Rosenberg, J., Schulzrinne, H., Camarillo, G., Johnston, A., Peterson, J., Sparks, R., Handley, M., and E. Schooler, "SIP: Session Initiation Protocol", RFC 3261, DOI 10.17487/RFC3261, June 2002, <https://www.rfc-editor.org/info/rfc3261>.

[RFC3329] Arkko, J., Torvinen, V., Camarillo, G., Niemi, A., and T. Haukka, "Security Mechanism Agreement for the Session Initiation Protocol (SIP)", RFC 3329, DOI 10.17487/RFC3329, January 2003, <https://www.rfc-editor.org/info/rfc3329>.

[RFC3436] Jungmaier, A., Rescorla, E., and M. Tuexen, "Transport Layer Security over Stream Control Transmission Protocol", RFC 3436, DOI 10.17487/RFC3436, December 2002, <https://www.rfc-editor.org/info/rfc3436>.

[RFC3470] Hollenbeck, S., Rose, M., and L. Masinter, "Guidelines for the Use of Extensible Markup Language (XML) within IETF Protocols", BCP 70, RFC 3470, DOI 10.17487/RFC3470, January 2003, <https://www.rfc-editor.org/info/rfc3470>.

[RFC3501] Crispin, M., "INTERNET MESSAGE ACCESS PROTOCOL - VERSION 4rev1", RFC 3501, DOI 10.17487/RFC3501, March 2003, <https://www.rfc-editor.org/info/rfc3501>.

[RFC3552] Rescorla, E. and B. Korver, "Guidelines for Writing RFC Text on Security Considerations", BCP 72, RFC 3552, DOI 10.17487/RFC3552, July 2003, <https://www.rfc-editor.org/info/rfc3552>.

[RFC3568] Barbir, A., Cain, B., Nair, R., and O. Spatscheck, "Known Content Network (CN) Request-Routing Mechanisms", RFC 3568, DOI 10.17487/RFC3568, July 2003, <https://www.rfc-editor.org/info/rfc3568>.

[RFC3656] Siemborski, R., "The Mailbox Update (MUPDATE) Distributed Mailbox Database Protocol", RFC 3656, DOI 10.17487/RFC3656, December 2003, <https://www.rfc-editor.org/info/rfc3656>.

[RFC3749] Hollenbeck, S., "Transport Layer Security Protocol Compression Methods", RFC 3749, DOI 10.17487/RFC3749, May 2004, <https://www.rfc-editor.org/info/rfc3749>.

[RFC3767] Farrell, S., Ed., "Securely Available Credentials Protocol", RFC 3767, DOI 10.17487/RFC3767, June 2004, <https://www.rfc-editor.org/info/rfc3767>.

[RFC3856] Rosenberg, J., "A Presence Event Package for the Session Initiation Protocol (SIP)", RFC 3856, DOI 10.17487/RFC3856, August 2004, <https://www.rfc-editor.org/info/rfc3856>.

[RFC3871] Jones, G., Ed., "Operational Security Requirements for Large Internet Service Provider (ISP) IP Network Infrastructure", RFC 3871, DOI 10.17487/RFC3871, September 2004, <https://www.rfc-editor.org/info/rfc3871>.

[RFC3887] Hansen, T., "Message Tracking Query Protocol", RFC 3887, DOI 10.17487/RFC3887, September 2004, <https://www.rfc-editor.org/info/rfc3887>.

[RFC3903] Niemi, A., Ed., "Session Initiation Protocol (SIP) Extension for Event State Publication", RFC 3903, DOI 10.17487/RFC3903, October 2004, <https://www.rfc-editor.org/info/rfc3903>.

[RFC3943] Friend, R., "Transport Layer Security (TLS) Protocol Compression Using Lempel-Ziv-Stac (LZS)", RFC 3943, DOI 10.17487/RFC3943, November 2004, <https://www.rfc-editor.org/info/rfc3943>.

[RFC3983] Newton, A. and M. Sanz, "Using the Internet Registry Information Service (IRIS) over the Blocks Extensible Exchange Protocol (BEEP)", RFC 3983, DOI 10.17487/RFC3983, January 2005, <https://www.rfc-editor.org/info/rfc3983>.

[RFC4097] Barnes, M., Ed., "Middlebox Communications (MIDCOM) Protocol Evaluation", RFC 4097, DOI 10.17487/RFC4097, June 2005, <https://www.rfc-editor.org/info/rfc4097>.

[RFC4111] Fang, L., Ed., "Security Framework for Provider-Provisioned Virtual Private Networks (PPVPNs)", RFC 4111, DOI 10.17487/RFC4111, July 2005, <https://www.rfc-editor.org/info/rfc4111>.

[RFC4162] Lee, H., Yoon, J., and J. Lee, "Addition of SEED Cipher Suites to Transport Layer Security (TLS)", RFC 4162, DOI 10.17487/RFC4162, August 2005, <https://www.rfc-editor.org/info/rfc4162>.

[RFC4168] Rosenberg, J., Schulzrinne, H., and G. Camarillo, "The Stream Control Transmission Protocol (SCTP) as a Transport for the Session Initiation Protocol (SIP)", RFC 4168, DOI 10.17487/RFC4168, October 2005, <https://www.rfc-editor.org/info/rfc4168>.

[RFC4217] Ford-Hutchinson, P., "Securing FTP with TLS", RFC 4217, DOI 10.17487/RFC4217, October 2005, <https://www.rfc-editor.org/info/rfc4217>.

[RFC4235] Rosenberg, J., Schulzrinne, H., and R. Mahy, Ed., "An INVITE-Initiated Dialog Event Package for the Session Initiation Protocol (SIP)", RFC 4235, DOI 10.17487/RFC4235, November 2005, <https://www.rfc-editor.org/info/rfc4235>.

[RFC4261] Walker, J. and A. Kulkarni, Ed., "Common Open Policy Service (COPS) Over Transport Layer Security (TLS)", RFC 4261, DOI 10.17487/RFC4261, December 2005, <https://www.rfc-editor.org/info/rfc4261>.

[RFC4279] Eronen, P., Ed. and H. Tschofenig, Ed., "Pre-Shared Key Ciphersuites for Transport Layer Security (TLS)", RFC 4279, DOI 10.17487/RFC4279, December 2005, <https://www.rfc-editor.org/info/rfc4279>.

[RFC4346] Dierks, T. and E. Rescorla, "The Transport Layer Security (TLS) Protocol Version 1.1", RFC 4346, DOI 10.17487/RFC4346, April 2006, <https://www.rfc-editor.org/info/rfc4346>.

[RFC4497] Elwell, J., Derks, F., Mourot, P., and O. Rousseau, "Interworking between the Session Initiation Protocol (SIP) and QSIG", BCP 117, RFC 4497, DOI 10.17487/RFC4497, May 2006, <https://www.rfc-editor.org/info/rfc4497>.

[RFC4513] Harrison, R., Ed., "Lightweight Directory Access Protocol (LDAP): Authentication Methods and Security Mechanisms", RFC 4513, DOI 10.17487/RFC4513, June 2006, <https://www.rfc-editor.org/info/rfc4513>.

[RFC4531] Zeilenga, K., "Lightweight Directory Access Protocol (LDAP) Turn Operation", RFC 4531, DOI 10.17487/RFC4531, June 2006, <https://www.rfc-editor.org/info/rfc4531>.

[RFC4540] Stiemerling, M., Quittek, J., and C. Cadar, "NEC's Simple Middlebox Configuration (SIMCO) Protocol Version 3.0", RFC 4540, DOI 10.17487/RFC4540, May 2006, <https://www.rfc-editor.org/info/rfc4540>.

[RFC4582] Camarillo, G., Ott, J., and K. Drage, "The Binary Floor Control Protocol (BFCP)", RFC 4582, DOI 10.17487/RFC4582, November 2006, <https://www.rfc-editor.org/info/rfc4582>.

[RFC4616] Zeilenga, K., Ed., "The PLAIN Simple Authentication and Security Layer (SASL) Mechanism", RFC 4616, DOI 10.17487/RFC4616, August 2006, <https://www.rfc-editor.org/info/rfc4616>.

[RFC4642] Murchison, K., Vinocur, J., and C. Newman, "Using Transport Layer Security (TLS) with Network News Transfer Protocol (NNTP)", RFC 4642, DOI 10.17487/RFC4642, October 2006, <https://www.rfc-editor.org/info/rfc4642>.

[RFC4680] Santesson, S., "TLS Handshake Message for Supplemental Data", RFC 4680, DOI 10.17487/RFC4680, October 2006, <https://www.rfc-editor.org/info/rfc4680>.

[RFC4681] Santesson, S., Medvinsky, A., and J. Ball, "TLS User Mapping Extension", RFC 4681, DOI 10.17487/RFC4681, October 2006, <https://www.rfc-editor.org/info/rfc4681>.

[RFC4712] Siddiqui, A., Romascanu, D., Golovinsky, E., Rahman, M., and Y. Kim, "Transport Mappings for Real-time Application Quality-of-Service Monitoring (RAQMON) Protocol Data Unit (PDU)", RFC 4712, DOI 10.17487/RFC4712, October 2006, <https://www.rfc-editor.org/info/rfc4712>.

[RFC4732] Handley, M., Ed., Rescorla, E., Ed., and IAB, "Internet Denial-of-Service Considerations", RFC 4732, DOI 10.17487/RFC4732, December 2006, <https://www.rfc-editor.org/info/rfc4732>.

[RFC4743] Goddard, T., "Using NETCONF over the Simple Object Access Protocol (SOAP)", RFC 4743, DOI 10.17487/RFC4743, December 2006, <https://www.rfc-editor.org/info/rfc4743>.

[RFC4744] Lear, E. and K. Crozier, "Using the NETCONF Protocol over the Blocks Extensible Exchange Protocol (BEEP)", RFC 4744, DOI 10.17487/RFC4744, December 2006, <https://www.rfc-editor.org/info/rfc4744>.

[RFC4785] Blumenthal, U. and P. Goel, "Pre-Shared Key (PSK) Ciphersuites with NULL Encryption for Transport Layer Security (TLS)", RFC 4785, DOI 10.17487/RFC4785, January 2007, <https://www.rfc-editor.org/info/rfc4785>.

[RFC4791] Daboo, C., Desruisseaux, B., and L. Dusseault, "Calendaring Extensions to WebDAV (CalDAV)", RFC 4791, DOI 10.17487/RFC4791, March 2007, <https://www.rfc-editor.org/info/rfc4791>.

[RFC4823] Harding, T. and R. Scott, "FTP Transport for Secure Peer-to-Peer Business Data Interchange over the Internet", RFC 4823, DOI 10.17487/RFC4823, April 2007, <https://www.rfc-editor.org/info/rfc4823>.

[RFC4851] Cam-Winget, N., McGrew, D., Salowey, J., and H. Zhou, "The Flexible Authentication via Secure Tunneling Extensible Authentication Protocol Method (EAP-FAST)", RFC 4851, DOI 10.17487/RFC4851, May 2007, <https://www.rfc-editor.org/info/rfc4851>.

[RFC4964] Allen, A., Ed., Holm, J., and T. Hallin, "The P-Answer-State Header Extension to the Session Initiation Protocol for the Open Mobile Alliance Push to Talk over Cellular", RFC 4964, DOI 10.17487/RFC4964, September 2007, <https://www.rfc-editor.org/info/rfc4964>.

[RFC4975] Campbell, B., Ed., Mahy, R., Ed., and C. Jennings, Ed., "The Message Session Relay Protocol (MSRP)", RFC 4975, DOI 10.17487/RFC4975, September 2007, <https://www.rfc-editor.org/info/rfc4975>.

[RFC4976] Jennings, C., Mahy, R., and A. Roach, "Relay Extensions for the Message Sessions Relay Protocol (MSRP)", RFC 4976, DOI 10.17487/RFC4976, September 2007, <https://www.rfc-editor.org/info/rfc4976>.

[RFC4992] Newton, A., "XML Pipelining with Chunks for the Internet Registry Information Service", RFC 4992, DOI 10.17487/RFC4992, August 2007, <https://www.rfc-editor.org/info/rfc4992>.

[RFC5018] Camarillo, G., "Connection Establishment in the Binary Floor Control Protocol (BFCP)", RFC 5018, DOI 10.17487/RFC5018, September 2007, <https://www.rfc-editor.org/info/rfc5018>.

[RFC5019] Deacon, A. and R. Hurst, "The Lightweight Online Certificate Status Protocol (OCSP) Profile for High-Volume Environments", RFC 5019, DOI 10.17487/RFC5019, September 2007, <https://www.rfc-editor.org/info/rfc5019>.

[RFC5023] Gregorio, J., Ed. and B. de hOra, Ed., "The Atom Publishing Protocol", RFC 5023, DOI 10.17487/RFC5023, October 2007, <https://www.rfc-editor.org/info/rfc5023>.

[RFC5024] Friend, I., "ODETTE File Transfer Protocol 2.0", RFC 5024, DOI 10.17487/RFC5024, November 2007, <https://www.rfc-editor.org/info/rfc5024>.

[RFC5049] Bormann, C., Liu, Z., Price, R., and G. Camarillo, Ed., "Applying Signaling Compression (SigComp) to the Session Initiation Protocol (SIP)", RFC 5049, DOI 10.17487/RFC5049, December 2007, <https://www.rfc-editor.org/info/rfc5049>.

[RFC5054] Taylor, D., Wu, T., Mavrogiannopoulos, N., and T. Perrin, "Using the Secure Remote Password (SRP) Protocol for TLS Authentication", RFC 5054, DOI 10.17487/RFC5054, November 2007, <https://www.rfc-editor.org/info/rfc5054>.

[RFC5091] Boyen, X. and L. Martin, "Identity-Based Cryptography Standard (IBCS) #1: Supersingular Curve Implementations of the BF and BB1 Cryptosystems", RFC 5091, DOI 10.17487/RFC5091, December 2007, <https://www.rfc-editor.org/info/rfc5091>.

[RFC5158] Huston, G., "6to4 Reverse DNS Delegation Specification", RFC 5158, DOI 10.17487/RFC5158, March 2008, <https://www.rfc-editor.org/info/rfc5158>.

[RFC5216] Simon, D., Aboba, B., and R. Hurst, "The EAP-TLS Authentication Protocol", RFC 5216, DOI 10.17487/RFC5216, March 2008, <https://www.rfc-editor.org/info/rfc5216>.

[RFC5238] Phelan, T., "Datagram Transport Layer Security (DTLS) over the Datagram Congestion Control Protocol (DCCP)", RFC 5238, DOI 10.17487/RFC5238, May 2008, <https://www.rfc-editor.org/info/rfc5238>.

[RFC5263] Lonnfors, M., Costa-Requena, J., Leppanen, E., and H. Khartabil, "Session Initiation Protocol (SIP) Extension for Partial Notification of Presence Information", RFC 5263, DOI 10.17487/RFC5263, September 2008, <https://www.rfc-editor.org/info/rfc5263>.

[RFC5281] Funk, P. and S. Blake-Wilson, "Extensible Authentication Protocol Tunneled Transport Layer Security Authenticated Protocol Version 0 (EAP-TTLSv0)", RFC 5281, DOI 10.17487/RFC5281, August 2008, <https://www.rfc-editor.org/info/rfc5281>.

[RFC5364] Garcia-Martin, M. and G. Camarillo, "Extensible Markup Language (XML) Format Extension for Representing Copy Control Attributes in Resource Lists", RFC 5364, DOI 10.17487/RFC5364, October 2008, <https://www.rfc-editor.org/info/rfc5364>.

[RFC5422] Cam-Winget, N., McGrew, D., Salowey, J., and H. Zhou, "Dynamic Provisioning Using Flexible Authentication via Secure Tunneling Extensible Authentication Protocol (EAP-FAST)", RFC 5422, DOI 10.17487/RFC5422, March 2009, <https://www.rfc-editor.org/info/rfc5422>.

[RFC5469] Eronen, P., Ed., "DES and IDEA Cipher Suites for Transport Layer Security (TLS)", RFC 5469, DOI 10.17487/RFC5469, February 2009, <https://www.rfc-editor.org/info/rfc5469>.

[RFC5734] Hollenbeck, S., "Extensible Provisioning Protocol (EPP) Transport over TCP", STD 69, RFC 5734, DOI 10.17487/RFC5734, August 2009, <https://www.rfc-editor.org/info/rfc5734>.

[RFC5878] Brown, M. and R. Housley, "Transport Layer Security (TLS) Authorization Extensions", RFC 5878, DOI 10.17487/RFC5878, May 2010, <https://www.rfc-editor.org/info/rfc5878>.

[RFC6042] Keromytis, A., "Transport Layer Security (TLS) Authorization Using KeyNote", RFC 6042, DOI 10.17487/RFC6042, October 2010, <https://www.rfc-editor.org/info/rfc6042>.

[RFC6176] Turner, S. and T. Polk, "Prohibiting Secure Sockets Layer (SSL) Version 2.0", RFC 6176, DOI 10.17487/RFC6176, March 2011, <https://www.rfc-editor.org/info/rfc6176>.

[RFC6367] Kanno, S. and M. Kanda, "Addition of the Camellia Cipher Suites to Transport Layer Security (TLS)", RFC 6367, DOI 10.17487/RFC6367, September 2011, <https://www.rfc-editor.org/info/rfc6367>.

[RFC6739] Schulzrinne, H. and H. Tschofenig, "Synchronizing Service Boundaries and <mapping> Elements Based on the Location-to-Service Translation (LoST) Protocol", RFC 6739, DOI 10.17487/RFC6739, October 2012, <https://www.rfc-editor.org/info/rfc6739>.

[RFC6749] Hardt, D., Ed., "The OAuth 2.0 Authorization Framework", RFC 6749, DOI 10.17487/RFC6749, October 2012, <https://www.rfc-editor.org/info/rfc6749>.

[RFC6750] Jones, M. and D. Hardt, "The OAuth 2.0 Authorization Framework: Bearer Token Usage", RFC 6750, DOI 10.17487/RFC6750, October 2012, <https://www.rfc-editor.org/info/rfc6750>.

[RFC7030] Pritikin, M., Ed., Yee, P., Ed., and D. Harkins, Ed., "Enrollment over Secure Transport", RFC 7030, DOI 10.17487/RFC7030, October 2013, <https://www.rfc-editor.org/info/rfc7030>.

[RFC7255] Allen, A., Ed., "Using the International Mobile station Equipment Identity (IMEI) Uniform Resource Name (URN) as an Instance ID", RFC 7255, DOI 10.17487/RFC7255, May 2014, <https://www.rfc-editor.org/info/rfc7255>.

[RFC7465] Popov, A., "Prohibiting RC4 Cipher Suites", RFC 7465, DOI 10.17487/RFC7465, February 2015, <https://www.rfc-editor.org/info/rfc7465>.

[RFC7507] Moeller, B. and A. Langley, "TLS Fallback Signaling Cipher Suite Value (SCSV) for Preventing Protocol Downgrade Attacks", RFC 7507, DOI 10.17487/RFC7507, April 2015, <https://www.rfc-editor.org/info/rfc7507>.

[RFC7525] Sheffer, Y., Holz, R., and P. Saint-Andre, "Recommendations for Secure Use of Transport Layer Security (TLS) and Datagram Transport Layer Security (DTLS)", BCP 195, RFC 7525, DOI 10.17487/RFC7525, May 2015, <https://www.rfc-editor.org/info/rfc7525>.

[RFC7562] Thakore, D., "Transport Layer Security (TLS) Authorization Using Digital Transmission Content Protection (DTCP) Certificates", RFC 7562, DOI 10.17487/RFC7562, July 2015, <https://www.rfc-editor.org/info/rfc7562>.

[RFC7568] Barnes, R., Thomson, M., Pironti, A., and A. Langley, "Deprecating Secure Sockets Layer Version 3.0", RFC 7568, DOI 10.17487/RFC7568, June 2015, <https://www.rfc-editor.org/info/rfc7568>.

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <https://www.rfc-editor.org/info/rfc8174>.

[RFC8422] Nir, Y., Josefsson, S., and M. Pegourie-Gonnard, "Elliptic Curve Cryptography (ECC) Cipher Suites for Transport Layer Security (TLS) Versions 1.2 and Earlier", RFC 8422, DOI 10.17487/RFC8422, August 2018, <https://www.rfc-editor.org/info/rfc8422>.

[RFC8465] Atarius, R., Ed., "Using the Mobile Equipment Identity (MEID) URN as an Instance ID", RFC 8465, DOI 10.17487/RFC8465, September 2018, <https://www.rfc-editor.org/info/rfc8465>.

10.2. Informative References

[Bhargavan2016] Bhargavan, K. and G. Leuren, "Transcript Collision Attacks: Breaking Authentication in TLS, IKE, and SSH https://www.mitls.org/downloads/transcript-collisions.pdf", 2016.

[Canada] Treasury Board of Canada Secretariat, "Implementing HTTPS for Secure Web Connections: Information Technology Policy Implementation Notice (ITPIN)", June 2018, <https://www.canada.ca/en/treasury-board-secretariat/services/information-technology/policy-implementation-notices/implementing-https-secure-web-connections-itpin.html>.

[NIST800-52r2]
National Institute of Standards and Technology, "NIST SP800-52r2 https://csrc.nist.gov/CSRC/media/Publications/sp/800-52/rev-2/draft/documents/sp800-52r2-draft.pdf", 2018.

[PCI-TLS1]
PCI Security Standards Council, "Migrating from SSL and Early TLS https://www.pcisecuritystandards.org/documents/Migrating-from-SSL-Early-TLS-Info-Supp-v1_1.pdf", 2016.

[RFC3316] Arkko, J., Kuijpers, G., Soliman, H., Loughney, J., and J. Wiljakka, "Internet Protocol Version 6 (IPv6) for Some Second and Third Generation Cellular Hosts", RFC 3316, DOI 10.17487/RFC3316, April 2003, <https://www.rfc-editor.org/info/rfc3316>.

[RFC3489] Rosenberg, J., Weinberger, J., Huitema, C., and R. Mahy, "STUN - Simple Traversal of User Datagram Protocol (UDP) Through Network Address Translators (NATs)", RFC 3489, DOI 10.17487/RFC3489, March 2003, <https://www.rfc-editor.org/info/rfc3489>.

[RFC3546] Blake-Wilson, S., Nystrom, M., Hopwood, D., Mikkelsen, J., and T. Wright, "Transport Layer Security (TLS) Extensions", RFC 3546, DOI 10.17487/RFC3546, June 2003, <https://www.rfc-editor.org/info/rfc3546>.

[RFC3588] Calhoun, P., Loughney, J., Guttman, E., Zorn, G., and J. Arkko, "Diameter Base Protocol", RFC 3588, DOI 10.17487/RFC3588, September 2003, <https://www.rfc-editor.org/info/rfc3588>.

[RFC3734] Hollenbeck, S., "Extensible Provisioning Protocol (EPP) Transport Over TCP", RFC 3734, DOI 10.17487/RFC3734, March 2004, <https://www.rfc-editor.org/info/rfc3734>.

[RFC3920] Saint-Andre, P., Ed., "Extensible Messaging and Presence Protocol (XMPP): Core", RFC 3920, DOI 10.17487/RFC3920, October 2004, <https://www.rfc-editor.org/info/rfc3920>.

[RFC4132] Moriai, S., Kato, A., and M. Kanda, "Addition of Camellia Cipher Suites to Transport Layer Security (TLS)", RFC 4132, DOI 10.17487/RFC4132, July 2005, <https://www.rfc-editor.org/info/rfc4132>.

[RFC4244] Barnes, M., Ed., "An Extension to the Session Initiation Protocol (SIP) for Request History Information", RFC 4244, DOI 10.17487/RFC4244, November 2005, <https://www.rfc-editor.org/info/rfc4244>.

[RFC4347] Rescorla, E. and N. Modadugu, "Datagram Transport Layer Security", RFC 4347, DOI 10.17487/RFC4347, April 2006, <https://www.rfc-editor.org/info/rfc4347>.

[RFC4366] Blake-Wilson, S., Nystrom, M., Hopwood, D., Mikkelsen, J., and T. Wright, "Transport Layer Security (TLS) Extensions", RFC 4366, DOI 10.17487/RFC4366, April 2006, <https://www.rfc-editor.org/info/rfc4366>.

[RFC4492] Blake-Wilson, S., Bolyard, N., Gupta, V., Hawk, C., and B. Moeller, "Elliptic Curve Cryptography (ECC) Cipher Suites for Transport Layer Security (TLS)", RFC 4492, DOI 10.17487/RFC4492, May 2006, <https://www.rfc-editor.org/info/rfc4492>.

[RFC4507] Salowey, J., Zhou, H., Eronen, P., and H. Tschofenig, "Transport Layer Security (TLS) Session Resumption without Server-Side State", RFC 4507, DOI 10.17487/RFC4507, May 2006, <https://www.rfc-editor.org/info/rfc4507>.

[RFC4572] Lennox, J., "Connection-Oriented Media Transport over the Transport Layer Security (TLS) Protocol in the Session Description Protocol (SDP)", RFC 4572, DOI 10.17487/RFC4572, July 2006, <https://www.rfc-editor.org/info/rfc4572>.

[RFC4934] Hollenbeck, S., "Extensible Provisioning Protocol (EPP) Transport Over TCP", RFC 4934, DOI 10.17487/RFC4934, May 2007, <https://www.rfc-editor.org/info/rfc4934>.

[RFC5077] Salowey, J., Zhou, H., Eronen, P., and H. Tschofenig, "Transport Layer Security (TLS) Session Resumption without Server-Side State", RFC 5077, DOI 10.17487/RFC5077, January 2008, <https://www.rfc-editor.org/info/rfc5077>.

[RFC5081] Mavrogiannopoulos, N., "Using OpenPGP Keys for Transport Layer Security (TLS) Authentication", RFC 5081, DOI 10.17487/RFC5081, November 2007, <https://www.rfc-editor.org/info/rfc5081>.

[RFC5101] Claise, B., Ed., "Specification of the IP Flow Information Export (IPFIX) Protocol for the Exchange of IP Traffic Flow Information", RFC 5101, DOI 10.17487/RFC5101, January 2008, <https://www.rfc-editor.org/info/rfc5101>.

[RFC5246] Dierks, T. and E. Rescorla, "The Transport Layer Security (TLS) Protocol Version 1.2", RFC 5246, DOI 10.17487/RFC5246, August 2008, <https://www.rfc-editor.org/info/rfc5246>.

[RFC7457] Sheffer, Y., Holz, R., and P. Saint-Andre, "Summarizing Known Attacks on Transport Layer Security (TLS) and Datagram TLS (DTLS)", RFC 7457, DOI 10.17487/RFC7457, February 2015, <https://www.rfc-editor.org/info/rfc7457>.

[RFC8446] Rescorla, E., "The Transport Layer Security (TLS) Protocol Version 1.3", RFC 8446, DOI 10.17487/RFC8446, August 2018, <https://www.rfc-editor.org/info/rfc8446>.

[RFC8447] Salowey, J. and S. Turner, "IANA Registry Updates for TLS and DTLS", RFC 8447, DOI 10.17487/RFC8447, August 2018, <https://www.rfc-editor.org/info/rfc8447>.

Appendix A. Change Log

[[RFC editor: please remove this before publication.]]

From draft-ietf-tls-oldversions-deprecate-00 to draft-ietf-tls-oldversions-deprecate-01:

- o PRs with typos and similar: so far just #1
- o PR#2 noting msft browser announced deprecation (but this was OBE as per...)
- o Implemented actions as per IETF-103 meeting:
  - * Details about which RFC's, BCP's are affected were generated using a script in the git repo: https://github.com/tlswg/oldversions-deprecate/blob/master/nonobsnorms.sh
  - * Removed the 'measurements' part
  - * Removed SHA-1 deprecation (section 8 of -00)

From draft-moriarty-tls-oldversions-diediedie-01 to draft-ietf-tls-oldversions-deprecate-00:

- o I-Ds became RFCs 8446/8447 (old-repo PR#4, for TLS1.3)
- o Accepted old-repo PR#5 fixing typos

From draft-moriarty-tls-oldversions-diediedie-00 to draft-moriarty-tls-oldversions-diediedie-01:

- o Added stats sent to list so far
- o PR's #2,3
- o a few more references
- o added section on email

Authors' Addresses

Kathleen Moriarty
Dell EMC
176 South Street
Hopkinton
United States

EMail: Kathleen.Moriarty.ietf@gmail.com

Stephen Farrell
Trinity College Dublin
Dublin 2
Ireland

Phone: +353-1-896-2354
EMail: stephen.farrell@cs.tcd.ie