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Deprecating TLSv1.0 and TLSv1.1
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Abstract

This document, if approved, formally deprecates Transport Layer Security (TLS) versions 1.0 ([RFC 2246](#)) and 1.1 ([RFC 4346](#)). Accordingly, those documents (will be moved|have been moved) to Historic status. These versions lack support for current and recommended cryptographic algorithms and mechanisms, 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. Removing support for older versions from implementations reduces the attack surface, reduces opportunity for misconfiguration, and streamlines library and product maintenance.

This document also deprecates Datagram TLS (DTLS) version 1.0 ([RFC6347](#)), but not DTLS version 1.2, and there is no DTLS version 1.1.

This document updates many RFCs that normatively refer to TLSv1.0 or TLSv1.1 as described herein. This document also updates the best practices for TLS usage in [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](#).

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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Transport Layer Security (TLS) versions 1.0 [[RFC2246](#)] and 1.1 [[RFC4346](#)] were superceded by TLSv1.2 [[RFC5246](#)] in 2008, which has now itself been superceded by TLSv1.3 [[RFC8446](#)]. Datagram Transport Layer Security (DTLS) version 1.0 [[RFC4347](#)] was superceded by DTLSv1.2 [[RFC6347](#)] in 2012. It is therefore timely to further deprecate these old versions. Accordingly, those documents (will be moved|have been moved) to Historic status.

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 AEAD ciphers which are not supported prior to TLSv1.2. Note: registry entries for no-longer-desirable ciphersuites remain in the registries, but many TLS registries are being updated through [[RFC8447](#)] which indicates that such entries are not recommended by the IETF.
- o Integrity of the handshake depends on SHA-1 hash.
- o Authentication of the peers depends on SHA-1 signatures.
- o Support for four TLS 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 (D)TLS versions and to migrate to a minimum of (D)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. RFCs Updated

This document updates the following RFCs that normatively reference TLSv1.0 or TLSv1.1 or DTLS1.0. The update is to obsolete usage of these older versions. Fallback to these versions are prohibited through this update. Specific references to mandatory minimum protocol versions of TLSv1.0 or TLSv1.1 are replaced by TLSv1.2, and references to minimum protocol version DTLSv1.0 are replaced by

DTLSv1.2. Statements that "TLS 1.0 is the most widely deployed version and will provide the broadest interoperability" are removed without replacement.

[RFC8422] [[RFC8261](#)] [[RFC7568](#)] [[RFC7562](#)] [[RFC7525](#)] [[RFC7465](#)] [[RFC7030](#)]
[[RFC6750](#)] [[RFC6749](#)] [[RFC6739](#)] [[RFC6084](#)] [[RFC6083](#)] [[RFC6367](#)] [[RFC6176](#)]
[[RFC6042](#)] [[RFC6012](#)] [[RFC5878](#)] [[RFC5734](#)] [[RFC5456](#)] [[RFC5422](#)] [[RFC5415](#)]
[[RFC5364](#)] [[RFC5281](#)] [[RFC5263](#)] [[RFC5238](#)] [[RFC5216](#)] [[RFC5158](#)] [[RFC5091](#)]
[[RFC5054](#)] [[RFC5049](#)] [[RFC5024](#)] [[RFC5023](#)] [[RFC5019](#)] [[RFC5018](#)] [[RFC4992](#)]
[[RFC4976](#)] [[RFC4975](#)] [[RFC4964](#)] [[RFC4851](#)] [[RFC4823](#)] [[RFC4791](#)] [[RFC4785](#)]
[[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](#)]

The status of [[RFC7562](#)], [[RFC6042](#)], [[RFC5456](#)], [[RFC5024](#)], [[RFC4540](#)], and [[RFC3656](#)] will be updated with permission of the Independent Stream Editor.

In addition these RFCs normatively refer to TLSv1.0 or TLSv1.1 and have already been obsoleted; they are still listed here and marked as updated by this document in order to reiterate that any usage of the obsolete protocol should still use modern TLS: [[RFC5101](#)] [[RFC5081](#)] [[RFC5077](#)] [[RFC4934](#)] [[RFC4572](#)] [[RFC4507](#)] [[RFC4492](#)] [[RFC4366](#)] [[RFC4347](#)] [[RFC4244](#)] [[RFC4132](#)] [[RFC3920](#)] [[RFC3734](#)] [[RFC3588](#)] [[RFC3546](#)] [[RFC3489](#)] [[RFC3316](#)]

Note that [[RFC4642](#)] has already been updated by [[RFC8143](#)], which makes an overlapping, but not quite identical, update as this document.

[RFC6614] has a requirement for TLSv1.1 or later, although only makes an informative reference to [[RFC4346](#)]. This requirement is updated to be for TLSv1.2 or later.

[[RFC6460](#)], [[RFC4744](#)], and [[RFC4743](#)] are already Historic; they are still listed here and marked as updated by this document in order to reiterate that any usage of the obsolete protocol should still use modern TLS.

This document updates DTLS [[RFC6347](#)]. [[RFC6347](#)] had allowed for negotiating the use of DTLSv1.0, which is now forbidden.

The DES and IDEA cipher suites specified in [[RFC5469](#)] were specifically removed from TLSv1.2 by [[RFC5246](#)]; since the only versions of TLS for which their usage is defined are now Historic, [RFC 5469](#) (will be|has been) moved to Historic as well.

The version-fallback Signaling Cipher Suite Value specified in [RFC7507] was defined to detect when a given client and server negotiate a lower version of (D)TLS than their highest shared version. TLSv1.3 ([RFC8446]) incorporates a different mechanism that achieves this purpose, via sentinel values in the ServerHello.Random field. With (D)TLS versions prior to 1.2 fully deprecated, the only way for (D)TLS implementations to negotiate a lower version than their highest shared version would be to negotiate (D)TLSv1.2 while supporting (D)TLSv1.3; supporting (D)TLSv1.3 implies support for the ServerHello.Random mechanism. Accordingly, the functionality from [RFC7507] has been superseded, and this document marks it as Obsolete.

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

Specific details on attacks against TLSv1.0 and TLSv1.1, as well as their mitigations, are provided in [NIST800-52r2], RFC 7457 [RFC7457] and other RFCs referenced therein. Although mitigations for the current known vulnerabilities have been developed, any future issues discovered in old protocol versions might not be mitigated in older library versions when newer library versions do not support those old protocols.

NIST for example have provided the following rationale, copied with permission from [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](#).

TLSv1.2, 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. TLSv1.2 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.

3. SHA-1 Usage Problematic in TLSv1.0 and TLSv1.1

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 a SHA-1 hash or a not appreciably 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. While TLSv1.0 can be configured to prevent some types of interception, using the highest version available is preferred.

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. While TLSv1.1 can be configured to prevent some types of interception, using the highest version available is preferred. 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](#)

[RFC7525](#) is [BCP195](#), "Recommendations for Secure Use of Transport Layer Security (TLS) and Datagram Transport Layer Security (DTLS)", which is the most recent best practice document for implementing TLS and was based on TLSv1.2. At the time of publication, TLSv1.0 and TLSv1.1 had not yet been deprecated. As such, this document is called out specifically to update text implementing the deprecation recommendations of this document.

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: TLSv1.0 (published in 1999) does not support many modern, strong cipher suites. In addition, TLSv1.0 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: TLSv1.1 (published in 2006) is a security improvement over TLSv1.0 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 [\[RFC4347\]](#), [\[RFC6347\]](#).

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

7. Security Considerations

This document deprecates two older TLS protocol versions and one older DTLS protocol version 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

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Rescorla, Yaron Sheffer, Robert Sparks, Martin Thomson, Loganaden Velvindron, and Jakub Wilk.

[[Note to RFC editor: At least Julien Elie's name above should have an accent on the first letter of the surname. Please fix that and any others needing a similar fix if you can, I'm not sure the tooling I have now allows that.]]

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] Stiernerling, 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 h0ra, 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>>.

- [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>>.

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.
- [NIST800-52r2]
National Institute of Standards and Technology, "NIST SP800-52r2 <https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-52r2.pdf>", August 2019.

- [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] Mavrogianopoulos, 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>>.
- [RFC5415] Calhoun, P., Ed., Montemurro, M., Ed., and D. Stanley, Ed., "Control And Provisioning of Wireless Access Points (CAPWAP) Protocol Specification", [RFC 5415](#), DOI 10.17487/RFC5415, March 2009, <<https://www.rfc-editor.org/info/rfc5415>>.

- [RFC5456] Spencer, M., Capouch, B., Guy, E., Ed., Miller, F., and K. Shumard, "IAX: Inter-Asterisk eXchange Version 2", [RFC 5456](#), DOI 10.17487/RFC5456, February 2010, <<https://www.rfc-editor.org/info/rfc5456>>.
- [RFC6012] Salowey, J., Petch, T., Gerhards, R., and H. Feng, "Datagram Transport Layer Security (DTLS) Transport Mapping for Syslog", [RFC 6012](#), DOI 10.17487/RFC6012, October 2010, <<https://www.rfc-editor.org/info/rfc6012>>.
- [RFC6083] Tuexen, M., Seggelmann, R., and E. Rescorla, "Datagram Transport Layer Security (DTLS) for Stream Control Transmission Protocol (SCTP)", [RFC 6083](#), DOI 10.17487/RFC6083, January 2011, <<https://www.rfc-editor.org/info/rfc6083>>.
- [RFC6084] Fu, X., Dickmann, C., and J. Crowcroft, "General Internet Signaling Transport (GIST) over Stream Control Transmission Protocol (SCTP) and Datagram Transport Layer Security (DTLS)", [RFC 6084](#), DOI 10.17487/RFC6084, January 2011, <<https://www.rfc-editor.org/info/rfc6084>>.
- [RFC6347] Rescorla, E. and N. Modadugu, "Datagram Transport Layer Security Version 1.2", [RFC 6347](#), DOI 10.17487/RFC6347, January 2012, <<https://www.rfc-editor.org/info/rfc6347>>.
- [RFC6460] Salter, M. and R. Housley, "Suite B Profile for Transport Layer Security (TLS)", [RFC 6460](#), DOI 10.17487/RFC6460, January 2012, <<https://www.rfc-editor.org/info/rfc6460>>.
- [RFC6614] Winter, S., McCauley, M., Venaas, S., and K. Wierenga, "Transport Layer Security (TLS) Encryption for RADIUS", [RFC 6614](#), DOI 10.17487/RFC6614, May 2012, <<https://www.rfc-editor.org/info/rfc6614>>.
- [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>>.
- [RFC8143] Elie, J., "Using Transport Layer Security (TLS) with Network News Transfer Protocol (NNTP)", [RFC 8143](#), DOI 10.17487/RFC8143, April 2017, <<https://www.rfc-editor.org/info/rfc8143>>.

- [RFC8261] Tuexen, M., Stewart, R., Jesup, R., and S. Loreto, "Datagram Transport Layer Security (DTLS) Encapsulation of SCTP Packets", [RFC 8261](#), DOI 10.17487/RFC8261, November 2017, <<https://www.rfc-editor.org/info/rfc8261>>.
- [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-05](#) to [draft-ietf-tls-oldversions-deprecate-06](#):

- o Fixed "yaleman" ack.
- o Added [RFC6614](#) to UPDATES list.
- o per preliminary AD review:
 - * Remove references from abstract
 - * s/primary technical reasons/technical reasons/
 - * Add [rfc7030](#) to 1.1
 - * verified that all the RFCs in the (massive:-) Updates meta-data are mentioned in [section 1.1](#) (I think appropriately;-)

From [draft-ietf-tls-oldversions-deprecate-04](#) to [draft-ietf-tls-oldversions-deprecate-05](#):

- o Removed references to government related deprecation statements: US, Canada, and Germany. NIST documentation rationale remains as a reference describing the relevant RFCs and justification.

From [draft-ietf-tls-oldversions-deprecate-02](#) to [draft-ietf-tls-oldversions-deprecate-03](#):

- o Added 8261 to updates list based on IETF-104 meeting.

From [draft-ietf-tls-oldversions-deprecate-01](#) to [draft-ietf-tls-oldversions-deprecate-02](#):

- o Correction: 2nd list of referenced RFCs in [Section 1.1](#) aren't informatively referring to tls1.0/1.1
- o Remove [RFC7255](#) from updates list - datatracker has bad data (spotted by Robert Sparks)
- o Added point about RFCs 8143 and 4642
- o Added UPDATES for RFCs that refer to 4347 and aren't OBSOLETEd
- o Added note about [RFC8261](#) to see what WG want.

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 TLSv1.3)
- 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

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