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Deprecate DES support for Kerberos
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Abstract

The Kerberos 5 network authentication protocol, originally specified in [RFC1510](#), can use the Data Encryption Standard (DES) for encryption. Almost 30 years after first publishing DES, the National Institute of Standards and Technology (NIST) finally withdrew the standard in 2005, reflecting a long-established consensus that DES is insufficiently secure. By 2008, commercial hardware costing less than USD 15,000 could break DES keys in less than a day on average. DES is long past its sell-by date. Accordingly, this document updates [RFC1964](#), [RFC4120](#), and [RFC4121](#) to deprecate the use of DES in Kerberos. Because [RFC1510](#) (obsoleted by [RFC4120](#)) supports only DES, this document reclassifies [RFC1510](#) as Historic. This document also deprecates the weak "export strength" RC4 enctype of [RFC4757](#).

Status of this Memo

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1. Requirements Notation

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119](#).

2. Introduction

The original specification of the Kerberos 5 network authentication protocol [\[RFC1510\]](#) supports only the Data Encryption Standard (DES) for encryption. For many years, the cryptographic community has regarded DES as providing inadequate security. Accordingly, this document reclassifies [\[RFC1510\]](#) (obsoleted by [\[RFC4120\]](#)) as Historic, and updates current Kerberos-related specifications [\[RFC1964\]](#), [\[RFC4120\]](#), and [\[RFC4121\]](#) to deprecate the use of DES in Kerberos. This document also deprecates the weak "export strength" RC4 enctype of [\[RFC4757\]](#).

3. Affected specifications

The original IETF specification of Kerberos 5 [\[RFC1510\]](#) only supports DES for encryption. [\[RFC4120\]](#) obsoletes [\[RFC1510\]](#) and updates the Kerberos specification to include additional cryptographic algorithms, but still permits the use of DES. [\[RFC3961\]](#) describes the Kerberos cryptographic system and includes support for DES encryption types, but it does not specify requirement levels for them.

The specification of the Kerberos Generic Security Services Application Programming Interface (GSS-API) mechanism [\[RFC1964\]](#) and its updated version [\[RFC4121\]](#) define checksum and encryption mechanisms based on DES. With the existence of newer encryption types for Kerberos GSS-API defined in [\[RFC4121\]](#), Microsoft's RC4-HMAC based GSS-API mechanism, and MIT's DES3, there is no need to support the old DES based integrity (SGN) and confidentiality (SEAL) types.

[RFC4757] describes the RC4-HMAC encryption types used by Microsoft Windows, and allows for a 56-bit "export strength" variant. (The character constant "fortybits" used in the definition is a historical reference and does not refer to the actual key size of the enctype.)

4. DES insecurity

The insecurity of DES has been evident for many years. The National Institute of Standards and Technology (NIST) officially withdrew DES in 2005 [[DES-Withdrawal](#)], and also announced a transition period that ended on May 19, 2007 [[DES-Transition-Plan](#)]. The IETF has also published its position in [[RFC4772](#)], in which the recommendation summary is very clear: "don't use DES".

In 2006, researchers demonstrated the ability to brute force a DES key in an average of less than 9 days using less than EUR 10,000 worth of hardware [[Break-DES](#)]. By 2008, a company was offering hardware capable of breaking a DES key in less than a day on average [[DES-1day](#)] that cost less than USD 15,000 [[DES-crack](#)]. Brute force key searches of DES will only get faster and cheaper. (The aforementioned company markets its device for one-click recovery of lost DES keys.) It is clear that it is well past time to retire the use of DES in Kerberos.

5. Recommendations

This document hereby removes the following RECOMMENDED types from [[RFC4120](#)]:

Encryption: DES-CBC-MD5(3)

Checksums: DES-MD5 (8, named RSA-MD5-DES in [[RFC3961](#)]).

Kerberos implementations and deployments SHOULD NOT implement the following single DES encryption types: DES-CBC-CRC(1), DES-CBC-MD4(2), DES-CBC-MD5(3) (updates [[RFC4120](#)]).

Kerberos implementations and deployments SHOULD NOT implement the following "export strength" RC4 encryption type: RC4-HMAC-EXP(24) (updates [[RFC4757](#)]).

Kerberos implementations and deployments SHOULD NOT implement the following checksum types: CRC32(1), RSA-MD4(2), RSA-MD4-DES(3), DES-MAC(4), DES-MAC-K(5), RSA-MD4-DES-K(6), RSA-MD5-DES(8) (updates [[RFC4120](#)]).

It is possible to safely use the RSA-MD5(7) checksum type, but only with additional protection, such as the protection that an encrypted

Authenticator provides. Implementations MAY use RSA-MD5 inside an encrypted Authenticator for backward compatibility with systems that do not support newer checksum types (updates [\[RFC4120\]](#)). One example is that some legacy systems only support RC4-HMAC(23) [\[RFC4757\]](#) for encryption when DES is not available; these systems use RSA-MD5 checksums inside Authenticators encrypted with RC4-HMAC.

Kerberos GSS mechanism implementations and deployments SHOULD NOT implement the following SGN ALG: DES MAC MD5(0000), MD2.5(0100), DES MAC(0200) (updates [\[RFC1964\]](#)).

Kerberos GSS mechanism implementations and deployments SHOULD NOT implement the following SEAL ALG: DES(0000) (updates [\[RFC1964\]](#)).

The effect of the two last sentences is that this document deprecates [section 1.2 in \[RFC1964\]](#).

This document hereby reclassifies [\[RFC1510\]](#) as Historic.

6. Acknowledgements

Mattias Amnefelt, Ran Atkinson, Henry Hotz, Jeffrey Hutzelman, Leif Johansson, and Simon Josefsson have read the document and provided suggestions for improvements. Sam Hartman proposed moving [\[RFC1510\]](#) to Historic.

7. Security Considerations

Removing support for single DES improves security, because DES is considered to be insecure.

Kerberos defines some encryption types that are either underspecified or that only have number assignments but no specifications. Implementations should make sure that they only implement and enable secure encryption types.

RC4, used in RC4-HMAC, is considered weak; however, the use in Kerberos is vetted and considered secure for now. The main reason to not actively discourage the use of RC4-HMAC is that it is the only encryption type that interoperates with older versions of Microsoft Windows once DES and RC4-HMAC-EXP are removed.

8. IANA Considerations

There are no IANA Considerations for this document.

9. References

9.1. Normative References

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- [RFC4121] Zhu, L., Jaganathan, K., and S. Hartman, "The Kerberos Version 5 Generic Security Service Application Program Interface (GSS-API) Mechanism: Version 2", [RFC 4121](#), July 2005.
- [RFC4757] Jaganathan, K., Zhu, L., and J. Brezak, "The RC4-HMAC Kerberos Encryption Types Used by Microsoft Windows", [RFC 4757](#), December 2006.

9.2. Informative References

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[DES-crack]

Scott, T., "DES Brute Force Cracking Efforts 1977 to 2010", 2010, <<http://www.tjscott.net/security.extras/des.crack.efforts.pdf>>.

[RFC1510]

Kohl, J. and B. Neuman, "The Kerberos Network Authentication Service (V5)", [RFC 1510](#), September 1993.

[RFC4772]

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