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## SHA-2 Data Integrity Verification for the Secure Shell (SSH) Transport Layer Protocol

### Abstract

This memo defines algorithm names and parameters for use in some of the SHA-2 family of secure hash algorithms for data integrity verification in the Secure Shell (SSH) protocol. It also updates [RFC 4253](#) by specifying a new RECOMMENDED data integrity algorithm.

### Status of This Memo

This is an Internet Standards Track document.

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Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at <http://www.rfc-editor.org/info/rfc6668>.

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## 1. Overview and Rationale

The Secure Shell (SSH) [RFC4251] is a very common protocol for secure remote login on the Internet. Currently, SSH defines data integrity verification using SHA-1 and MD5 algorithms [RFC4253]. Due to recent security concerns with these two algorithms ([RFC6194] and [RFC6151], respectively), implementors and users request support for data integrity verification using some of the SHA-2 family of secure hash algorithms.

### 1.1. Requirements Terminology

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. Data Integrity Algorithms

This memo adopts the style and conventions of [RFC4253] in specifying how the use of new data integrity algorithms are indicated in SSH.

The following new data integrity algorithms are defined:

hmac-sha2-256	RECOMMENDED	HMAC-SHA2-256 (digest length = 32 bytes, key length = 32 bytes)
hmac-sha2-512	OPTIONAL	HMAC-SHA2-512 (digest length = 64 bytes, key length = 64 bytes)

Figure 1

The Hashed Message Authentication Code (HMAC) mechanism was originally defined in [RFC2104] and has been updated in [RFC6151].

The SHA-2 family of secure hash algorithms is defined in [FIPS-180-3].

Sample code for the SHA-based HMAC algorithms are available in [RFC6234]. The variants, HMAC-SHA2-224 and HMAC-SHA2-384 algorithms, were considered but not added to this list as they have the same computational requirements of HMAC-SHA2-256 and HMAC-SHA2-512, respectively, and do not seem to be much used in practice.

Test vectors for use of HMAC with SHA-2 are provided in [RFC4231]. Users, implementors, and administrators may choose to put these new MACs into the proposal ahead of the REQUIRED hmac-sha1 algorithm defined in [RFC4253] so that they are negotiated first.

### 3. IANA Considerations

This document augments the MAC Algorithm Names in [RFC4253] and [RFC4250].

IANA has updated the "Secure Shell (SSH) Protocol Parameters" registry with the following entries:

MAC Algorithm Name	Reference	Note
hmac-sha2-256	<a href="#">RFC 6668</a>	<a href="#">Section 2</a>
hmac-sha2-512	<a href="#">RFC 6668</a>	<a href="#">Section 2</a>

Figure 2

### 4. Security Considerations

The security considerations of [RFC 4253](#) [RFC4253] apply to this document.

The National Institute of Standards and Technology (NIST) publications: NIST Special Publication (SP) 800-107 [800-107] and NIST SP 800-131A [800-131A] suggest that HMAC-SHA1 and HMAC-SHA2-256 have a security strength of 128 bits and 256 bits, respectively, which are considered acceptable key lengths.

Many users seem to be interested in the perceived safety of using the SHA2-based algorithms for hashing.

### 5. References

#### 5.1. Normative References

- [FIPS-180-3]  
National Institute of Standards and Technology (NIST),  
United States of America, "Secure Hash Standard (SHS)",  
FIPS PUB 180-3, October 2008, <[http://csrc.nist.gov/publications/fips/fips180-3/fips180-3\\_final.pdf](http://csrc.nist.gov/publications/fips/fips180-3/fips180-3_final.pdf)>.
- [RFC2104] Krawczyk, H., Bellare, M., and R. Canetti, "HMAC: Keyed-Hashing for Message Authentication", [RFC 2104](#), February 1997.

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [RFC4231] Nystrom, M., "Identifiers and Test Vectors for HMAC-SHA-224, HMAC-SHA-256, HMAC-SHA-384, and HMAC-SHA-512", [RFC 4231](#), December 2005.
- [RFC4253] Ylonen, T. and C. Lonvick, Ed., "The Secure Shell (SSH) Transport Layer Protocol", [RFC 4253](#), January 2006.

## 5.2. Informative References

- [800-107] National Institute of Standards and Technology (NIST), "Recommendation for Applications Using Approved Hash Algorithms", NIST Special Publication 800-107, February 2009, <<http://csrc.nist.gov/publications/nistpubs/800-107/NIST-SP-800-107.pdf>>.
- [800-131A] National Institute of Standards and Technology (NIST), "Transitions: Recommendation for the Transitioning of the Use of Cryptographic Algorithms and Key Lengths", DRAFT NIST Special Publication 800-131A, January 2011, <<http://csrc.nist.gov/publications/nistpubs/800-131A/sp800-131A.pdf>>.
- [RFC4250] Lehtinen, S. and C. Lonvick, Ed., "The Secure Shell (SSH) Protocol Assigned Numbers", [RFC 4250](#), January 2006.
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- [RFC6151] Turner, S. and L. Chen, "Updated Security Considerations for the MD5 Message-Digest and the HMAC-MD5 Algorithms", [RFC 6151](#), March 2011.
- [RFC6194] Polk, T., Chen, L., Turner, S., and P. Hoffman, "Security Considerations for the SHA-0 and SHA-1 Message-Digest Algorithms", [RFC 6194](#), March 2011.
- [RFC6234] Eastlake 3rd, D. and T. Hansen, "US Secure Hash Algorithms (SHA and SHA-based HMAC and HKDF)", [RFC 6234](#), May 2011.

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