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More Modular Exponential (MODP) Diffie-Hellman (DH) Key Exchange (KEX) Groups for Secure Shell (SSH) draft-ietf-curdle-ssh-modp-dh-sha2-05

Abstract

This document defines added Modular Exponential (MODP) Groups for the Secure Shell (SSH) protocol using SHA-2 hashes. This document updates RFC 4250. This document updates RFC 4253.

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. Overview and Rationale

Secure Shell (SSH) is a common protocol for secure communication on the Internet. Due to recent security concerns with SHA-1 [RFC6194] and with MODP groups with less than 2048 bits [NIST-SP-800-131Ar1] implementer and users request support for larger Diffie Hellman (DH) MODP group sizes with data integrity verification using the SHA-2 family of secure hash algorithms as well as MODP groups providing more security.

The United States Information Assurance Directorate at the National Security Agency has published a FAQ [MFQ-U-OO-815099-15] suggesting both: a) DH groups using less than 3072-bits, and b) the use of SHA-2 based hashes less than SHA2-384, are no longer sufficient for transport of Top Secret information. For this reason, the new MODP groups are being introduced starting with the MODP 3072-bit group 15 are all using SHA2-512 as the hash algorithm.

The DH 2048-bit MODP group 14 is already present in most SSH implementations and most implementations already have a SHA2-256 implementation, so diffie-hellman-group14-sha256 is provided as an easy to implement and faster to use key exchange for small embedded applications.

It is intended that these new MODP groups with SHA-2 based hashes update the [RFC4253] section 6.4 and [RFC4250] section 4.10 standards.

[TO BE REMOVED: Please send comments on this draft to curdle@ietf.org.]

2. Requirements Language

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 RFC 2119 [RFC2119].

3. Key Exchange Algorithms

This memo adopts the style and conventions of [RFC4253] in specifying how the use of new data key exchange is indicated in SSH.

The following new key exchange algorithms are defined:

```
Key Exchange Method Name
diffie-hellman-group14-sha256
diffie-hellman-group15-sha512
diffie-hellman-group16-sha512
diffie-hellman-group17-sha512
diffie-hellman-group18-sha512
```

Figure 1

The SHA-2 family of secure hash algorithms are defined in [RFC6234].

The method of key exchange used for the name "diffie-hellman-group14-sha256" is the same as that for "diffie-hellman-group14-sha1" except that the SHA2-256 hash algorithm is used. It is recommended that diffie-hellman-group14-sha256 SHOULD be supported to smooth the transition to newer group sizes.

The group15 through group18 names are the same as those specified in [RFC3526] 3072-bit MODP Group 15, 4096-bit MODP Group 16, 6144-bit MODP Group 17, and 8192-bit MODP Group 18.

The SHA2-512 algorithm is to be used when "sha512" is specified as a part of the key exchange method name.

4. IANA Considerations

This document augments the Key Exchange Method Names in [RFC4253] and [RFC4250].

IANA is requested to add to the Key Exchange Method Names algorithm registry [IANA-KEX] with the following entries:

Key Exchange Method Name	Reference
diffie-hellman-group14-sha256	This Draft
diffie-hellman-group15-sha512	This Draft
diffie-hellman-group16-sha512	This Draft
diffie-hellman-group17-sha512	This Draft
diffie-hellman-group18-sha512	This Draft

[TO BE REMOVED: This registration should take place at the following location: <http://www.iana.org/assignments/ssh-parameters/ssh-parameters.xhtml#ssh-parameters-16>]

5. Security Considerations

The security considerations of [RFC4253] apply to this document.

The security considerations of [RFC3526] suggest that these MODP groups have security strengths given in this table. They are based on [RFC3766] Determining Strengths For Public Keys Used For Exchanging Symmetric Keys.

Group modulus security strength estimates (RFC3526)

Group	Modulus	Strength Estimate 1		Strength Estimate 2	
		in bits	exponent size	in bits	exponent size
14	2048-bit	110	220-	160	320-
15	3072-bit	130	260-	210	420-
16	4096-bit	150	300-	240	480-
17	6144-bit	170	340-	270	540-
18	8192-bit	190	380-	310	620-

Figure 2

Using a fixed set of Diffie-Hellman parameters makes them a high value target for precomputation. Generating additional sets of primes to be used, or moving to larger values is a mitigation against this issue. Care should be taken to avoid backdoored primes ([SNFS]) by using "nothing up my sleve" parameters.

6. References

6.1. 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, <http://www.rfc-editor.org/info/rfc2119>.

[RFC3526] Kivinen, T. and M. Kojo, "More Modular Exponential (MODP) Diffie-Hellman groups for Internet Key Exchange (IKE)", RFC 3526, DOI 10.17487/RFC3526, May 2003, <http://www.rfc-editor.org/info/rfc3526>.

[RFC4250] Lehtinen, S. and C. Lonvick, Ed., "The Secure Shell (SSH) Protocol Assigned Numbers", RFC 4250, DOI 10.17487/RFC4250, January 2006, <http://www.rfc-editor.org/info/rfc4250>.

[RFC4253] Ylonen, T. and C. Lonvick, Ed., "The Secure Shell (SSH) Transport Layer Protocol", RFC 4253, DOI 10.17487/RFC4253, January 2006, <http://www.rfc-editor.org/info/rfc4253>.

6.2. Informative References

[IANA-KEX]
Internet Assigned Numbers Authority (IANA), "Secure Shell (SSH) Protocol Parameters: Key Exchange Method Names", March 2017, <http://www.iana.org/assignments/ssh-parameters/ssh-parameters.xhtml#ssh-parameters-16>.

[MFQ-U-OO-815099-15]
"National Security Agency/Central Security Service", "CNSA Suite and Quantum Computing FAQ", January 2016, <https://www.iad.gov/iad/library/ia-guidance/ia-solutions-for-classified/algorithm-guidance/cnsa-suite-and-quantum-computing-faq.cfm>.

[NIST-SP-800-131Ar1]
Barker, and Roginsky, "Transitions: Recommendation for the Transitioning of the Use of Cryptographic Algorithms and Key Lengths", NIST Special Publication 800-131A Revision 1, November 2015, <http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-131Ar1.pdf>.

[RFC3766] Orman, H. and P. Hoffman, "Determining Strengths For Public Keys Used For Exchanging Symmetric Keys", BCP 86, RFC 3766, DOI 10.17487/RFC3766, April 2004, <http://www.rfc-editor.org/info/rfc3766>.

[RFC6194] Polk, T., Chen, L., Turner, S., and P. Hoffman, "Security Considerations for the SHA-0 and SHA-1 Message-Digest Algorithms", RFC 6194, DOI 10.17487/RFC6194, March 2011, <http://www.rfc-editor.org/info/rfc6194>.

[RFC6234] Eastlake 3rd, D. and T. Hansen, "US Secure Hash Algorithms (SHA and SHA-based HMAC and HKDF)", RFC 6234, DOI 10.17487/RFC6234, May 2011, <http://www.rfc-editor.org/info/rfc6234>.

[SNFS] Fried, , Gaudry, , Heninger, , and Thome, "A kilobit hidden SNFS discrete logarithm computation", 2016, <http://eprint.iacr.org/2016/961.pdf>.

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