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Increase SSH minimum recommended DH modulus size to 2048 bits
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Abstract

The Diffie-Hellman (DH) Group Exchange for the Secure Shell (SSH) Transport layer Protocol specifies that servers and clients should support groups with a modulus length of k bits, where the recommended minimum value is 1024 bits. Recent security research has shown that a minimum value of 1024 bits is insufficient against state-sponsored actors, and possibly any organization with enough computing resources. As such, this document formally updates the specification such that the minimum recommended value for k is 2048 bits and the group size is 2048 bits at minimum. This RFC updates [RFC4419](#) which allowed for DH moduli less than 2048 bits.

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Recommended minimum modulus size

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1. Introduction

[RFC4419] specifies a recommended minimum size of 1024 bits for k , which is the modulus length of the DH Group. It also suggests that in all cases, the size of the group needs be at least 1024 bits. This document updates [RFC4419] so that the minimum recommended size be 2048 bits. This recommendation is based on recent research [LOGJAM] on DH Group weaknesses.

1.1. 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].

2. 2048 bits DH Group

Recent research [LOGJAM] strongly suggests that DH groups that are 1024 bits can be broken by state actors, and possibly any organization with enough computing resources. The authors show how they are able to break 768 bits DH group and extrapolate the attack to 1024 bits DH groups. In their analysis, they show that breaking 1024 bits can be done with enough computing resources. This document provides the following recommendation: SSH Servers and SSH clients SHOULD support groups with a modulus length of k bits where $2048 \leq k \leq 8192$, where it is possible to set k to 3072 should the need arise in the coming years.

[RFC4419] specifies a recommended minimum size of 1024 bits for k , which is the modulus length of the DH Group. It also suggests that in all cases, the size of the group needs be at least 1024 bits. This document updates [RFC4419] as described below:

- o section 3 Paragraph 9: Servers and clients SHOULD support groups with a modulus length of k bits where $2048 \leq k \leq 8192$. The recommended minimum values for min and max are 2048 and 8192,

respectively. k SHOULD be able to be set to 3072 by an implementation should the need arise in the coming years.

- o [Section 3](#) Paragraph 11: In all cases, the size of the group SHOULD be at least 2048 bits, with the possibility to be set to 3072 bits should the need arise in the coming years.

[3.](#) Interoperability

This document keeps the [[RFC4419](#)] requirement "The server should return the smallest group it knows that is larger than the size the client requested. If the server does not know a group that is larger than the client request, then it SHOULD return the largest group it knows." and updates the sentence that follows to read: "In all cases, the size of the returned group SHOULD be at least 2048 bits."

[4.](#) Security Considerations

This document discusses security issues of DH groups that are 1024 bits in size, and formally updates the minimum size of DH groups to be 2048 bits. A hostile or "owned" Secure Shell server implementation could potentially use Backdoored Diffie-Hellman primes using the methods described in [[Backdoor-DH](#)] to provide the g,p values to be used. Or, they could just send the calculated secret through a covert channel of some sort to a passive listener.

A malicious client could cause a Denial of Service by making multiple connections which are less 2048 bits in size on purpose. Therefore, Operating Systems SHOULD NOT log DH groups less than 2048 bits in size, as it would create an additional attack surface.

[5.](#) IANA Considerations

This document contains no considerations for IANA.

[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, <<https://www.rfc-editor.org/info/rfc2119>>.

[RFC4419] Friedl, M., Provos, N., and W. Simpson, "Diffie-Hellman Group Exchange for the Secure Shell (SSH) Transport Layer Protocol", [RFC 4419](#), DOI 10.17487/RFC4419, March 2006, <<https://www.rfc-editor.org/info/rfc4419>>.

[6.2.](#) Informative References

[Backdoor-DH]

Wong, D., "How to Backdoor Diffie-Hellman", Cryptology ePrint Archive Report 2016/644, June 2016, <<http://eprint.iacr.org/2016/644.pdf>>.

[LOGJAM]

Adrian, D., Bhargavan, K., Durumeric, Z., Gaudry, P., Green, M., Halderman, J., Heninger, N., Springall, D., Thome, E., Valenta, L., VanderSloot, B., Wustrow, E., Zanella-Beguelin, S., and P. Zimmermann, "Imperfect Forward Secrecy: How Diffie-Hellman Fails in Practice", ACM Conference on Computer and Communications Security (CCS) 2015, 2015, <<https://weakdh.org/imperfect-forward-secrecy-ccs15.pdf>>.

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