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XMSS public key algorithms for the Secure Shell (SSH) protocol
draft-mu-curdle-ssh-xmss-00

Abstract

This document describes the use of the XMSS (XMSS: eXtended Merkle Signature Scheme) which is resistant to quantum computers attack, as a digital signature algorithm in the Secure Shell (SSH) protocol.

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Internet-Draft

XMSS for SSH

October 2019

1. Introduction

Secure Shell (SSH) [[RFC4251](#)] is a secure remote-login protocol. It provides for an extensible variety of public key algorithms for identifying servers and users to one another. XMSS [[RFC8391](#)] is a digital signature system. OpenSSH 7.7 [[OpenSSH-7.7](#)] introduced support for using XMSS for server and user authentication and was then followed by other SSH implementations.

This document describes the method implemented by OpenSSH and others, and formalizes its use of the name "ssh-xmss".

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

2. Conventions Used in This Document

The descriptions of key and signature formats use the notation introduced in [[RFC4251](#)], [Section 3](#) [[RFC4251](#)] and the string data type from [[RFC4251](#)], [Section 5](#) [[RFC4251](#)].

2.1. 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](#)] [RFC 8174](#) [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

3. Public Key Algorithm

This document describes a public key algorithm for use with SSH in accordance with [[RFC4253](#)], [Section 6.6](#) [[RFC4253](#)]. The name of the algorithm is "ssh-xmss". This algorithm only supports signing and not encryption.

Standard implementations of SSH SHOULD implement these signature algorithms.

4. Public Key Format

The "ssh-xmss" key format has the following encoding:

```
string    "ssh-xmss"
string    key
```

Here 'key' is the 32-octet public key described by [[RFC8391](#)], [Section 4.1.7 \[RFC8391\]](#).

[5.](#) Signature Algorithm

Signatures are generated according to the procedure in [[RFC8391](#)], [Section 4.1.8 \[RFC8391\]](#).

[6.](#) Signature Format

The "ssh-xmss" key format has the following encoding:

```
string    "ssh-xmss"
string    signature
```

Here 'signature' is the 64-octet signature produced in accordance with [[RFC8391](#)], [Section 4.1.9 \[RFC8391\]](#).

[7.](#) Verification Algorithm

XMSS signatures are verified according to the procedure in [[RFC8391](#)], [Section 4.1.10 \[RFC8391\]](#).

[8.](#) SSHFP DNS resource records

Usage and generation of SSHFP DNS resource record is described in [[RFC4255](#)]. This section illustrates the generation of SSHFP resource records for "ssh-xmss" keys and the document specifies the corresponding xmss code point to the "SSHFP RR Types for public key algorithms" IANA registry.

The generation of SSHFP resource records for "ssh-xmss" keys is described as follows.

The encoding of xmss public keys is described in [[RFC8391](#)]. In brief, an xmss public key is a 57-octet value representing a 455-bit y-coordinate of an elliptic curve point, and a sign bit indicating the the corresponding x-coordinate.

The SSHFP Resource Record for the xmss public key with SHA-256 fingerprint would for example be:

example.com. IN SSHFP TBD 2 (a87f1b687ac0e57d2a081a2f2826723 34d90ed316d2b818ca9580ea384d924 01)

The 2 here indicates SHA-256 [[RFC6594](#)].

9. IANA Considerations

This document augments the Public Key Algorithm Names in [[RFC4250](#)], [Section 4.6.2](#) [[RFC4250](#)].

IANA is requested to add to the Public Key Algorithm Names registry [[IANA-PKA](#)] with the following entry:

| Public Key Algorithm Name | Reference |
|---------------------------|------------|
| ssh-xmss | This Draft |

IANA is requested to add the following entry to the "SSHFP RR Types for public key algorithms" registry [[IANA-SSHFP](#)]:

| Value | Description | Reference |
|-------|-------------|--------------|
| TBD | xmss | [this-draft] |

We strongly suggest 5 as value.

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

[parameters.xhtml#ssh-parameters-19>\]](#)

10. Security Considerations

The security considerations in [RFC4251], [Section 9 \[RFC4251\]](#) apply to all SSH implementations, including those using xmss.

The security considerations in [RFC8391], [Section 8 \[RFC8391\]](#) apply to all uses of xmss including those in SSH.

11. Acknowledgements

The OpenSSH implementation of XMSS in SSH was written by Markus Friedl. We are also grateful to Daniel Migault for their comments.

12. References

12.1. Normative References

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[12.2.](#) Informative References

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