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Preparation and Comparison of Internationalized Strings Representing
Simple User Names and Passwords
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Abstract

This document describes how to handle Unicode strings representing simple user names and passwords, primarily for purposes of comparison. This profile is intended to be used by Simple Authentication and Security Layer (SASL) mechanisms (such as PLAIN and SCRAM-SHA-1), as well as other protocols that exchange simple user names or passwords. This document obsoletes [RFC 4013](#).

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[1.](#) Introduction

[1.1.](#) Overview

User names and passwords are used pervasively in authentication and authorization on the Internet. To increase the likelihood that the input and comparison of user names and passwords will work in ways that make sense for typical users throughout the world, this document defines rules for preparing and comparing internationalized strings that represent simple user names and passwords.

The algorithms defined in this document assume that all strings are comprised of characters from the Unicode character set [[UNICODE](#)].

The algorithms are designed for use in Simple Authentication and Security Layer (SASL) [[RFC4422](#)] mechanisms, such as PLAIN [[RFC4616](#)] and SCRAM-SHA-1 [[RFC5802](#)]. However, they might be applicable wherever simple user names or passwords are used. This profile is not intended for use in preparing strings that are not simple user names (e.g., email addresses, DNS domain names, LDAP distinguished names), nor in cases where identifiers or secrets are not character data (e.g., keys) or require different handling (e.g., case folding).

This document builds upon the PRECIS framework defined in [[FRAMEWORK](#)], which differs fundamentally from the stringprep technology [[RFC3454](#)] used in SASLprep [[RFC4013](#)]. The primary difference is that stringprep profiles allowed all characters except those which were explicitly disallowed, whereas PRECIS profiles disallow all characters except those which are explicitly allowed (this "inclusion model" was originally used for internationalized domain names in [[RFC5891](#)]; see [[RFC5894](#)] for further discussion). It is important to keep this distinction in mind when comparing the technology defined in this document to SASLprep [[RFC4013](#)].

This document obsoletes [RFC 4013](#).

[1.2.](#) Terminology

Many important terms used in this document are defined in [[FRAMEWORK](#)], [[RFC4422](#)], [[RFC5890](#)], [[RFC6365](#)], and [[UNICODE](#)]. The term "non-ASCII" space refers to any Unicode code point with a general category of "Zs", with the exception of U+0020 (here called "ASCII space").

As used here, the term "password" is not literally limited to a word; i.e., a password could be a passphrase consisting of more than one word, perhaps separated by spaces or other such characters.

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

[2.](#) Simple User Names

[2.1.](#) Definition

Some SASL mechanisms (e.g., CRAM-MD5, DIGEST-MD5, and SCRAM) specify that the authentication identity used in the context of such mechanisms is a "simple user name" (see [Section 2 of \[RFC4422\]](#) as well as [\[RFC4013\]](#)). However, the exact form of a simple user name in any particular mechanism or deployment thereof is a local matter, and a simple user name does not necessarily map to an application identifier such as the localpart of an email address.

For purposes of preparation and comparison of authentication identities, this document specifies that a simple user name is a string of [\[UNICODE\]](#) code points, encoded using UTF-8 [\[RFC3629\]](#), and structured as an ordered sequence of "simpleparts" (where the complete simple user name can consist of a single simplepart or a space-separated sequence of simpleparts).

Therefore the syntax for a simple user name is defined as follows using the Augmented Backus-Naur Form (ABNF) as specified in [\[RFC5234\]](#).

```
simpleusername = simplepart [1*(1*SP simplepart)]
simplepart     = 1*(namepoint)
               ;
               ; a "namepoint" is a UTF-8 encoded
               ; Unicode code point that conforms to
               ; the "NameClass" string class defined
               ; in draft-ietf-precis-framework
               ;
```

[2.2.](#) Preparation

A simple user name MUST NOT be zero bytes in length. This rule is to be enforced after any normalization or mapping of code points.

Each simplepart of a simple user name MUST be treated as follows, where the operations specified MUST be completed in the order shown:

1. Apply Unicode Normalization Form C (NFC) to all characters.
2. Map uppercase and titlecase characters to their lowercase equivalents.
3. Optionally apply additional mappings, such as those defined in [\[MAPPINGS\]](#).
4. Ensure that the resulting string conforms to the definition of the PRECIS NameClass.

With regard to directionality, the "Bidi Rule" provided in [\[RFC5893\]](#) applies.

[2.3.](#) Migration

The rules defined in the previous section differ slightly from those defined by the SASLprep specification [\[RFC4013\]](#). Therefore, deployments that currently use SASLprep for handling user names will need to scrub existing data when migrating to use of the rules defined here. In particular:

- o SASLprep specified the use of Unicode Normalization Form KC (NFKC), whereas this usage of the PRECIS NameClass employs Unicode Normalization Form C (NFC). In practice this change is unlikely to cause significant problems, because NFKC provides methods for mapping Unicode code points with compatibility equivalents to those equivalents, whereas the PRECIS NameClass entirely disallows Unicode code points with compatibility equivalents. For migration purposes, deployments need to search their simple user names for Unicode code points with compatibility equivalents and map those code points to their compatibility equivalents.
- o SASLprep mapped non-ASCII spaces to ASCII space (U+0020), whereas the PRECIS NameClass entirely disallows non-ASCII spaces. For migration purposes, deployments need to convert non-ASCII space characters to ASCII space in simple user names.
- o SASLprep mapped the "characters commonly mapped to nothing" from [Appendix B.1 of \[RFC3454\]](#) to nothing, whereas the PRECIS NameClass entirely disallows such characters, which correspond to the code points from the "M" category defined under Section 6.13 of [\[FRAMEWORK\]](#) (with the exception of U+1806 MONGOLIAN TODO SOFT HYPHEN, which was commonly mapped to nothing in Unicode 3.2 but at the time of this writing is allowed by Unicode 6.1). For migration purposes, deployments need to remove code points from the PRECIS "M" category in simple user names.

- o SASLprep allowed uppercase and titlecase characters, whereas this usage of the PRECIS NameClass maps uppercase and titlecase characters to their lowercase equivalents. For migration purposes, deployments can either convert uppercase and titlecase characters to their lowercase equivalents in simple user names (thus losing the case information) or preserve uppercase and titlecase characters and ignore the case difference when comparing simple user names.

Note well that all code points and blocks not explicitly allowed in the PRECIS NameClass are disallowed; this includes private use characters, surrogate code points, and the other code points and blocks defined as "Prohibited Output" in [Section 2.3 of RFC 4013](#).

[3.](#) Passwords

[3.1.](#) Definition

For purposes of preparation and comparison of passwords, this document specifies that a password is a string of [[UNICODE](#)] code points, encoded using UTF-8 [[RFC3629](#)], and conformant to the PRECIS FreeClass.

Therefore the syntax for a password is defined as follows using the Augmented Backus-Naur Form (ABNF) as specified in [[RFC5234](#)].

```
password      = 1*(freepoint)
               ;
               ; a "freepoint" is a UTF-8 encoded
               ; Unicode code point that conforms to
               ; the "FreeClass" string class defined
               ; in draft-ietf-precis-framework
               ;
```

[3.2.](#) Preparation

A password MUST NOT be zero bytes in length. This rule is to be enforced after any normalization or mapping of code points.

A password MUST be treated as follows, where the operations specified MUST be completed in the order shown:

1. Apply Unicode Normalization Form C (NFC) to all characters.

2. Map any instances of non-ASCII space to ASCII space (U+0020).
3. Ensure that the resulting string conforms to the definition of the PRECIS FreeClass.

With regard to directionality, the "Bidi Rule" (defined in [[RFC5893](#)]) and similar rules are unnecessary and inapplicable to passwords, since they can reduce the range of characters that are allowed in a string and therefore reduce the amount of entropy that is possible in a password. Furthermore, such rules are intended to minimize the possibility that the same string will be displayed differently on a system set for right-to-left display and a system set for left-to-right display; however, passwords are typically not displayed at all and are rarely meant to be interoperable across different systems in the way that non-secret strings like domain names and user names are.

[3.3](#). Migration

The rules defined in the previous section differ slightly from those defined by the SASLprep specification [[RFC4013](#)]. Depending on local service policy, migration from [RFC 4013](#) to this specification might not involve any scrubbing of data (since passwords might not be stored in the clear anyway); however, service providers need to be aware of possible issues that might arise during migration. In particular:

- o SASLprep specified the use of Unicode Normalization Form KC (NFKC), whereas this usage of the PRECIS FreeClass employs Unicode Normalization Form C (NFC). Because NFKC is more aggressive about finding matches than NFC, in practice this change is unlikely to cause significant problems and indeed will probably result in fewer false positives when comparing passwords.
- o SASLprep mapped the "characters commonly mapped to nothing" from [Appendix B.1 of \[RFC3454\]](#) to nothing, whereas the PRECIS FreeClass entirely disallows such characters, which correspond to the code points from the "M" category defined under Section 6.13 of [[FRAMEWORK](#)] (with the exception of U+1806 MONGOLIAN TODO SOFT HYPHEN, which was commonly mapped to nothing in Unicode 3.2 but at the time of this writing is allowed by Unicode 6.1).

Note well that all code points and blocks not explicitly allowed in the PRECIS FreeClass are disallowed; this includes private use characters, surrogate code points, and the other code points and blocks defined as "Prohibited Output" in [Section 2.3 of RFC 4013](#).

4. Open Issues

We need to compare the output obtained when applying the new rules with Unicode 3.2 and Unicode 6.1 data to the output obtained when applying the SASLprep rules with Unicode 3.2 data, then make sure that the PRECIS Working Group and KITTEN Working Group are comfortable with any changes to the Unicode characters that are allowed and disallowed. (See also the migration issues described in the foregoing sections.)

5. Security Considerations

5.1. Password/Passphrase Strength

The ability to include a wide range of characters in passwords and passphrases can increase the potential for creating a strong password with high entropy. However, in practice, the ability to include such characters ought to be weighed against the possible need to reproduce them on various devices using various input methods.

5.2. Reuse of PRECIS

The security considerations described in [[FRAMEWORK](#)] apply to the "NameClass" and "FreeClass" base string classes used in this document for user names and passwords, respectively.

5.3. Reuse of Unicode

The security considerations described in [[UTR39](#)] apply to the use of Unicode characters in user names and passwords.

6. IANA Considerations

6.1. Use of NameClass

The IANA shall add an entry to the PRECIS Usage Registry for reuse of the PRECIS NameClass in SASL, as follows:

Application Protocol: SASL/Kerberos.

Base Class: NameClass.

Subclassing: No.

Directionality: The "Bidi Rule" defined in [RFC 5893](#) applies.

Casemapping: Map uppercase and titlecase code points to their lowercase equivalents.
Normalization: NFC.
Specification: RFC XXXX.

[6.2.](#) Use of FreeClass

The IANA shall add an entry to the PRECIS Usage Registry for reuse of the PRECIS FreeClass in SASL, as follows:

Application Protocol: SASL/Kerberos.
Base Class: FreeClass
Subclassing: No.
Directionality: The "Bidi Rule" defined in [RFC 5893](#) applies.
Casemapping: None.
Normalization: NFC.
Specification: RFC XXXX.

[7.](#) References

[7.1.](#) Normative References

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[Appendix A](#). Differences from [RFC 4013](#)

The following substantive modifications were made from [RFC 3920](#).

- o A single SASLprep algorithm was replaced by two separate algorithms: one for user names and another for passwords.
- o The new preparation algorithms use PRECIS instead of a stringprep profile. The new algorithms work independently of Unicode versions.
- o As recommended in the PRECIS framework, changed the Unicode normalization form from NFKC to NFC.
- o Some Unicode code points that were mapped to nothing in [RFC 4013](#) are simply disallowed by PRECIS.

[Appendix B](#). Acknowledgements

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