Network Working Group
Request for Comments: 4402
Category: Standards Track

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Sun

February 2006

A Pseudo-Random Function (PRF) for the Kerberos V Generic Security Service Application Program Interface (GSS-API) Mechanism

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Abstract

This document defines the Pseudo-Random Function (PRF) for the Kerberos V mechanism for the Generic Security Service Application Program Interface (GSS-API), based on the PRF defined for the Kerberos V cryptographic framework, for keying application protocols given an established Kerberos V GSS-API security context.

Table of Contents

1. Introduction

This document specifies the Kerberos V GSS-API mechanism's [RFC4121] pseudo-random function corresponding to [RFC4401]. The function is a "PRF+" style construction. For more information see [RFC4401], [RFC2743], [RFC2744], and [RFC4121].

1.1. Conventions Used in This Document

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. Kerberos V GSS Mechanism PRF

The GSS-API PRF [RFC4401] function for the Kerberos V mechanism [RFC4121] shall be the output of a PRF+ function based on the encryption type's PRF function keyed with the negotiated session key of the security context corresponding to the 'prf_key' input parameter of GSS_Pseudo_random().

This PRF+ MUST be keyed with the key indicated by the 'prf_key' input parameter as follows:

- GSS_C_PRF_KEY_FULL -- use the sub-session key asserted by the acceptor, if any, or the sub-session asserted by the initiator, if any, or the Ticket's session key

- GSS_C_PRF_KEY_PARTIAL -- use the sub-session key asserted by the initiator, if any, or the Ticket's session key

The PRF+ function is a simple counter-based extension of the Kerberos V pseudo-random function [RFC3961] for the encryption type of the security context's keys:

```
PRF+(K, L, S) = truncate(L, T1 || T2 || .. || Tn)

Tn = pseudo-random(K, n || S)
```

where '||' is the concatenation operator, 'n' is encoded as a network byte order 32-bit unsigned binary number, truncate(L, S) truncates the input octet string S to length L, and pseudo-random() is the Kerberos V pseudo-random function [RFC3961].

The maximum output size of the Kerberos V mechanism's GSS-API PRF then is, necessarily, 2^32 times the output size of the pseudo-random() function for the encryption type of the given key.

When the input size is longer than 2^14 octets as per [RFC4401] and exceeds an implementation's resources, then the mechanism MUST return GSS_S_FAILURE and GSS_KRB5_S_KG_INPUT_TOO_LONG as the minor status code.

3. IANA Considerations

This document has no IANA considerations currently. If and when a relevant IANA registry of GSS-API symbols and constants is created, then the GSS_KRB5_S_KG_INPUT_TOO_LONG minor status code should be added to such a registry.

4. Security Considerations

Kerberos V encryption types' PRF functions use a key derived from contexts' session keys and should preserve the forward security properties of the mechanisms' key exchanges.

Legacy Kerberos V encryption types may be weak, particularly the single-DES encryption types.

See also [RFC4401] for generic security considerations of GSS_Pseudo_random().

See also [RFC3961] for generic security considerations of the Kerberos V cryptographic framework.

Use of Ticket session keys, rather than sub-session keys, when initiators and acceptors fail to assert sub-session keys, is dangerous as ticket reuse can lead to key reuse; therefore, initiators should assert sub-session keys always, and acceptors should assert sub-session keys at least when initiators fail to do so.

The computational cost of computing this PRF+ may vary depending on the Kerberos V encryption types being used, but generally the computation of this PRF+ gets more expensive as the input and output octet string lengths grow (note that the use of a counter in the PRF+ construction allows for parallelization). This means that if an application can be tricked into providing very large input octet strings and requesting very long output octet strings, then that may constitute a denial of service attack on the application; therefore, applications SHOULD place appropriate limits on the size of any input octet strings received from their peers without integrity protection.

5. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC2743] Linn, J., "Generic Security Service Application Program Interface Version 2, Update 1", RFC 2743, January 2000.

[RFC2744] Wray, J., "Generic Security Service API Version 2 : C-bindings", RFC 2744, January 2000.

[RFC3961] Raeburn, K., "Encryption and Checksum Specifications for Kerberos 5", RFC 3961, February 2005.

[RFC4121] Zhu, L., Jaganathan, K., and S. Hartman, "The Kerberos Version 5 Generic Security Service Application Program Interface (GSS-API) Mechanism: Version 2", RFC 4121, July 2005.

[RFC4401] Williams, N., "A Pseudo-Random Function (PRF) API Extension for the Generic Security Service Application Program Interface (GSS-API)", RFC 4401, February 2006.

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Acknowledgement

Funding for the RFC Editor function is provided by the IETF Administrative Support Activity (IASA).