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Kerberos Support for Camellia Cipher in CCM Mode
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Abstract

This draft proposes the Kerberos (v5) support for the Camellia Cipher in Counter with CBC-MAC (CCM) mode.

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[1.](#) Introduction

This document defines encryption key and checksum types for Kerberos (v5) using the Camellia algorithm in Counter with CBC-MAC (CCM) Mode [[SP800-38C](#)]. The Camellia cipher was developed by NTT and Mitsubishi Electric Corporation in 2000. These new types support 128-bit block encryption and key sizes of 128 or 256 bits. The Camellia algorithm and its properties are described in [[RFC3713](#)].

There are a number of motivations to providing support for Camellia in Kerberos v5. Among others, it is desirable to provide an alternate cipher should weaknesses be discovered in the AES and SHA-256 algorithms which are predominant today. Additionally, due to the international user-base of Kerberos, supporting additional ciphers in key markets allows easier adoption and deployment of Kerberos in those regions.

Because the encryption types use the CCM mode, they do not rely on a hash algorithm to ensure message integrity. To preserve this property, the corresponding checksum types use the CMAC algorithm [[SP800-38B](#)].

For key derivation, the encryption and checksum types use KDF in feedback mode as described in [[SP800-108](#)], with CMAC as the underlying pseudo-random function.

[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.](#) Protocol Key Representation

The profile in [[RFC3961](#)] treats keys and random octet strings as conceptually different. But since the Camellia key space is dense, we can use any bit string of appropriate length as a key. We use the byte representation for the key described in [[RFC3713](#)], where the first bit of the bit string is the high bit of the first byte of the byte string (octet string) representation.

[4.](#) Key Generation from Pass Phrases or Random Data

Given the above format for keys, we can generate keys from the appropriate amounts of random data (128 or 256 bits) by simply

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copying the input string. To generate an encryption key from a pass phrase and salt string, we use a slight variation on the equivalent algorithm described in [section 4 of \[RFC3962\]](#). To ensure that different long-term keys are used with Camellia and AES, we prepend the enctype name to the salt string, separated by a null byte. The enctype name is "camellia128-ccm-128" or "camellia256-ccm-128" (without the quotes).

```
saltp = enctype-name | 0x00 | salt
```

```
tkey = random2key(PBKDF2(passphrase, saltp, iter_count, keylength))
```

```
key = DK(tkey, "kerberos")
```

The pseudo-random function used by PBKDF2 is unchanged from [section 4 of \[RFC3962\]](#), as is the default iteration count if no string-to-key parameters are supplied.

[5.](#) Kerberos Algorithm Profile Parameters

This is a summary of the parameters to be used with the simplified algorithm profile described in [[RFC3961](#)].

Cryptosystem from CCM Profile

protocol key format

As given.

specific key structure	Two protocol-format keys: { Kc, Ke }.
key-generation seed length	As given.
required checksum mechanism	As defined below.
cipher state	counter index i, expressed as q octets in big-endian order
initial cipher state	i = 0
encryption function	adata = associated data adata_pad = shortest string of zero octets to bring adata to a length that is a multiple of the block size plaintext_pad = shortest string of zero octets to bring plaintext to a length

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```

                                that is a multiple of the
                                block size
N = random nonce of length n
Q = binary representation of octet length of
    plaintext of length q
i = counter index
m = number of blocks
B0 = Flags | N | Q
Ctr0 = Flags | N | oldstate.i
T = CBC-MAC(Ke, B0 | adata_len |
            adata_pad | pad | plaintext | pad)
(H1, Ctr1) = E(Ke, T, Ctr0)
(C1, Ctrm) = E(Ke, plaintext, Ctr1)
ciphertext = N | C1 | H1
newstate.i = Ctrm.i

decryption function
(N,C1,H1) = ciphertext
Ctr0 = Flags | N | oldstate.i
(T, Ctr1) = D(Ke, H1, Ctr0)
(P1, Ctrm) = D(Ke, C1, Ctr1)
if (T != CBC-MAC(Ke, B0 | adata_len |
                adata | adata_pad | plaintext | pad))

```


Checksum Mechanism from CCM Profile

associated cryptosystem	As defined above.
get_mic	CMAC(Kc, message)
verify_mic	get_mic and compare

Figure 1

protocol key format	128- or 256-bit string
string-to-key function	PBKDF2+DK with variable iteration count (see above) and salt given by type-name 0x00 salt type-name is "camellia 128-ccm-128" or "camellia 256-ccm-128" (without the quotes). salt is the original input to the string-to-key function.
default string-to-key parameters	00 00 10 00
key-generation seed length	key size
random-to-key function	identity function

nonce length, n	12 octets (96 bits)
tag length, t	16 octets (128 bits)
counter length, q	3 octets (24 bits)
message block size, m	1 octet

encryption/decryption functions, E and D		Camellia in CTR mode (cipher block size 16 octets), with counter block as cipher state

encryption types		

type-name	etype value	key size

camellia128-ccm-128	TBD	128
camellia256-ccm-128	TBD	256

checksum types		

type-name	sumtype value	length

cmac-128-camellia128	TBD	128
cmac-128-camellia256	TBD	128

Figure 2

6. Assigned numbers

TBD

7. IANA Considerations

Kerberos encryption and checksum type values used in [section 7](#) were previously reserved in [\[RFC3961\]](#) for the mechanisms defined in this document. The registries have been updated to list this document as the reference.

8. Security Considerations

At the time of writing this document, there are no known weak keys for Camellia, and no security problem has been found on Camellia (see [[NESSIE](#)], [[CRYPTREC](#)], and [[LNCS](#)]).

The CCM mode requires a unique nonce for each message. If two messages use the same nonce, the XOR of the plain texts of the messages can be recovered without the key, compromising the confidentiality of the messages. Kerberos can only probabilistically ensure nonce uniqueness by choosing random nonce values. Since the length of the nonce is 96 bits, the probability of a collision becomes significant as the number of observed messages approaches 2^{48} .

CCM was chosen over GCM partly in order to minimize the impact of a nonce collision. Under GCM, a nonce collision results not only in a loss of confidentiality of the plaintexts, but also in the ability to construct forged messages.

[9.](#) Test Vectors

TBD

[10.](#) Acknowledgements

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[Appendix A](#). Additional Stuff

This becomes an Appendix.

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