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Asymmetric Key Packages
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Abstract

This document defines the syntax for private key information and a content type for it. Private-key information includes a private key for some public-key algorithm and a set of attributes. The document also describes a syntax for encrypted private keys. The Cryptographic Message Syntax, as defined in [RFC 3852](#), can be used to

digitally sign, digest, authenticate, or encrypt the asymmetric key format content type. This document obsoletes [RFC 5208](#).

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[1.](#) Introduction

This document defines the syntax for private key information and a content type for it. Private-key information includes a private key for some public-key algorithm and a set of attributes. The document also describes a syntax for encrypted private keys. The Cryptographic Message Syntax [[RFC3852](#)] can be used to digitally sign, digest, authenticate, or encrypt the asymmetric key format content type. This document obsoletes [[RFC5208](#)].

[1.1.](#) Requirements Terminology

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](#)].

[1.2.](#) ASN.1 Syntax Notation

The key package is defined using ASN.1 [[X.680](#)], [[X.681](#)], [[X.682](#)], and [[X.683](#)].

[1.3.](#) Changes since [RFC 5208](#)

The following are the changes since [[RFC5208](#)]:

- Defined Asymmetric Key Package CMS content type.
- Removed IMPLICIT from aKeyAttrs to align text with module.

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- Added public key to OneAsymmetricKey and added new version number.
- Added that PKCS#9 attributes MAY be supported.
- Added Other Considerations section.

[2.](#) Asymmetric Key Package Content Type

The asymmetric key package content type is used to transfer one or more plaintext asymmetric keys from one party to another. An asymmetric key package MAY be encapsulated in one or more CMS protecting content types (see [Section 4](#)). This content type MUST be DER encoded [[X.690](#)].

The asymmetric key package content type has the following syntax:

```
PKCS7-CONTENT-TYPE ::= TYPE-IDENTIFIER
```

```
asymmetric-key-package PKCS7-CONTENT-TYPE ::=  
  { AsymmetricKeyPackage IDENTIFIED BY id-ct-KP-aKeyPackage }
```

```
id-ct-KP-aKeyPackage OBJECT IDENTIFIER ::= |  
  { TBD }
```

```
AsymmetricKeyPackage ::= SEQUENCE SIZE (1..MAX) OF OneAsymmetricKey
```

```
OneAsymmetricKey ::= SEQUENCE {  
  version             Version,  
  privateKeyAlgorithm PrivateKeyAlgorithmIdentifier,  
  privateKey          PrivateKey, -- DER encoded  
  aKeyAttrs           [0] Attributes OPTIONAL,  
  publicKey            [1] PublicKey OPTIONAL }
```

```
PrivateKeyInfo ::= OneAsymmetricKey -- Used in [P12]
```


the public key (e.g., certificates). The attributes field uses the class ATTRIBUTE which is restricted by the SupportedAttributes parameterized type. SupportedAttributes is an open ended set in this document. Others documents can constrain these values. Attributes from [\[RFC2985\]](#) MAY be supported.

- publicKey is optional. When present, it contains the public key encoded as an OCTET STRING. The structure within the octet string, if any, depends on the privateKeyAlgorithm.

[3.](#) Encrypted Private Key Info

This section gives the syntax for encrypted private-key information, which is used with the [\[P12\]](#).

Encrypted private-key information shall have ASN.1 type EncryptedPrivateKeyInfo:

```
EncryptedPrivateKeyInfo ::= SEQUENCE {  
    encryptionAlgorithm  EncryptionAlgorithmIdentifier,  
    encryptedData         EncryptedData }
```

```
EncryptionAlgorithmIdentifier ::= AlgorithmIdentifier  
                                { { KeyEncryptionAlgorithms } }
```

```
EncryptedData ::= OCTET STRING
```

The EncAsymmetricKeyPackage contains one or more EncryptedPrivateKeyInfo elements. The fields in EncryptedPrivateKeyInfo are used as follows:

- encryptionAlgorithm identifies the algorithm under which the private-key information is encrypted. Implementations MUST the TBD algorithm.
- encryptedData is the result of encrypting the private-key information (i.e., the PrivateKeyInfo).

The encryption process involves the following two steps:

1. The private-key information is BER encoded, yielding an octet string.

2. The result of step 1 is encrypted with the secret key to give an octet string, the result of the encryption process.

[4.](#) Protecting the AsymmetricKeyPackage

CMS [[RFC3852](#)] protecting content types can be used to provide security to the AsymmetricKeyPackage:

- SignedData can be used to apply a digital signature to the AsymmetricKeyPackage.
- EncryptedData can be used to encrypt the AsymmetricKeyPackage encapsulate the AsymmetricKeyPackage to provide confidentiality but does not distribute the content encryption keys.
- EnvelopedData can be used to encrypt the AsymmetricKeyPackage with simple symmetric encryption, where the sender and the receiver already share the necessary encryption key
- AuthenticatedData can be used to protect the AsymmetricKeyPackage with message authentication codes, where key management information is handled in a manner similar to EnvelopedData.

[5.](#) Other Considerations

This document defines the syntax and the semantics for content types that exchange asymmetric keys. There are two other standards for transporting asymmetric private keys:

- Personal Information Exchange (PEM) or more commonly referred to as P12 [[P12](#)], is a transfer syntax for personal identity information, including private keys, certificates, miscellaneous secrets, and extensions. Both PrivateKeyInfo and EncryptedPrivateKeyInfo can be carried in a P12 message.
- Microsoft's Exchange Security format, which is a proprietary format.

When locally storing private keys, the file format is either a DER encoded file with the file extension .p12 or a PEM encoded file with the file extension .pem.

When the private key is a character string, the OCTET STRING contains

an embedded UTF8String.

6. Security Considerations

Protection of the private-key information is vital to public-key cryptography. Disclosure of the private-key material to another entity can lead to masquerades. The encryption algorithm used in the encryption process must be as 'strong' as the key it is protecting.

The asymmetric key package contents are not protected. This content type can be combined with a security protocol to protect the contents of the package.

The encrypted asymmetric key package contents are protected; as noted above the encryption algorithm must be as 'strong' as the key it is protecting.

7. IANA Considerations

None: All identifiers are already registered. Please remove this section prior to publication as an RFC.

8. References

8.1. Normative References

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

[RFC3852] Housley, R., "Cryptographic Message Syntax (CMS)", [RFC3852](#), July 2004.

[X.680] ITU-T Recommendation X.680 (2002) | ISO/IEC 8824-1:2002. Information Technology - Abstract Syntax Notation One.

[X.681] ITU-T Recommendation X.681 (2002) | ISO/IEC 8824-2:2002. Information Technology - Abstract Syntax Notation One: Information Object Specification.

[X.682] ITU-T Recommendation X.682 (2002) | ISO/IEC 8824-3:2002. Information Technology - Abstract Syntax Notation One: Constraint Specification.

[X.683] ITU-T Recommendation X.683 (2002) | ISO/IEC 8824-4:2002.
Information Technology – Abstract Syntax Notation One:
Parameterization of ASN.1 Specifications.

[X.690] ITU-T Recommendation X.690 (2002) | ISO/IEC 8825-1:2002.
Information Technology – ASN.1 encoding rules: Specification of Basic
Encoding Rules (BER), Canonical Encoding Rules (CER) and
Distinguished Encoding Rules (DER).

8.2. Non-Normative References

[P12] RSA Laboratories, "PKCS #12 v1.0: Personal Information Exchange
Syntax", June 1999.

[RFC2985] Nystrom, M., and B. Kaliski, "PKCS #9: Selected Object
Classes and Attribute Types Version 2.0", [RFC 2985](#), November 2000.

[RFC5208] Kaliski, B., "PKCS #8: Private Key Information Syntax
Standard Version 1.2", [RFC 5208](#), May 2008.

APPENDIX A: ASN.1 Module

This annex provides the normative ASN.1 definitions for the structures described in this specification using ASN.1 as defined in [X.680] through [X.683].

```
AsymmetricKeyPackageModulev1 { tbd }
```

```
DEFINITIONS IMPLICIT TAGS ::=
```

```
BEGIN
```

```
-- EXPORTS ALL
```

```
IMPORTS NOTHING
```

```
Attribute{}, ATTRIBUTE, AlgorithmIdentifier{}
```

```
FROM PKIX-CommonTypes
```

```
{ iso(1) identified-organization(3) dod(6) internet(1)
  security(5) mechanisms(5) pkix(7) id-mod(0)
  id-mod-pkixCommon(43) }
```

```
id-aes128-wrap, id-aes192-wrap, id-aes1256-wrap
```

```
FROM CMSAesRsaesOaep
```

```
{ iso(1) member-body(2) us(840) rsadsi(113549) pkcs(1)
  pkcs-9(9) smime(16) modules(0) id-mod-cms-aes(19) }
```

```
;
```

```
PKCS7-CONTENT-TYPE ::= TYPE-IDENTIFIER
```

```
KeyPackageContentTypes PKCS7-CONTENT-TYPE ::= {
```

```
  asymmetric-key-package |
```

```
  ... -- Expect additional content types --
```

```
}
```

```
asymmetric-key-package PKCS7-CONTENT-TYPE ::=
```

```
{ AsymmetricKeyPackage IDENTIFIED BY id-ct-KP-aKeyPackage }
```

```
id-ct-KP-aKeyPackage OBJECT IDENTIFIER ::=
```

```
{ TBD }
```

```
AsymmetricKeyPackage ::= SEQUENCE SIZE (1..MAX) OF OneAsymmetricKey
```

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```
OneAsymmetricKey ::= SEQUENCE {
    version             Version,
    privateKeyAlgorithm PrivateKeyAlgorithmIdentifier,
    privateKey          PrivateKey, -- DER encoded
    aKeyAttrs           [0] Attributes OPTIONAL,
    publicKey            [1] PublicKey OPTIONAL }

PrivateKeyInfo ::= OneAsymmetricKey

Version ::= INTEGER {v1(0), v2(1)} (v1, v2,...)

PrivateKeyAlgorithmIdentifier ::= AlgorithmIdentifier
                                { { PrivateKeyAlgorithms } }

PrivateKey ::= OCTET STRING -- Content varies based on type of key
                                -- DSA is INTEGER, ECDSA is ECPublicKey

PublicKey ::= OCTET STRING

Attributes ::= Set of Attribute { { SupportAttributes } }

SupportedAttributes ATTRIBUTE ::= {
    ... -- For local profiles
}

EncAsymmetricKeyPackage ::= SEQUENCE SIZE (1..MAX) OF
    EncryptedPrivateKeyInfo

EncryptedPrivateKeyInfo ::= SEQUENCE {
    encryptionAlgorithm EncryptionAlgorithmIdentifier,
    encryptedData         EncryptedData }

EncryptionAlgorithmIdentifier ::= AlgorithmIdentifier
                                { { KeyEncryptionAlgorithms } }

EncryptedData ::= OCTET STRING -- Encrypted PrivateKeyInfo

PrivateKeyAlgorithms ALGORITHM-IDENTIFIER ::= {
    ... -- Extensible
}

KeyEncryptionAlgorithms ALGORITHM-IDENTIFIER ::= {
    id-aes128-wrap |
```

```
id-aes192-wrap |  
id-aes256-wrap,  
... -- Extensible  
}
```

END

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