

PKCS #9: Selected Object Classes and Attribute Types
Version 2.0

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Abstract

This memo represents a republication of PKCS #9 v2.0 from RSA Laboratories' Public-Key Cryptography Standards (PKCS) series, and change control is retained within the PKCS process. The body of this document, except for the security considerations section, is taken directly from that specification.

This memo provides a selection of object classes and attribute types for use in conjunction with public-key cryptography and Lightweight Directory Access Protocol (LDAP) accessible directories. It also includes ASN.1 syntax for all constructs.

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1. Introduction

This document defines two new auxiliary object classes, `pkcsEntity` and `naturalPerson`, and selected attribute types for use with these classes. It also defines some attribute types for use in conjunction with PKCS #7 [14] (and S/MIME CMS [3]) digitally signed messages, PKCS #10 [16] certificate-signing requests, PKCS #12 [17] personal information exchanges and PKCS #15 [18] cryptographic tokens. Matching rules for use with these attributes are also defined, whenever necessary.

2. Definitions, notation and document conventions

2.1 Definitions

For the purposes of this document, the following definitions apply.

ASN.1 Abstract Syntax Notation One, as defined in [5].

Attributes An ASN.1 type that specifies a set of attributes. Each attribute contains an attribute type (specified by object identifier) and one or more attribute values. Some attribute types are restricted in their definition to have a single value; others may have multiple values. This type is defined in [7].

CertificationRequestInfo

An ASN.1 type that specifies a subject name, a public key, and a set of attributes. This type is defined in [16].

ContentInfo

An ASN.1 type that specifies content exchanged between entities. The contentType field, which has type OBJECT IDENTIFIER, specifies the content type, and the content field, whose type is defined by the contentType field, contains the content value. This type is defined in [14] and [3].

PrivateKeyInfo

A type that specifies a private key and a set of extended attributes. This type and the associated EncryptedPrivateKeyInfo type are defined in [15].

SignerInfo

A type that specifies per-signer information in the signed-data content type, including a set of attributes authenticated by the signer, and a set of attributes not authenticated by the signer. This type is defined in [14] and [3].

DER

Distinguished Encoding Rules for ASN.1, as defined in [6].

UCS

Universal Multiple-Octet Coded Character Set, as defined in [11].

UTF8String

UCS Transformation Format encoded string. The UTF-8 encoding is defined in [11].

2.2 Notation and document conventions

In this document, all attribute type and object class definitions are written in the ASN.1 value notation defined in [5]. Appendix B contains most of these definitions written in the augmented BNF notation defined in [2] as well. This has been done in an attempt to simplify the task of integrating this work into LDAP [22] development environments.

The keywords "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [1].

3. Overview

This document specifies two new auxiliary object classes, `pkcsEntity` and `naturalPerson`, and some new attribute types and matching rules. All ASN.1 object classes, attributes, matching rules and types are exported for use in other environments.

Attribute types defined in this document that are useful in conjunction with storage of PKCS-related data and the `pkcsEntity` object class includes PKCS #12 PFX PDUs, PKCS #15 tokens and encrypted private keys.

Attribute types defined in this document that are useful in conjunction with PKCS #10 certificate requests and the `naturalPerson` object class includes electronic-mail address, pseudonym, unstructured name, and unstructured address.

Attribute types defined in this document that are useful in PKCS #7 digitally signed messages are content type, message digest, signing time, sequence number, random nonce and countersignature. The attributes would be used in the `authenticatedAttributes` and `unauthenticatedAttributes` fields of a `SignerInfo` or an `AuthenticatedData` ([3]) value.

Attribute types that are useful especially in PKCS #10 certification requests are the challenge password and the extension-request attribute. The attributes would be used in the `attributes` field of a `CertificationRequestInfo` value.

Note - The attributes types (from [8]) in Table 1, and probably several others, might also be helpful in PKCS #10, PKCS #12 and PKCS #15-aware applications.

businessCategory	preferredDeliveryMethod
commonName	presentationAddress
countryName	registeredAddress
description	roleOccupant
destinationIndicator	serialNumber
facsimileTelephoneNumber	stateOrProvinceName
iSDNAddress	streetAddress
localityName	supportedApplicationContext
member	surname
objectClass	telephoneNumber
organizationName	teletexTerminalIdentifier
physicalDeliveryOfficeName	telexNumber
postalAddress	title
postalCode	x121Address
postOfficeBox	

Table 1: ISO/IEC 9594-6 attribute types useful in PKCS documents

4. Auxiliary object classes

This document defines two new auxiliary object classes: `pkcsEntity` and `naturalPerson`.

4.1 The `pkcsEntity` auxiliary object class

The `pkcsEntity` object class is a general-purpose auxiliary object class that is intended to hold attributes about PKCS-related entities. It has been designed for use within directory services based on the LDAP protocol [22] and the X.500 family of protocols, where support for PKCS-defined attributes is considered useful.

```
pkcsEntity OBJECT-CLASS ::= {
    SUBCLASS OF { top }
    KIND auxiliary
    MAY CONTAIN { PKCSEntityAttributeSet }
    ID pkcs-9-oc-pkcsEntity
}
```

```
PKCSEntityAttributeSet ATTRIBUTE ::= {
    pKCS7PDU |
    userPKCS12 |
    pKCS15Token |
    encryptedPrivateKeyInfo,
    ... -- For future extensions
}
```

Attributes in the `PKCSEntityAttributeSet` are defined in Section 5.

4.2 The naturalPerson auxiliary object class

The naturalPerson object class is a general-purpose auxiliary object class that is intended to hold attributes about human beings. It has been designed for use within directory services based on the LDAP protocol [22] and the X.500 family of protocols, where support for these attributes is considered useful.

```
naturalPerson OBJECT-CLASS ::= {  
    SUBCLASS OF { top }  
    KIND auxiliary  
    MAY CONTAIN { NaturalPersonAttributeSet }  
    ID pkcs-9-oc-naturalPerson  
}
```

```
NaturalPersonAttributeSet ATTRIBUTE ::= {  
    emailAddress |  
    unstructuredName |  
    unstructuredAddress |  
    dateOfBirth |  
    placeOfBirth |  
    gender |  
    countryOfCitizenship |  
    countryOfResidence |  
    pseudonym |  
    serialNumber,  
    ... -- For future extensions  
}
```

Attributes in the NaturalPersonAttributeSet are defined in Section 5.

5. Selected attribute types

5.1 Attribute types for use with the "pkcsEntity" object class

5.1.1 PKCS #7 PDU

PKCS #7 provides several formats for enveloped, signed and otherwise protected data. When such information is stored in a directory service, the pKCS7PDU attribute may be used.

```
pKCS7PDU ATTRIBUTE ::= {  
    WITH SYNTAX ContentInfo  
    ID pkcs-9-at-pkcs7PDU  
}
```

5.1.2 PKCS #12 token

PKCS #12 provides a format for exchange of personal identity information. When such information is stored in a directory service, the userPKCS12 attribute should be used.

```
userPKCS12 ATTRIBUTE ::= {  
    WITH SYNTAX PFX  
    ID pkcs-9-at-userPKCS12  
}
```

This type was originally defined in [20].

5.1.3 PKCS #15 token

PKCS #15 provides a format for cryptographic tokens. When software variants of such tokens are stored in a directory service, the pKCS15Token attribute should be used.

```
pKCS15Token ATTRIBUTE ::= {  
    WITH SYNTAX PKCS15Token  
    ID pkcs-9-at-pkcs15Token  
}
```

5.1.4 PKCS #8 encrypted private key information

PKCS #8 provides a format for encrypted private keys. When such information is stored in a directory service, the encryptedPrivateKeyInfo attribute should be used.

```
encryptedPrivateKeyInfo ATTRIBUTE ::= {  
    WITH SYNTAX EncryptedPrivateKeyInfo  
    ID pkcs-9-at-encryptedPrivateKeyInfo  
}
```

5.2 Attribute types for use with the "naturalPerson" object class

5.2.1 Electronic-mail address

The emailAddress attribute type specifies the electronic-mail address or addresses of a subject as an unstructured ASCII string. The interpretation of electronic-mail addresses is intended to be specified by certificate issuers etc.; no particular interpretation is required.

```
emailAddress ATTRIBUTE ::= {  
    WITH SYNTAX IA5String (SIZE(1..pkcs-9-ub-emailAddress))  
    EQUALITY MATCHING RULE pkcs9CaseIgnoreMatch  
    ID pkcs-9-at-emailAddress  
}
```

An electronic-mail address attribute can have multiple attribute values. When comparing two email addresses, case is irrelevant. The pkcs9CaseIgnoreMatch is defined in Section 6.

Note - It is likely that other standards bodies overseeing electronic-mail systems will, or have, registered electronic-mail address attribute types specific to their system. The electronic-mail address attribute type defined here was intended as a short-term substitute for those specific attribute types, but is included here for backwards-compatibility reasons.

5.2.2 Unstructured name

The unstructuredName attribute type specifies the name or names of a subject as an unstructured ASCII string. The interpretation of unstructured names is intended to be specified by certificate issuers etc.; no particular interpretation is required.

```
unstructuredName ATTRIBUTE ::= {  
    WITH SYNTAX PKCS9String {pkcs-9-ub-unstructuredName}  
    EQUALITY MATCHING RULE pkcs9CaseIgnoreMatch  
    ID pkcs-9-at-unstructuredName  
}  
  
PKCS9String { INTEGER : maxSize } ::= CHOICE {  
    ia5String          IA5String (SIZE(1..maxSize)),  
    directoryString DirectoryString {maxSize}  
}
```

An unstructured-name attribute can have multiple attribute values. When comparing two unstructured names, case is irrelevant.

The PKCS9String type is defined as a choice of IA5String and DirectoryString. Applications SHOULD use the IA5String type when generating attribute values in accordance with this version of this document, unless internationalization issues makes this impossible. In that case, the UTF8String alternative of the DirectoryString alternative is the preferred choice. PKCS #9-attribute processing systems MUST be able to recognize and process all string types in PKCS9String values.

Note - Version 1.1 of this document defined unstructuredName as having the syntax IA5String, but did contain a note explaining that this might be changed to a CHOICE of different string types in future versions. To better accommodate international names, this type has been extended to also include a directory string in this version of this document. Since [21] does not support a directory string type containing IA5Strings, a separate syntax object identifier has been defined (see [21] and Appendix B).

5.2.3 Unstructured address

The unstructuredAddress attribute type specifies the address or addresses of a subject as an unstructured directory string. The interpretation of unstructured addresses is intended to be specified by certificate issuers etc; no particular interpretation is required. A likely interpretation is as an alternative to the postalAddress attribute type defined in [8].

```
unstructuredAddress ATTRIBUTE ::= {
    WITH SYNTAX DirectoryString {pkcs-9-ub-unstructuredAddress}
    EQUALITY MATCHING RULE caseIgnoreMatch
    ID pkcs-9-at-unstructuredAddress
}
```

An unstructured-address attribute can have multiple attribute values. The caseIgnoreMatch matching rule is defined in [8].

Note 1 - It is recommended to use the ASN.1 type TeletexString's new-line character (hexadecimal code 0d) as a line separator in multi-line addresses.

Note 2 - Previous versions of this document defined unstructuredAddress as having the following syntax:

```
CHOICE {
    teletexString TeletexString,
    printableString PrintableString,
}
```

But also mentioned the possibility of a future definition as follows:

```
CHOICE {
    teletexString TeletexString,
    printableString PrintableString,
    universalString UniversalString
}
```

In this version of this document, the X.520 type `DirectoryString` has been used in order to be more aligned with international standards and current practice. When generating attribute values in accordance with this version of this document, applications SHOULD use the `PrintableString` alternative unless internationalization issues makes this impossible. In those cases, the `UTF8String` alternative SHOULD be used. PKCS #9-attribute processing systems MUST be able to recognize and process all string types in `DirectoryString` values.

5.2.4 Date of birth

The `dateOfBirth` attribute specifies the date of birth for the subject it is associated with.

```
dateOfBirth ATTRIBUTE ::= {  
    WITH SYNTAX GeneralizedTime  
    EQUALITY MATCHING RULE generalizedTimeMatch  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-dateOfBirth  
}
```

`dateOfBirth` attributes must be single-valued. The `generalizedTimeMatch` matching rule is defined in [8].

5.2.5 Place of birth

The `placeOfBirth` attribute specifies the place of birth for the subject it is associated with.

```
placeOfBirth ATTRIBUTE ::= {  
    WITH SYNTAX DirectoryString {pkcs-9-ub-placeOfBirth}  
    EQUALITY MATCHING RULE caseExactMatch  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-placeOfBirth  
}
```

`placeOfBirth` attributes must be single-valued. The `caseExactMatch` matching rule is defined in [8].

5.2.6 Gender

The gender attribute specifies the gender of the subject it is associated with.

```
gender ATTRIBUTE ::= {  
    WITH SYNTAX PrintableString (SIZE(1) ^  
        FROM ("M" | "F" | "m" | "f"))  
    EQUALITY MATCHING RULE caseIgnoreMatch  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-gender  
}
```

The letter "M" (or "m") represents "male" and the letter "F" (or "f") represents "female". gender attributes must be single-valued.

5.2.7 Country of citizenship

The countryOfCitizenship attribute specifies the (claimed) countries of citizenship for the subject it is associated with. It SHALL be a 2-letter acronym of a country in accordance with [4].

```
countryOfCitizenship ATTRIBUTE ::= {  
    WITH SYNTAX PrintableString (SIZE(2) ^ CONSTRAINED BY {  
        -- Must be a two-letter country acronym in accordance with  
        -- ISO/IEC 3166 --})  
    EQUALITY MATCHING RULE caseIgnoreMatch  
    ID pkcs-9-at-countryOfCitizenship  
}
```

Attributes of this type need not be single-valued.

5.2.8 Country of residence

The countryOfResidence attribute specifies the (claimed) country of residence for the subject it is associated with. It SHALL be a 2-letter acronym of a country in accordance with [4].

```
countryOfResidence ATTRIBUTE ::= {  
    WITH SYNTAX PrintableString (SIZE(2) ^ CONSTRAINED BY {  
        -- Must be a two-letter country acronym in accordance with  
        -- ISO/IEC 3166 --})  
    EQUALITY MATCHING RULE caseIgnoreMatch  
    ID pkcs-9-at-countryOfResidence  
}
```

Attributes of this type need not be single-valued, since it is possible to be a resident of several countries.

5.2.9 Pseudonym

The pseudonym attribute type shall contain a pseudonym of a subject. The exact interpretation of pseudonyms is intended to be specified by certificate issuers etc.; no particular interpretation is required.

```
pseudonym ATTRIBUTE ::= {  
    WITH SYNTAX DirectoryString {pkcs-9-ub-pseudonym}  
    EQUALITY MATCHING RULE caseExactMatch  
    ID id-at-pseudonym  
}
```

Note - The pseudonym attribute has received an object identifier in the joint-iso-itu-t object identifier tree.

The caseExactMatch matching rule is defined in [8].

5.2.10 Serial number

The serialNumber attribute is defined in [8].

5.3 Attribute types for use in PKCS #7 data

5.3.1 Content type

The contentType attribute type specifies the content type of the ContentInfo value being signed in PKCS #7 (or S/MIME CMS) digitally signed data. In such data, the contentType attribute type is required if there are any PKCS #7 authenticated attributes.

```
contentType ATTRIBUTE ::= {  
    WITH SYNTAX ContentType  
    EQUALITY MATCHING RULE objectIdentifierMatch  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-contentType  
}
```

ContentType ::= OBJECT IDENTIFIER

As indicated, content-type attributes must have a single attribute value. For two content-type values to match, their octet string representation must be of equal length and corresponding octets identical. The objectIdentifierMatch matching rule is defined in [7].

Note - This attribute type is described in [3] as well.

5.3.2 Message digest

The messageDigest attribute type specifies the message digest of the contents octets of the DER-encoding of the content field of the ContentInfo value being signed in PKCS #7 digitally signed data, where the message digest is computed under the signer's message digest algorithm. The message-digest attribute type is required in these cases if there are any PKCS #7 authenticated attributes present.

```
messageDigest ATTRIBUTE ::= {  
    WITH SYNTAX MessageDigest  
    EQUALITY MATCHING RULE octetStringMatch  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-messageDigest  
}
```

MessageDigest ::= OCTET STRING

As indicated, a message-digest attribute must have a single attribute value. For two messageDigest values to match, their octet string representation must be of equal length and corresponding octets identical. The octetStringMatch matching rule is defined in [8].

Note - This attribute is described in [3] as well.

5.3.3 Signing time

The signingTime attribute type is intended for PKCS #7 digitally signed data. It specifies the time at which the signer (purportedly) performed the signing process.

```
signingTime ATTRIBUTE ::= {  
    WITH SYNTAX SigningTime  
    EQUALITY MATCHING RULE signingTimeMatch  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-signingTime  
}
```

SigningTime ::= Time -- imported from ISO/IEC 9594-8

A signing-time attribute must have a single attribute value.

The signingTimeMatch matching rule (defined in Section 6.1) returns TRUE if an attribute value represents the same time as a presented value.

Quoting from [3]:

"Dates between 1 January 1950 and 31 December 2049 (inclusive) MUST be encoded as UTCTime. Any dates with year values before 1950 or after 2049 MUST be encoded as GeneralizedTime. [Further,] UTCTime values MUST be expressed in Greenwich Mean Time (Zulu) and MUST include seconds (i.e., times are YYMMDDHHMMSSZ), even where the number of seconds is zero. Midnight (GMT) must be represented as "YYMMDD000000Z". Century information is implicit, and the century shall be determined as follows:

- Where YY is greater than or equal to 50, the year shall be interpreted as 19YY; and
- Where YY is less than 50, the year shall be interpreted as 20YY.

GeneralizedTime values shall be expressed in Greenwich Mean Time (Zulu) and must include seconds (i.e., times are YYYYMMDDHHMMSSZ), even where the number of seconds is zero. GeneralizedTime values must not include fractional seconds."

Note 1 - The definition of SigningTime matches the definition of Time specified in [10].

Note 2 - No requirement is imposed concerning the correctness of the signing time, and acceptance of a purported signing time is a matter of a recipient's discretion. It is expected, however, that some signers, such as time-stamp servers, will be trusted implicitly.

5.3.4 Random nonce

The randomNonce attribute type is intended for PKCS #7 digitally signed data. It may be used by a signer unable (or unwilling) to specify the time at which the signing process was performed. Used in a correct manner, it will make it possible for the signer to protect against certain attacks, i.e. replay attacks.

```
randomNonce ATTRIBUTE ::= {  
    WITH SYNTAX RandomNonce  
    EQUALITY MATCHING RULE octetStringMatch  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-randomNonce  
}
```

```
RandomNonce ::= OCTET STRING (SIZE(4..MAX))  
    -- At least four bytes long
```

A random nonce attribute must have a single attribute value.

5.3.5 Sequence number

The sequenceNumber attribute type is intended for PKCS #7 digitally signed data. A signer wishing to associate a sequence number to all signature operations (much like a physical checkbook) may use it as an alternative to the randomNonce attribute. Used in a correct manner, it will make it possible for the signer to protect against certain attacks, i.e. replay attacks.

```
sequenceNumber ATTRIBUTE ::= {  
    WITH SYNTAX SequenceNumber  
    EQUALITY MATCHING RULE integerMatch  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-sequenceNumber  
}
```

```
SequenceNumber ::= INTEGER (1..MAX)
```

A sequence number attribute must have a single attribute value.

The integerMatch matching rule is defined in [8].

5.3.6 Countersignature

The counterSignature attribute type specifies one or more signatures on the content octets of the DER encoding of the encryptedDigest field of a SignerInfo value in PKCS #7 digitally signed data. Thus, the countersignature attribute type countersigns (signs in serial) another signature. The countersignature attribute must be an unauthenticated PKCS #7 attribute; it cannot be an authenticated attribute.

```
counterSignature ATTRIBUTE ::= {  
    WITH SYNTAX SignerInfo  
    ID pkcs-9-at-counterSignature  
}
```

Countersignature values have the same meaning as SignerInfo values for ordinary signatures (see Section 9 of [14] and Section 5.3 of [3]), except that:

1. The authenticatedAttributes field must contain a messageDigest attribute if it contains any other attributes, but need not contain a contentType attribute, as there is no content type for countersignatures; and

2. The input to the message-digesting process is the content octets of the DER encoding of the signatureValue field of the SignerInfo value with which the attribute is associated.

A countersignature attribute can have multiple attribute values.

Note 1 - The fact that a countersignature is computed on a signature (encrypted digest) means that the countersigning process need not know the original content input to the signing process. This has advantages both in efficiency and in confidentiality.

Note 2 - A countersignature, since it has type SignerInfo, can itself contain a countersignature attribute. Thus it is possible to construct arbitrarily long series of countersignatures.

5.4 Attribute types for use with PKCS #10 certificate requests

5.4.1 Challenge password

The challengePassword attribute type specifies a password by which an entity may request certificate revocation. The interpretation of challenge passwords is intended to be specified by certificate issuers etc; no particular interpretation is required.

```
challengePassword ATTRIBUTE ::= {  
    WITH SYNTAX DirectoryString {pkcs-9-ub-challengePassword}  
    EQUALITY MATCHING RULE caseExactMatch  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-challengePassword  
}
```

A challenge-password attribute must have a single attribute value.

ChallengePassword attribute values generated in accordance with this version of this document SHOULD use the PrintableString encoding whenever possible. If internationalization issues make this impossible, the UTF8String alternative SHOULD be used. PKCS #9-attribute processing systems MUST be able to recognize and process all string types in DirectoryString values.

Note - Version 1.1 of this document defined challengePassword as having the syntax CHOICE {PrintableString, T61String}, but did contain a note explaining that this might be changed to a CHOICE of different string types in the future See also Note 2 in section 5.2.3.

5.4.2 Extension request

The extensionRequest attribute type may be used to carry information about certificate extensions the requester wishes to be included in a certificate.

```
extensionRequest ATTRIBUTE ::= {  
    WITH SYNTAX ExtensionRequest  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-extensionRequest  
}
```

ExtensionRequest ::= Extensions

The Extensions type is imported from [10].

5.4.3 Extended-certificate attributes (deprecated)

The extendedCertificateAttributes attribute type specified a set of attributes for a PKCS #6 [13] extended certificate in a PKCS #10 certification request (the value of the extended certificate-attributes attribute would become the extension in the requested PKCS #6 extended certificate). Since the status of PKCS #6 is historic after the introduction of X.509 v3 certificates [10], the use of this attribute is deprecated.

```
extendedCertificateAttributes ATTRIBUTE ::= {  
    WITH SYNTAX SET OF Attribute  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-extendedCertificateAttributes  
}
```

An extended certificate attributes attribute must have a single attribute value (that value is a set, which itself may contain multiple values, but there must be only one set).

5.5 Attributes for use in PKCS #12 "PFX" PDUs or PKCS #15 tokens

5.5.1 Friendly name

The friendlyName attribute type specifies a user-friendly name of the object it belongs to. It is referenced in [17].

```
friendlyName ATTRIBUTE ::= {  
    WITH SYNTAX BMPString (SIZE(1..pkcs-9-ub-friendlyName))  
    EQUALITY MATCHING RULE caseIgnoreMatch  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-friendlyName  
}
```

As indicated, friendlyName attributes must have a single attribute value.

5.5.2 Local key identifier

The localKeyId attribute type specifies an identifier for a particular key. It is only to be used locally in applications. This attribute is referenced in [17].

```
localKeyId ATTRIBUTE ::= {  
    WITH SYNTAX OCTET STRING  
    EQUALITY MATCHING RULE octetStringMatch  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-localKeyId  
}
```

As indicated, localKeyId attributes must have a single attribute value. For two localKeyId values to match, their octet string representation must be of equal length and corresponding octets identical.

5.6 Attributes defined in S/MIME

S/MIME (c.f. [12]) defines some attributes and object identifiers in the PKCS #9 object identifier tree. For completeness, they are mentioned here.

5.6.1 Signing description

The signingDescription attribute is intended to provide a short synopsis of a message that can be used to present a user with an additional confirmation step before committing to a cryptographic operation. In most cases, the replication of the "Subject:" line from the header of a message should be sufficient and is recommended.

```
signingDescription ATTRIBUTE ::= {  
    WITH SYNTAX DirectoryString {pkcs-9-ub-signingDescription}  
    EQUALITY MATCHING RULE caseIgnoreMatch  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-signingDescription  
}
```

5.6.2 S/MIME capabilities

The syntax and semantics of the `smimeCapabilities` attribute is defined in [12]. It is included here for the sake of completeness.

```
smimeCapabilities ATTRIBUTE ::= {
    WITH SYNTAX SMIMECapabilities
    SINGLE VALUE
    ID pkcs-9-at-smimeCapabilities
}

SMIMECapabilities ::= SEQUENCE OF SMIMECapability

SMIMECapability ::= SEQUENCE {
    algorithm ALGORITHM.&id ({SMIMEv3Algorithms}),
    parameters ALGORITHM.&Type ({SMIMEv3Algorithms}{@algorithm})
}

SMIMEv3Algorithms ALGORITHM ::= {... -- See RFC 2633 -- }
```

6. Matching rules

This section defines matching rules used in the definition of attributes in this document.

6.1 Case ignore match

The `pkcs9CaseIgnoreMatch` rule compares for equality a presented string with an attribute value of type `PKCS9String`, without regard to the case (upper or lower) of the strings (e.g. "Pkcs" and "PKCS" match).

```
pkcs9CaseIgnoreMatch MATCHING-RULE ::= {
    SYNTAX PKCS9String {pkcs9-ub-match}
    ID id-mr-pkcs9CaseIgnoreMatch
}
```

The rule returns TRUE if the strings are the same length and corresponding characters are identical except possibly with regard to case.

Where the strings being matched are of different ASN.1 syntax, the comparison proceeds as normal so long as the corresponding characters are in both character sets. Otherwise matching fails.

6.2 Signing time match

The signingTimeMatch rule compares for equality a presented value with an attribute value of type SigningTime.

```
signingTimeMatch MATCHING-RULE ::= {  
    SYNTAX SigningTime  
    ID pkcs-9-mr-signingTimeMatch  
}
```

The rule returns TRUE if the attribute value represents the same time as the presented value. If a time is specified with seconds (or fractional seconds) absent, the number of seconds (fractional seconds) is assumed to be zero.

Where the strings being matched are of different ASN.1 syntax, the comparison proceeds as follows:

- a) Convert both values to DER-encoded values of type GeneralizedTime, coordinated universal time. If this is not possible the matching fails.
- b) Compare the strings for equality. The rule returns TRUE if and only if the strings are of the same length and corresponding octets are identical.

7. Security Considerations

Attributes of directory entries are used to provide descriptive information about the real-world objects they represent, which can be people, organizations or devices. Most countries have privacy laws regarding the publication of information about people.

The challengePassword attribute should not be stored un-encrypted in a directory.

Users of directory-aware applications making use of attributes defined for use with the pkcsEntity object class should make sure that the class's attributes are adequately protected, since they may potentially be read by third parties. If a password-protected value is stored (PKCS #8, #12 or #15), the directory should authenticate the requester before delivering the value to prevent an off-line password-search attack. Note that this potentially raises non-repudiation issues since the directory itself can try a password search to recover a private value, if stored this way.

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APPENDICES

A. ASN.1 module

This appendix includes all of the ASN.1 type and value definitions contained in this document in the form of the ASN.1 module PKCS-9.

```
PKCS-9 {iso(1) member-body(2) us(840) rsadsi(113549) pkcs(1)
pkcs-9(9) modules(0) pkcs-9(1)}
```

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

```
BEGIN
```

```
-- EXPORTS All --
```

```
-- All types and values defined in this module is exported for use
-- in other ASN.1 modules.
```

```
IMPORTS
```

```
informationFramework, authenticationFramework,
selectedAttributeTypes, upperBounds , id-at
    FROM UsefulDefinitions {joint-iso-itu-t ds(5) module(1)
    usefulDefinitions(0) 3}
```

```
ub-name
    FROM UpperBounds upperBounds
```

```
OBJECT-CLASS, ATTRIBUTE, MATCHING-RULE, Attribute, top,
objectIdentifierMatch
    FROM InformationFramework informationFramework
```

```
ALGORITHM, Extensions, Time
    FROM AuthenticationFramework authenticationFramework
```

```
DirectoryString, octetStringMatch, caseIgnoreMatch, caseExactMatch,
generalizedTimeMatch, integerMatch, serialNumber
    FROM SelectedAttributeTypes selectedAttributeTypes
```

```
ContentInfo, SignerInfo
    FROM CryptographicMessageSyntax {iso(1) member-body(2) us(840)
    rsadsi(113549) pkcs(1) pkcs-9(9) smime(16) modules(0) cms(1)}
```

```
EncryptedPrivateKeyInfo
    FROM PKCS-8 {iso(1) member-body(2) us(840) rsadsi(113549)
    pkcs(1) pkcs-8(8) modules(1) pkcs-8(1)}
```

PFX

```
FROM PKCS-12 {iso(1) member-body(2) us(840) rsadsi(113549)
pkcs(1) pkcs-12(12) modules(0) pkcs-12(1)}
```

PKCS15Token

```
FROM PKCS-15 {iso(1) member-body(2) us(840) rsadsi(113549)
pkcs(1) pkcs-15(15) modules(1) pkcs-15(1)};
```

-- Upper bounds

```
pkcs-9-ub-pkcs9String      INTEGER ::= 255
pkcs-9-ub-emailAddress     INTEGER ::= pkcs-9-ub-pkcs9String
pkcs-9-ub-unstructuredName INTEGER ::= pkcs-9-ub-pkcs9String
pkcs-9-ub-unstructuredAddress INTEGER ::= pkcs-9-ub-pkcs9String
pkcs-9-ub-challengePassword INTEGER ::= pkcs-9-ub-pkcs9String
pkcs-9-ub-friendlyName    INTEGER ::= pkcs-9-ub-pkcs9String
pkcs-9-ub-signingDescription INTEGER ::= pkcs-9-ub-pkcs9String
pkcs-9-ub-match           INTEGER ::= pkcs-9-ub-pkcs9String
pkcs-9-ub-pseudonym       INTEGER ::= ub-name
pkcs-9-ub-placeOfBirth    INTEGER ::= ub-name
```

-- Object Identifiers

```
pkcs-9 OBJECT IDENTIFIER ::= {iso(1) member-body(2) us(840)
rsadsi(113549) pkcs(1) 9}
```

-- Main arcs

```
pkcs-9-mo OBJECT IDENTIFIER ::= {pkcs-9 0} -- Modules branch
pkcs-9-oc OBJECT IDENTIFIER ::= {pkcs-9 24} -- Object class branch
pkcs-9-at OBJECT IDENTIFIER ::= {pkcs-9 25} -- Attribute branch, for
-- new attributes
pkcs-9-sx OBJECT IDENTIFIER ::= {pkcs-9 26} -- For syntaxes (RFC 2252)
pkcs-9-mr OBJECT IDENTIFIER ::= {pkcs-9 27} -- Matching rules
```

-- Object classes

```
pkcs-9-oc-pkcsEntity OBJECT IDENTIFIER ::= {pkcs-9-oc 1}
pkcs-9-oc-naturalPerson OBJECT IDENTIFIER ::= {pkcs-9-oc 2}
```

-- Attributes

```
pkcs-9-at-emailAddress OBJECT IDENTIFIER ::= {pkcs-9 1}
pkcs-9-at-unstructuredName OBJECT IDENTIFIER ::= {pkcs-9 2}
pkcs-9-at-contentType OBJECT IDENTIFIER ::= {pkcs-9 3}
pkcs-9-at-messageDigest OBJECT IDENTIFIER ::= {pkcs-9 4}
pkcs-9-at-signingTime OBJECT IDENTIFIER ::= {pkcs-9 5}
pkcs-9-at-counterSignature OBJECT IDENTIFIER ::= {pkcs-9 6}
pkcs-9-at-challengePassword OBJECT IDENTIFIER ::= {pkcs-9 7}
pkcs-9-at-unstructuredAddress OBJECT IDENTIFIER ::= {pkcs-9 8}
```

pkcs-9-at-extendedCertificateAttributes

OBJECT IDENTIFIER ::= {pkcs-9 9}

-- Obsolete (?) attribute identifiers, purportedly from "tentative
 -- PKCS #9 draft"

-- pkcs-9-at-issuerAndSerialNumber OBJECT IDENTIFIER ::= {pkcs-9 10}
 -- pkcs-9-at-passwordCheck OBJECT IDENTIFIER ::= {pkcs-9 11}
 -- pkcs-9-at-publicKey OBJECT IDENTIFIER ::= {pkcs-9 12}

pkcs-9-at-signingDescription OBJECT IDENTIFIER ::= {pkcs-9 13}
 pkcs-9-at-extensionRequest OBJECT IDENTIFIER ::= {pkcs-9 14}
 pkcs-9-at-smimeCapabilities OBJECT IDENTIFIER ::= {pkcs-9 15}

-- Unused (?)
 -- pkcs-9-at-? OBJECT IDENTIFIER ::= {pkcs-9 17}
 -- pkcs-9-at-? OBJECT IDENTIFIER ::= {pkcs-9 18}
 -- pkcs-9-at-? OBJECT IDENTIFIER ::= {pkcs-9 19}

pkcs-9-at-friendlyName OBJECT IDENTIFIER ::= {pkcs-9 20}
 pkcs-9-at-localKeyId OBJECT IDENTIFIER ::= {pkcs-9 21}
 pkcs-9-at-userPKCS12 OBJECT IDENTIFIER ::= {2 16 840 1 113730 3 1 216}

pkcs-9-at-pkcs15Token OBJECT IDENTIFIER ::= {pkcs-9-at 1}
 pkcs-9-at-encryptedPrivateKeyInfo OBJECT IDENTIFIER ::= {pkcs-9-at 2}
 pkcs-9-at-randomNonce OBJECT IDENTIFIER ::= {pkcs-9-at 3}
 pkcs-9-at-sequenceNumber OBJECT IDENTIFIER ::= {pkcs-9-at 4}
 pkcs-9-at-pkcs7PDU OBJECT IDENTIFIER ::= {pkcs-9-at 5}

-- IETF PKIX Attribute branch
 ietf-at OBJECT IDENTIFIER ::= {1 3 6 1 5 5 7 9}

pkcs-9-at-dateOfBirth OBJECT IDENTIFIER ::= {ietf-at 1}
 pkcs-9-at-placeOfBirth OBJECT IDENTIFIER ::= {ietf-at 2}
 pkcs-9-at-gender OBJECT IDENTIFIER ::= {ietf-at 3}
 pkcs-9-at-countryOfCitizenship OBJECT IDENTIFIER ::= {ietf-at 4}
 pkcs-9-at-countryOfResidence OBJECT IDENTIFIER ::= {ietf-at 5}

-- Syntaxes (for use with LDAP accessible directories)
 pkcs-9-sx-pkcs9String OBJECT IDENTIFIER ::= {pkcs-9-sx 1}
 pkcs-9-sx-signingTime OBJECT IDENTIFIER ::= {pkcs-9-sx 2}

-- Matching rules
 pkcs-9-mr-caseIgnoreMatch OBJECT IDENTIFIER ::= {pkcs-9-mr 1}
 pkcs-9-mr-signingTimeMatch OBJECT IDENTIFIER ::= {pkcs-9-mr 2}


```

-- Arcs with attributes defined elsewhere
smime                                OBJECT IDENTIFIER ::= {pkcs-9 16}

-- Main arc for S/MIME (RFC 2633)
certTypes                            OBJECT IDENTIFIER ::= {pkcs-9 22}

-- Main arc for certificate types defined in PKCS #12
crlTypes                             OBJECT IDENTIFIER ::= {pkcs-9 23}

-- Main arc for crl types defined in PKCS #12

-- Other object identifiers
id-at-pseudonym                      OBJECT IDENTIFIER ::= {id-at 65}

-- Useful types

PKCS9String {INTEGER : maxSize} ::= CHOICE {
    ia5String IA5String (SIZE(1..maxSize)),
    directoryString DirectoryString {maxSize}
}

-- Object classes

pkcsEntity OBJECT-CLASS ::= {
    SUBCLASS OF      { top }
    KIND              auxiliary
    MAY CONTAIN       { PKCSEntityAttributeSet }
    ID                pkcs-9-oc-pkcsEntity
}

naturalPerson OBJECT-CLASS ::= {
    SUBCLASS OF      { top }
    KIND              auxiliary
    MAY CONTAIN       { NaturalPersonAttributeSet }
    ID                pkcs-9-oc-naturalPerson
}

-- Attribute sets

PKCSEntityAttributeSet ATTRIBUTE ::= {
    pKCS7PDU |
    userPKCS12 |
    pKCS15Token |
    encryptedPrivateKeyInfo,
    ... -- For future extensions
}

```

```
NaturalPersonAttributeSet ATTRIBUTE ::= {
    emailAddress |
    unstructuredName |
    unstructuredAddress |
    dateOfBirth |
    placeOfBirth |
    gender |
    countryOfCitizenship |
    countryOfResidence |
    pseudonym |
    serialNumber,
    ... -- For future extensions
}

-- Attributes

pKCS7PDU ATTRIBUTE ::= {
    WITH SYNTAX ContentInfo
    ID pkcs-9-at-pkcs7PDU
}

userPKCS12 ATTRIBUTE ::= {
    WITH SYNTAX PFX
    ID pkcs-9-at-userPKCS12
}

pKCS15Token ATTRIBUTE ::= {
    WITH SYNTAX PKCS15Token
    ID pkcs-9-at-pkcs15Token
}

encryptedPrivateKeyInfo ATTRIBUTE ::= {
    WITH SYNTAX EncryptedPrivateKeyInfo
    ID pkcs-9-at-encryptedPrivateKeyInfo
}

emailAddress ATTRIBUTE ::= {
    WITH SYNTAX IA5String (SIZE(1..pkcs-9-ub-emailAddress))
    EQUALITY MATCHING RULE pkcs9CaseIgnoreMatch
    ID pkcs-9-at-emailAddress
}

unstructuredName ATTRIBUTE ::= {
    WITH SYNTAX PKCS9String {pkcs-9-ub-unstructuredName}
    EQUALITY MATCHING RULE pkcs9CaseIgnoreMatch
    ID pkcs-9-at-unstructuredName
}
```

```
unstructuredAddress ATTRIBUTE ::= {
    WITH SYNTAX DirectoryString {pkcs-9-ub-unstructuredAddress}
    EQUALITY MATCHING RULE caseIgnoreMatch
    ID pkcs-9-at-unstructuredAddress
}

dateOfBirth ATTRIBUTE ::= {
    WITH SYNTAX GeneralizedTime
    EQUALITY MATCHING RULE generalizedTimeMatch
    SINGLE VALUE TRUE
    ID pkcs-9-at-dateOfBirth
}

placeOfBirth ATTRIBUTE ::= {
    WITH SYNTAX DirectoryString {pkcs-9-ub-placeOfBirth}
    EQUALITY MATCHING RULE caseExactMatch
    SINGLE VALUE TRUE
    ID pkcs-9-at-placeOfBirth
}

gender ATTRIBUTE ::= {
    WITH SYNTAX PrintableString (SIZE(1) ^
        FROM ("M" | "F" | "m" | "f"))
    EQUALITY MATCHING RULE caseIgnoreMatch
    SINGLE VALUE TRUE
    ID pkcs-9-at-gender
}

countryOfCitizenship ATTRIBUTE ::= {
    WITH SYNTAX PrintableString (SIZE(2))(CONSTRAINED BY {
        -- Must be a two-letter country acronym in accordance with
        -- ISO/IEC 3166 --})
    EQUALITY MATCHING RULE caseIgnoreMatch
    ID pkcs-9-at-countryOfCitizenship
}

countryOfResidence ATTRIBUTE ::= {
    WITH SYNTAX PrintableString (SIZE(2))(CONSTRAINED BY {
        -- Must be a two-letter country acronym in accordance with
        -- ISO/IEC 3166 --})
    EQUALITY MATCHING RULE caseIgnoreMatch
    ID pkcs-9-at-countryOfResidence
}
```

```
pseudonym ATTRIBUTE ::= {  
    WITH SYNTAX DirectoryString {pkcs-9-ub-pseudonym}  
    EQUALITY MATCHING RULE caseExactMatch  
    ID id-at-pseudonym  
}
```

```
contentType ATTRIBUTE ::= {  
    WITH SYNTAX ContentType  
    EQUALITY MATCHING RULE objectIdentifierMatch  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-contentType  
}
```

ContentType ::= OBJECT IDENTIFIER

```
messageDigest ATTRIBUTE ::= {  
    WITH SYNTAX MessageDigest  
    EQUALITY MATCHING RULE octetStringMatch  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-messageDigest  
}
```

MessageDigest ::= OCTET STRING

```
signingTime ATTRIBUTE ::= {  
    WITH SYNTAX SigningTime  
    EQUALITY MATCHING RULE signingTimeMatch  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-signingTime  
}
```

SigningTime ::= Time -- imported from ISO/IEC 9594-8

```
randomNonce ATTRIBUTE ::= {  
    WITH SYNTAX RandomNonce  
    EQUALITY MATCHING RULE octetStringMatch  
    SINGLE VALUE TRUE  
    ID pkcs-9-at-randomNonce  
}
```

RandomNonce ::= OCTET STRING (SIZE(4..MAX))
 -- At least four bytes long

```
sequenceNumber ATTRIBUTE ::= {
    WITH SYNTAX SequenceNumber
    EQUALITY MATCHING RULE integerMatch
    SINGLE VALUE TRUE
    ID pkcs-9-at-sequenceNumber
}

SequenceNumber ::= INTEGER (1..MAX)

counterSignature ATTRIBUTE ::= {
    WITH SYNTAX SignerInfo
    ID pkcs-9-at-counterSignature
}

challengePassword ATTRIBUTE ::= {
    WITH SYNTAX DirectoryString {pkcs-9-ub-challengePassword}
    EQUALITY MATCHING RULE caseExactMatch
    SINGLE VALUE TRUE
    ID pkcs-9-at-challengePassword
}

extensionRequest ATTRIBUTE ::= {
    WITH SYNTAX ExtensionRequest
    SINGLE VALUE TRUE
    ID pkcs-9-at-extensionRequest
}

ExtensionRequest ::= Extensions

extendedCertificateAttributes ATTRIBUTE ::= {
    WITH SYNTAX SET OF Attribute
    SINGLE VALUE TRUE
    ID pkcs-9-at-extendedCertificateAttributes
}

friendlyName ATTRIBUTE ::= {
    WITH SYNTAX BMPString (SIZE(1..pkcs-9-ub-friendlyName))
    EQUALITY MATCHING RULE caseIgnoreMatch
    SINGLE VALUE TRUE
    ID pkcs-9-at-friendlyName
}

localKeyId ATTRIBUTE ::= {
    WITH SYNTAX OCTET STRING
    EQUALITY MATCHING RULE octetStringMatch
    SINGLE VALUE TRUE
    ID pkcs-9-at-localKeyId
}
```

```

signingDescription ATTRIBUTE ::= {
    WITH SYNTAX DirectoryString {pkcs-9-ub-signingDescription}
    EQUALITY MATCHING RULE caseIgnoreMatch
    SINGLE VALUE TRUE
    ID pkcs-9-at-signingDescription
}

smimeCapabilities ATTRIBUTE ::= {
    WITH SYNTAX SMIMECapabilities
    SINGLE VALUE TRUE
    ID pkcs-9-at-smimeCapabilities
}

SMIMECapabilities ::= SEQUENCE OF SMIMECapability

SMIMECapability ::= SEQUENCE {
    algorithm ALGORITHM.&id ({SMIMEv3Algorithms}),
    parameters ALGORITHM.&Type ({SMIMEv3Algorithms}{@algorithm})
}

SMIMEv3Algorithms ALGORITHM ::= {...-- See RFC 2633 --}

-- Matching rules

pkcs9CaseIgnoreMatch MATCHING-RULE ::= {
    SYNTAX PKCS9String {pkcs-9-ub-match}
    ID pkcs-9-mr-caseIgnoreMatch
}

signingTimeMatch MATCHING-RULE ::= {
    SYNTAX SigningTime
    ID pkcs-9-mr-signingTimeMatch
}

END

```

- B. BNF schema summary This appendix provides augmented BNF [2] definitions of the object class and most attribute types specified in this document along with their associated syntaxes and matching rules. The ABNF definitions have been done in accordance with [21], in an attempt to ease integration with LDAP-accessible Directory systems. Lines have been folded in some cases to improve readability.

B.1 Syntaxes

This section defines all syntaxes that are used in this document.

B.1.1 PKCS9String

```
(
    1.2.840.113549.1.9.26.1
    DESC 'PKCS9String'
)
```

The encoding of a value in this syntax is the string value itself.

B.1.2 SigningTime

```
(
    1.2.840.113549.1.9.26.2
    DESC 'SigningTime'
)
```

Values in this syntax are encoded as printable strings, represented as specified in [5]. Note that the time zone must be specified. For example, "199412161032Z".

B.2 Object classes

B.2.1 pkcsEntity

```
(
    1.2.840.113549.1.9.24.1
    NAME 'pkcsEntity'
    SUP top
    AUXILIARY
    MAY (
        pKCS7PDU $ userPKCS12 $ pKCS15Token $ encryptedPrivateKeyInfo
    )
)
```

B.2.2 naturalPerson

```
(
    1.2.840.113549.1.9.24.2
    NAME 'naturalPerson'
    SUP top
    AUXILIARY
    MAY (
        emailAddress $ unstructuredName $ unstructuredAddress $
        dateOfBirth & placeOfBirth & gender & countryOfCitizenship &
        countryOfResidence & pseudonym & serialNumber
    )
)
```

B.3 Attribute types

B.3.1 pKCS7PDU

This attribute is to be stored and requested in binary form, as pKCS7PDU;binary. The attribute values are BER- or DER-encoded ContentInfo values.

```
(
    1.2.840.113549.1.9.25.5
    NAME 'pKCS7PDU'
    DESC 'PKCS #7 ContentInfo PDU'
    SYNTAX 1.3.6.1.4.1.1466.115.121.1.5
)
```

B.3.2 userPKCS12

This attribute is to be stored and requested in binary form, as userPKCS12;binary. The attribute values are PFX PDUs stored as binary (BER- or DER-encoded) data.

```
(
    2.16.840.1.113730.3.1.216
    NAME 'userPKCS12'
    DESC 'PKCS #12 PFX PDU for exchange of personal information'
    SYNTAX 1.3.6.1.4.1.1466.115.121.1.5
)
```

B.3.3 pKCS15Token

This attribute is to be stored and requested in binary form, as pKCS15Token;binary. The attribute values are PKCS15Token PDUs stored as binary (BER- or DER-encoded) data.

```
(
    1.2.840.113549.1.9.25.1
    NAME 'pKCS15Token'
    DESC 'PKCS #15 token PDU'
    SYNTAX 1.3.6.1.4.1.1466.115.121.1.5
)
```

B.3.4 encryptedPrivateKeyInfo

This attribute is to be stored and requested in binary form, as encryptedPrivateKeyInfo;binary. The attribute values are EncryptedPrivateKeyInfo PDUs stored as binary (BER- or DER-encoded) data.


```
(
    1.2.840.113549.1.9.25.2
    NAME 'encryptedPrivateKeyInfo'
    DESC 'PKCS #8 encrypted private key info'
    SYNTAX 1.3.6.1.4.1.1466.115.121.1.5
)
```

B.3.5 emailAddress

```
(
    1.2.840.113549.1.9.1
    NAME 'emailAddress'
    DESC 'Email address'
    EQUALITY pkcs9CaseIgnoreMatch
    SYNTAX 1.3.6.1.4.1.1466.115.121.1.26
)
```

B.3.6 unstructuredName

```
(
    1.2.840.113549.1.9.2
    NAME 'unstructuredName'
    DESC 'PKCS #9 unstructured name'
    EQUALITY pkcs9CaseIgnoreMatch
    SYNTAX 1.2.840.113549.1.9.26.1
)
```

B.3.7 unstructuredAddress

```
(
    1.2.840.113549.1.9.8
    NAME 'unstructuredAddress'
    DESC 'PKCS #9 unstructured address'
    EQUALITY caseIgnoreMatch
    SYNTAX 1.3.6.1.4.1.1466.115.121.1.15
)
```

B.3.8 dateOfBirth

```
(
    1.3.6.1.5.5.7.9.1
    NAME 'dateOfBirth'
    DESC 'Date of birth'
    EQUALITY generalizedTimeMatch
    SYNTAX 1.3.6.1.4.1.1466.115.121.1.24
    SINGLE-VALUE
)
```

B.3.9 placeOfBirth

```
(  
    1.3.6.1.5.5.7.9.2  
    NAME 'placeOfBirth'  
    DESC 'Place of birth'  
    EQUALITY caseExactMatch  
    SYNTAX 1.3.6.1.4.1.1466.115.121.1.15  
    SINGLE-VALUE  
)
```

B.3.10 gender

```
(  
    1.3.6.1.5.5.7.9.3  
    NAME 'gender'  
    DESC 'Gender'  
    EQUALITY caseIgnoreMatch  
    SYNTAX 1.3.6.1.4.1.1466.115.121.1.44  
    SINGLE-VALUE  
)
```

B.3.11 countryOfCitizenship

```
(  
    1.3.6.1.5.5.7.9.4  
    NAME 'countryOfCitizenship'  
    DESC 'Country of citizenship'  
    EQUALITY caseIgnoreMatch  
    SYNTAX 1.3.6.1.4.1.1466.115.121.1.44  
)
```

B.3.12 countryOfResidence

```
(  
    1.3.6.1.5.5.7.9.5  
    NAME 'countryOfResidence'  
    DESC 'Country of residence'  
    EQUALITY caseIgnoreMatch  
    SYNTAX 1.3.6.1.4.1.1466.115.121.1.44  
)
```

B.3.13 pseudonym

```
(
    2.5.4.65
    NAME 'pseudonym'
    DESC 'Pseudonym'
    EQUALITY caseExactMatch
    SYNTAX 1.3.6.1.4.1.1466.115.121.1.15
)
```

B.3.14 contentType

In the (highly unlikely) event of this attribute being stored in a Directory it is to be stored and requested in binary form, as contentType;binary. Attribute values shall be OCTET STRINGS stored as binary (BER- or DER-encoded) data.

```
(
    1.2.840.113549.1.9.3
    NAME 'contentType'
    DESC 'PKCS #7 content type attribute'
    EQUALITY objectIdentifierMatch
    SYNTAX 1.3.6.1.4.1.1466.115.121.1.38
    SINGLE-VALUE
)
```

B.3.15 messageDigest

In the (highly unlikely) event of this attribute being stored in a Directory it is to be stored and requested in binary form, as messageDigest;binary. Attribute values shall be OCTET STRINGS stored as binary (BER- or DER-encoded) data.

```
(
    1.2.840.113549.1.9.4
    NAME 'messageDigest'
    DESC 'PKCS #7 message digest attribute'
    EQUALITY octetStringMatch
    SYNTAX 1.3.6.1.4.1.1466.115.121.1.5
    SINGLE-VALUE
)
```

B.3.16 signingTime

```
(
    1.2.840.113549.1.9.5
    NAME 'signingTime'
    DESC 'PKCS #7 signing time'
    EQUALITY signingTimeMatch
    SYNTAX 1.2.840.113549.1.9.26.2
    SINGLE-VALUE
)
```

B.3.17 counterSignature

In the (highly unlikely) event that this attribute is to be stored in a directory, it is to be stored and requested in binary form, as counterSignature;binary. Attribute values shall be stored as binary (BER- or DER-encoded) data.

```
(
    1.2.840.113549.1.9.6
    NAME 'counterSignature'
    DESC 'PKCS #7 countersignature'
    SYNTAX 1.3.6.1.4.1.1466.115.121.1.5
)
```

B.3.18 challengePassword

```
(
    1.2.840.113549.1.9.7
    NAME 'challengePassword'
    DESC 'Challenge password for certificate revocations'
    EQUALITY caseExactMatch
    SYNTAX 1.3.6.1.4.1.1466.115.121.1.15
    SINGLE-VALUE
)
```

Note - It is not recommended to store unprotected values of this attribute in a directory.

B.4 Matching rules

B.4.1 pkcs9CaseIgnoreMatch

```
(
    1.2.840.113549.1.9.27.1
    NAME 'pkcs9CaseIgnoreMatch'
    SYNTAX 1.2.840.113549.1.9.26.1
)
```

B.4.2 signingTimeMatch

```
(
    1.2.840.113549.1.9.27.3
    NAME 'signingTimeMatch'
    SYNTAX 1.2.840.113549.1.9.26.2
)
```

C. Intellectual property considerations

RSA Security makes no patent claims on the general constructions described in this document, although specific underlying techniques may be covered.

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D. Revision history

Version 1.0

Version 1.0 was part of the June 3, 1991 initial public release of PKCS. Version 1.0 was also published as NIST/OSI Implementors' Workshop document SEC-SIG-91-24.

Version 1.1

Version 1.1 incorporated several editorial changes, including updates to the references and the addition of a revision history. The following substantive changes were made:

- Section 6: challengePassword, unstructuredAddress, and extendedCertificateAttributes attribute types were added
- Section 7: challengePassword, unstructuredAddress, and extendedCertificateAttributes object identifiers were added

Version 2.0

Version 2.0 incorporates several editorial changes as well. In addition, the following substantive changes have been made:

- Addition of a Section defining two new auxiliary object classes, `pkcsEntity` and `naturalPerson`
- Addition of several new attribute types and matching rules for use in conjunction with these object classes and elsewhere
- Update of all ASN.1 to be in line with the 1997 version of this syntax
- Addition a "compilable" ASN.1 module
- Addition, in accordance with [21], an ABNF description of all attributes and object classes
- Addition of an intellectual property considerations section

E. References

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F. Contact information & About PKCS

The Public-Key Cryptography Standards are specifications produced by RSA Laboratories in cooperation with secure systems developers worldwide for the purpose of accelerating the deployment of public-key cryptography. First published in 1991 as a result of meetings with a small group of early adopters of public-key technology, the PKCS documents have become widely referenced and implemented. Contributions from the PKCS series have become part of many formal and de facto standards, including ANSI X9 documents, PKIX, SET, S/MIME, and SSL.

Further development of PKCS occurs through mailing list discussions and occasional workshops, and suggestions for improvement are welcome. For more information, contact:

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