public_key

version 0.2

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Contents

Chapter 1

public_key User's Guide

This application provides an API to public key infrastructure from RFC 3280 (X.509 certificates) and some public key formats defined by the PKCS-standard.

1.1 Introduction

1.1.1 Purpose

This application provides an API to public key infrastructure from RFC 3280 (X.509 certificates) and public key formats defined by the PKCS-standard.

1.1.2 Prerequisites

It is assumed that the reader is familiar with the Erlang programming language, concepts of OTP and has a basic understanding of the consepts of using public keys.

1.2 Public key records

This chapter briefly describes Erlang records derived from asn1 specifications used to handle public and private keys. The intent is to describe the data types and not to specify the meaning of each component for this we refer you to the relevant standards and RFCs.

Use the following include directive to get access to the records and constant macros used in the following sections.

```
-include_lib("public_key/include/public_key.hrl").
```

1.2.1 RSA as defined by the PKCS-1 standard and RFC 3447.

```
#'RSAPublicKey'{
          modulus,       % integer()
          publicExponent % integer()
          }.

#'RSAPrivateKey'{
          version,         % two-prime | multi
          modulus,         % integer()
          publicExponent,  % integer()
          privateExponent, % integer()
          prime1,          % integer()
          prime2,          % integer()
          exponent1,       % integer()
          exponent2,       % integer()
          coefficient,     % integer()
          otherPrimeInfos  % [#OtherPrimeInfo{}] | asn1_NOVALUE
         }.

#'OtherPrimeInfo'{
         prime,           % integer()
         exponent,        % integer()
         coefficient      % integer()
         }.
```

1.2.2 DSA as defined by Digital Signature Standard (NIST FIPS PUB 186-2)

```
#'DSAPrivateKey',{
          version,      % integer()
          p,            % integer()
          q,            % integer()
          g,            % integer()
          y,            % integer()
          x             % integer()
          }.

#'Dss-Parms',{
         p,         % integer()
         q,         % integer()
         g          % integer()
         }.
```

1.3 Certificate records

This chapter briefly describes erlang records derived from asn1 specifications used to handle X509 certificates. The intent is to describe the data types and not to specify the meaning of each component for this we refer you to RFC 3280.

Use the following include directive to get access to the records and constant macros described in the following sections.

```
-include_lib("public_key/include/public_key.hrl").
```

1.3.1 Common Data Types

Common non standard erlang data types used to described the record fields in the below sections are defined in public key reference manual [page 12] or follows here.

```
time() = uct_time() | general_time()

uct_time() = {utcTime, "YYMMDDHHMMSSZ"}

general_time() = {generalTime, "YYYYMMDDHHMMSSZ"}

general_name() = {rfc822Name, string()} | {dNSName, string()} | {x400Address,
string()} | {directoryName, {rdnSequence, [#AttributeTypeAndValue'{}]}} | |
{eidPartyName, special_string()} | {eidPartyName, special_string(), special_string()}
| {uniformResourceIdentifier, string()} | {ipAddress, string()} | {registeredId,
oid()} | {otherName, term()}

special_string() = {teletexString, string()} | {printableString, string()} |
{universalString, string()} | {utf8String, string()} | {bmpString, string()}

dist_reason() = unused | keyCompromise | cACompromise | affiliationChanged |
superseded | cessationOfOperation | certificateHold | privilegeWithdrawn |
aACompromise
```

1.3.2 PKIX Certificates

```
#'Certificate'{
               tbsCertificate,        % #'TBSCertificate'{}
               signatureAlgorithm,    % #'AlgorithmIdentifier'{}
               signature              % {0, binary()} - asn1 compact bitstring
              }.

#'TBSCertificate'{
          version,              % v1 | v2 | v3
          serialNumber,         % integer()
          signature,            % #'AlgorithmIdentifier'{}
          issuer,               % {rdnSequence, [#AttributeTypeAndValue'{}]}
          validity,             % #'Validity'{}
          subject,              % {rdnSequence, [#AttributeTypeAndValue'{}]}
          subjectPublicKeyInfo, % #'SubjectPublicKeyInfo'{}
          issuerUniqueID,       % binary() | asn1_novalue
          subjectUniqueID,      % binary() | asn1_novalue
          extensions            % [#'Extension'{}]
         }.

#'AlgorithmIdentifier'{
          algorithm,  % oid()
          parameters  % asn1_der_encoded()
         }.
#'SignatureAlgorithm'{
          algorithm,  % id_signature_algorithm()
          parameters  % public_key_params()
         }.
```

id_signature_algorithm() = ?oid_name_as_erlang_atom for available oid names see table below. Ex: ?'id-dsa-with-sha1'

OID name
id-dsa-with-sha1
md2WithRSAEncryption
md5WithRSAEncryption
sha1WithRSAEncryption
ecdsa-with-SHA1

Table 1.1: Signature algorithm oids

```
#'AttributeTypeAndValue'{
          type,   % id_attributes()
          value   % term()
         }.
```

id_attributes() = ?oid_name_as_erlang_atom for available oid names see table below. Ex: ?'id-at-name'

OID name	Value type
id-at-name	special_string()
id-at-surname	special_string()
id-at-givenName	special_string()
id-at-initials	special_string()
id-at-generationQualifier	special_string()
id-at-commonName	special_string()
id-at-localityName	special_string()
id-at-stateOrProvinceName	special_string()
id-at-organizationName	special_string()
id-at-title	special_string()
id-at-dnQualifier	{printableString, string()}
id-at-countryName	{printableString, string()}
id-at-serialNumber	{printableString, string()}
id-at-pseudonym	special_string()

Table 1.2: Attribute oids

```
#'Validity'{
          notBefore, % time()
          notAfter   % time()
         }.

#'SubjectPublicKeyInfo'{
          algorithm,       % #AlgorithmIdentifier{}
          subjectPublicKey % binary()
```

```
        }.

#'SubjectPublicKeyInfoAlgorithm'{
          algorithm,  % id_public_key_algorithm()
          parameters  % public_key_params()
         }.
```

`id_public_key_algorithm() = ?oid_name_as_erlang_atom` for available oid names see table below. Ex: ?'id-dsa'

OID name
rsaEncryption
id-dsa
dhpublicnumber
ecdsa-with-SHA1
id-keyExchangeAlgorithm

Table 1.3: Public key algorithm oids

```
#'Extension'{
          extnID,    % id_extensions() | oid()
          critical,  % boolean()
          extnValue  % asn1_der_encoded()
         }.
```

`id_extensions() = ?oid_name_as_erlang_atom` for available oid names see tables. Ex: ?'id-ce-authorityKeyIdentifier'Standard Certificate Extensions [page 5], Private Internet Extensions [page 8], CRL Extensions [page 9] and CRL Entry Extensions [page 9].

1.3.3 Standard certificate extensions

OID name	Value type
id-ce-authorityKeyIdentifier	#'AuthorityKeyIdentifier'{}
id-ce-subjectKeyIdentifier	oid()
id-ce-keyUsage	[key_usasge()]
id-ce-privateKeyUsagePeriod	#'PrivateKeyUsagePeriod'{}
id-ce-certificatePolicies	#'PolicyInformation'{}
id-ce-policyMappings	#'PolicyMappings_SEQOF'{}
id-ce-subjectAltName	general_name()
id-ce-issuerAltName	general_name()
id-ce-subjectDirectoryAttributes	[#'Attribute'{}]
id-ce-basicConstraints	#'BasicConstraints'{}
id-ce-nameConstraints	#'NameConstraints'{}

continued ...

... continued

id-ce-policyConstraints	#'PolicyConstraints'{}
id-ce-extKeyUsage	[id_key_purpose()]
id-ce-cRLDistributionPoints	#'DistributionPoint'{}
id-ce-inhibitAnyPolicy	integer()
id-ce-freshestCRL	[#'DistributionPoint'{}]

Table 1.4: Standard Certificate Extensions

`key_usasge() = digitalSignature | nonRepudiation | keyEncipherment| dataEncipherment | keyAgreement | keyCertSign | cRLSign | encipherOnly | decipherOnly`

`id_key_purpose() = ?oid_name_as_erlang_atom` for available oid names see table below. Ex: ?'id-kp-serverAuth'

OID name
id-kp-serverAuth
id-kp-clientAuth
id-kp-codeSigning
id-kp-emailProtection
id-kp-timeStamping
id-kp-OCSPSigning

Table 1.5: Key purpose oids

```
#'AuthorityKeyIdentifier'{
          keyIdentifier,            % oid()
          authorityCertIssuer,      % general_name()
          authorityCertSerialNumber % integer()
         }.

#'PrivateKeyUsagePeriod'{
          notBefore,   % general_time()
          notAfter     % general_time()
         }.

#'PolicyInformation'{
          policyIdentifier,  % oid()
          policyQualifiers   % [#PolicyQualifierInfo{}]
         }.

#'PolicyQualifierInfo'{
          policyQualifierId,   % oid()
          qualifier            % string() | #'UserNotice'{}
         }.

#'UserNotice'{
         noticeRef,   % #'NoticeReference'{}
         explicitText % string()
```

```
        }.

#'NoticeReference'{
        organization,    % string()
        noticeNumbers    % [integer()]
        }.

#'PolicyMappings_SEQOF'{
         issuerDomainPolicy,  % oid()
         subjectDomainPolicy  % oid()
        }.

#'Attribute'{
         type,  % oid()
         values % [asn1_der_encoded()]
         }).

#'BasicConstraints'{
         cA,               % boolean()
         pathLenConstraint % integer()
        }).

#'NameConstraints'{
         permittedSubtrees, % [#'GeneralSubtree'{}]
         excludedSubtrees   % [#'GeneralSubtree'{}]
        }).

#'GeneralSubtree'{
         base,    % general_name()
         minimum, % integer()
         maximum  % integer()
        }).

#'PolicyConstraints'{
         requireExplicitPolicy, % integer()
         inhibitPolicyMapping   % integer()
        }).

#'DistributionPoint'{
         distributionPoint, % general_name() | [#AttributeTypeAndValue{}]
         reasons,           % [dist_reason()]
         cRLIssuer          % general_name()
        }).
```

1.3.4 Private Internet Extensions

OID name	Value type
id-pe-authorityInfoAccess	[#'AccessDescription'{}]
id-pe-subjectInfoAccess	[#'AccessDescription'{}]

Table 1.6: Private Internet Extensions

```
#'AccessDescription'{
           accessMethod,    % oid()
           accessLocation   % general_name()
         }).
```

1.3.5 CRL and CRL Extensions Profile

```
#'CertificateList'{
          tbsCertList,        % #'TBSCertList{}
          signatureAlgorithm, % #'AlgorithmIdentifier'{}
          signature           % {0, binary()} - asn1 compact bitstring
          }).

#'TBSCertList'{
      version,             % v2 (if defined)
      signature,           % #AlgorithmIdentifier{}
      issuer,              % {rdnSequence, [#AttributeTypeAndValue'{}]}
      thisUpdate,          % time()
      nextUpdate,          % time()
      revokedCertificates, % [#'TBSCertList_revokedCertificates_SEQOF'{}]
      crlExtensions        % [#'Extension'{}]
      }).

#'TBSCertList_revokedCertificates_SEQOF'{
         userCertificate,      % integer()
         revocationDate,       % timer()
         crlEntryExtensions    % [#'Extension'{}]
         }).
```

CRL Extensions

OID name	Value type
id-ce-authorityKeyIdentifier	#'AuthorityKeyIdentifier{}
id-ce-issuerAltName	{rdnSequence, [#AttributeTypeAndValue'{}]}
id-ce-cRLNumber	integer()
id-ce-deltaCRLIndicator	integer()
id-ce-issuingDistributionPoint	#'IssuingDistributionPoint'{}
id-ce-freshestCRL	[#'Distributionpoint'{}]

Table 1.7: CRL Extensions

```
#'IssuingDistributionPoint'{
          distributionPoint,         % general_name() | [#AttributeTypeAndValue'{}]
          onlyContainsUserCerts,     % boolean()
          onlyContainsCACerts,       % boolean()
          onlySomeReasons,           % [dist_reason()]
          indirectCRL,               % boolean()
          onlyContainsAttributeCerts % boolean()
          }).
```

CRL Entry Extensions

OID name	Value type
id-ce-cRLReason	crl_reason()
id-ce-holdInstructionCode	oid()
id-ce-invalidityDate	general_time()
id-ce-certificateIssuer	general_name()

Table 1.8: CRL Entry Extensions

```
 crl_reason() = unspecified | keyCompromise | cACompromise | affiliationChanged |
superseded | cessationOfOperation | certificateHold | removeFromCRL |
privilegeWithdrawn | aACompromise
```

public_key Reference Manual

Short Summaries

- Erlang Module public_key [page 12] – API module for public key infrastructure.

public_key

The following functions are exported:

- `decode_private_key(KeyInfo) ->`
  [page 13] Decodes an asn1 der encoded private key.
- `decode_private_key(KeyInfo, Password) -> {ok, PrivateKey} | {error, Reason}`
  [page 13] Decodes an asn1 der encoded private key.
- `pem_to_der(File) -> {ok, [Entry]}`
  [page 13] Reads a PEM file and translates it into its asn1 der encoded parts.
- `pkix_decode_cert(Cert, Type) -> {ok, DecodedCert} | {error, Reason}`
  [page 13] Decodes an asn1 der encoded pkix certificate.

public_key

Erlang Module

This module provides functions to handle public key infrastructure from RFC 3280 - X.509 certificates (will later be upraded to RFC 5280) and some parts of the PKCS-standard. Currently this application is mainly used by the new ssl implementation. The API is yet under construction and only a few of the functions are currently documented and thereby supported.

COMMON DATA TYPES

> **Note:**
> All records used in this manual are generated from asn1 specifications and are documented in the User's Guide. See Public key records [page 1] and X.509 Certificate records [page 2].

Use the following include directive to get access to the records and constant macros described here and in the User's Guide.

```
-include_lib("public_key/include/public_key.hrl").
```

Data Types

```
boolean() = true | false

string = [bytes()]

asn1_der_encoded() = binary() | [bytes()]

der_bin() = binary()

oid() - a tuple of integers as generated by the asn1 compiler.

public_key() = rsa_public_key() | dsa_public_key()

rsa_public_key() = #'RSAPublicKey'{}

rsa_private_key() = #'RSAPrivateKey'{}

dsa_public_key() = integer()

public_key_params() = dsa_key_params()

dsa_key_params() = #'Dss-Parms'{}

private_key() = rsa_private_key() | dsa_private_key()

rsa_private_key() = #'RSAPrivateKey'{}

dsa_private_key() = #'DSAPrivateKey'{}

x509_certificate() = "#Certificate{}"
```

```
x509_tbs_certificate() = #'TBSCertificate'{}
```

Exports

```
decode_private_key(KeyInfo) ->
decode_private_key(KeyInfo, Password) -> {ok, PrivateKey} | {error, Reason}
```

Types:

- KeyInfo = {KeyType, der_bin(), ChipherInfo}
  As returned from pem_to_der/1 for private keys
- KeyType = rsa_private_key | dsa_private_key
- ChipherInfo = opaque() | no_encryption
  ChipherInfo may contain encryption parameters if the private key is password protected, these are opaque to the user just pass the value returned by pem_to_der/1 to this function.
- Password = string()
  Must be specified if CipherInfo =/= no_encryption
- PrivateKey = private_key()
- Reason = term()

Decodes an asn1 der encoded private key.

```
pem_to_der(File) -> {ok, [Entry]}
```

Types:

- File = path()
- Password = string()
- Entry = {entry_type(), der_bin(), CipherInfo}
- ChipherInfo = opaque() | no_encryption
  ChipherInfo may contain encryption parameters if the private key is password protected, these will be handled by the function decode_private_key/2.
- entry_type() = cert | cert_req | rsa_private_key | dsa_private_key | dh_params

Reads a PEM file and translates it into its asn1 der encoded parts.

```
pkix_decode_cert(Cert, Type) -> {ok, DecodedCert} | {error, Reason}
```

Types:

- Cert = asn1_der_encoded()
- Type = plain | otp
- DecodeCert = x509_certificate()
  When type is specified as otp the asn1 spec OTP-PKIX.asn1 is used to decode known extensions and enhance the signature field in #'Certificate'{} and '#TBSCertificate'{}. This is currently used by the new ssl implementation but not documented and supported for the public_key application.
- Reason = term()

Decodes an asn1 encoded pkix certificate.

List of Tables

Index of Modules and Functions

Modules are typed in *this way*.
Functions are typed in `this way`.