pyOpenSSL Documentation

Release 17.0.0

The pyOpenSSL developers

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Release v17.0.0 (*What's new?*).

pyOpenSSL is a rather thin wrapper around (a subset of) the OpenSSL library. With thin wrapper we mean that a lot of the object methods do nothing more than calling a corresponding function in the OpenSSL library.

CHAPTER 1

Contents:

Introduction

History

pyOpenSSL was originally created by Martin Sjögren because the SSL support in the standard library in Python 2.1 (the contemporary version of Python when the pyOpenSSL project was begun) was severely limited. Other OpenSSL wrappers for Python at the time were also limited, though in different ways.

Later it was maintained by Jean-Paul Calderone who among other things managed to make pyOpenSSL a pure Python project which the current maintainers are *very* grateful for.

Over the time the standard library's `ssl` module improved, never reaching the completeness of pyOpenSSL's API coverage. Despite PEP 466 many useful features remain Python 3-only and pyOpenSSL remains the only alternative for full-featured TLS code across all noteworthy Python versions from 2.6 through 3.5 and PyPy.

Development

pyOpenSSL is collaboratively developed by the Python Cryptography Authority (PyCA) that also maintains the low-level bindings called cryptography.

Current maintainer and release manager is Hynek Schlawack.

Contributing

First of all, thank you for your interest in contributing to pyOpenSSL! This project has no company backing its development therefore we're dependent on help by the community.

Filing bug reports

Bug reports are very welcome. Please file them on the GitHub issue tracker. Good bug reports come with extensive descriptions of the error and how to reproduce it. Reporters are strongly encouraged to include an short, self contained, correct example.

Patches

All patches to pyOpenSSL should be submitted in the form of pull requests to the main pyOpenSSL repository, pyca/pyopenssl. These pull requests should satisfy the following properties:

Code

- The pull request should focus on one particular improvement to pyOpenSSL. Create different pull requests for unrelated features or bugfixes.
- Code should follow PEP 8, especially in the "do what code around you does" sense. Follow OpenSSL naming for callables whenever possible is preferred.
- Pull requests that introduce code must test all new behavior they introduce as well as for previously untested or poorly tested behavior that they touch.
- Pull requests are not allowed to break existing tests. We usually don't comment on pull requests that are breaking the CI because we consider them work in progress. Please note that not having 100% code coverage for the code you wrote/touched also causes our CI to fail.

Documentation

When introducing new functionality, please remember to write documentation.

- New functions and methods should have a docstring describing what they do, what parameters they takes, what types those parameters are, and what they return.

  ```
  def dump_publickey(type, pkey):
      """
      Dump a public key to a buffer.

      :param type: The file type (one of :data:`FILETYPE_PEM` or
          :data:`FILETYPE_ASN1`).
      :param PKey pkey: The PKey to dump.

      :return: The buffer with the dumped key in it.
      :rtype: bytes
      """
  ```

  Don't forget to add an `.. auto(function|class|method)::` statement to the relevant API document found in `doc/api/` to actually add your function to the Sphinx documentation.

- Do *not* use `:py:` prefixes when cross-linking (Python is default). Do *not* use the generic `:data:` or `:obj:`. Instead use more specific types like `:class:`, `:func:` or `:meth:` if applicable.
- Pull requests that introduce features or fix bugs should note those changes in the CHANGELOG.rst file. Please add new entries to the *top* of the *current* Changes section followed by a line linking to the relevant pull request:

```
- Added ``OpenSSL.crypto.some_func()`` to do something awesome.
  [`#1 <https://github.com/pyca/pyopenssl/pull/1>`_]
```

- Use semantic newlines in reStructuredText files (files ending in `.rst`).

Review

Finally, pull requests must be reviewed before merging. This process mirrors the cryptography code review process. Everyone can perform reviews; this is a very valuable way to contribute, and is highly encouraged.

Pull requests are merged by members of PyCA. They should, of course, keep all the requirements detailed in this document as well as the `pyca/cryptography` merge requirements in mind.

The final responsibility for the reviewing of merged code lies with the person merging it. Since pyOpenSSL is a sensitive project from a security perspective, reviewers are strongly encouraged to take this review and merge process very seriously.

Finding Help

If you need any help with the contribution process, you'll find us hanging out at `#cryptography-dev` on Freenode IRC. You can also ask questions on our mailing list.

Please note that this project is released with a Contributor Code of Conduct. By participating in this project you agree to abide by its terms.

Security

If you feel that you found a security-relevant bug that you would prefer to discuss in private, please send us a GPG-encrypted e-mail.

The maintainer can be reached at hs@ox.cx and his GPG key ID is `0xAE2536227F69F181` (Fingerprint: `C2A0 4F86 ACE2 8ADC F817 DBB7 AE25 3622 7F69 F181`). Feel free to cross-check this information with Keybase.

Installation

To install pyOpenSSL:

```
$ pip install pyopenssl
```

If you are installing in order to *develop* on pyOpenSSL, move to the root directory of a pyOpenSSL checkout, and run:

```
$ pip install -e .
```

Warning: As of 0.14, pyOpenSSL is a pure-Python project. That means that if you encounter *any* kind of compiler errors, pyOpenSSL's bugtracker is the **wrong** place to report them because we *cannot* help you.

Please take the time to read the errors and report them/ask help from the appropriate project. The most likely culprit being cryptography that contains OpenSSL's library bindings.

Supported OpenSSL Versions

pyOpenSSL supports the same platforms and releases as the upstream cryptography project does. Currently that means:

- 1.0.1
- 1.0.2
- 1.1.0

If you need support for older releases, the following pinned versions will work:

- **OpenSSL 0.9.8**: `'pyOpenSSL<17.0' 'cryptography<1.4'`
- **OpenSSL 1.0.0**: `'pyOpenSSL<17.1' 'cryptography<1.7'`

Documentation

The documentation is written in reStructuredText and built using Sphinx:

```
$ cd doc
$ make html
```

`OpenSSL` — Python interface to OpenSSL

This package provides a high-level interface to the functions in the OpenSSL library. The following modules are defined:

`crypto` — Generic cryptographic module

Elliptic curves

`OpenSSL.crypto.`**`get_elliptic_curves`**`()`

Return a set of objects representing the elliptic curves supported in the OpenSSL build in use.

The curve objects have a `unicode` `name` attribute by which they identify themselves.

The curve objects are useful as values for the argument accepted by `Context.set_tmp_ecdh()` to specify which elliptical curve should be used for ECDHE key exchange.

`OpenSSL.crypto.`**`get_elliptic_curve`**`(`*name*`)`

Return a single curve object selected by *name*.

See *`get_elliptic_curves()`* for information about curve objects.

If the named curve is not supported then `ValueError` is raised.

Serialization and deserialization

The following serialization functions take one of these constants to determine the format.

`OpenSSL.crypto.`**`FILETYPE_PEM`**

FILETYPE_PEM serializes data to a Base64-encoded encoded representation of the underlying ASN.1 data structure. This representation includes delimiters that define what data structure is contained within the Base64-encoded block: for example, for a certificate, the delimiters are `-----BEGIN CERTIFICATE-----` and `-----END CERTIFICATE-----`.

`OpenSSL.crypto.`**`FILETYPE_ASN1`**

FILETYPE_ASN1 serializes data to the underlying ASN.1 data structure. The format used by *FILETYPE_ASN1* is also sometimes referred to as DER.

Certificates

`OpenSSL.crypto.`**`dump_certificate`**(*type*, *cert*)

Dump the certificate *cert* into a buffer string encoded with the type *type*.

`OpenSSL.crypto.`**`load_certificate`**(*type*, *buffer*)

Load a certificate (X509) from the string *buffer* encoded with the type *type*.

Certificate signing requests

`OpenSSL.crypto.`**`dump_certificate_request`**(*type*, *req*)

Dump the certificate request *req* into a buffer string encoded with the type *type*.

`OpenSSL.crypto.`**`load_certificate_request`**(*type*, *buffer*)

Load a certificate request (X509Req) from the string *buffer* encoded with the type *type*.

Private keys

`OpenSSL.crypto.`**`dump_privatekey`**(*type*, *pkey*, *cipher=None*, *passphrase=None*)

Dump the private key *pkey* into a buffer string encoded with the type *type*. Optionally (if *type* is *FILETYPE_PEM*) encrypting it using *cipher* and *passphrase*.

Parameters

- **type** – The file type (one of *FILETYPE_PEM*, *FILETYPE_ASN1*, or `FILETYPE_TEXT`)
- **pkey** (`PKey`) – The PKey to dump
- **cipher** – (optional) if encrypted PEM format, the cipher to use
- **passphrase** – (optional) if encrypted PEM format, this can be either the passphrase to use, or a callback for providing the passphrase.

Returns The buffer with the dumped key in

Return type *bytes*

`OpenSSL.crypto.`**`load_privatekey`**(*type*, *buffer*[, *passphrase*])

Load a private key (PKey) from the string *buffer* encoded with the type *type* (must be one of *FILETYPE_PEM* and *FILETYPE_ASN1*).

passphrase must be either a string or a callback for providing the pass phrase.

Public keys

`OpenSSL.crypto.`**`dump_publickey`**`(`*type*, *pkey*`)`

Dump a public key to a buffer.

Parameters

- **`type`** – The file type (one of *`FILETYPE_PEM`* or *`FILETYPE_ASN1`*).
- **`pkey`** (`PKey`) – The public key to dump

Returns The buffer with the dumped key in it.

Return type *bytes*

`OpenSSL.crypto.`**`load_publickey`**`(`*type*, *buffer*`)`

Load a public key from a buffer.

Parameters

- **`type`** – The file type (one of *`FILETYPE_PEM`*, *`FILETYPE_ASN1`*).
- **`buffer`** (*`A Python string object, either unicode or bytestring.`*) – The buffer the key is stored in.

Returns The PKey object.

Return type *`PKey`*

Certificate revocation lists

`OpenSSL.crypto.`**`dump_crl`**`(`*type*, *crl*`)`

Dump a certificate revocation list to a buffer.

Parameters

- **`type`** – The file type (one of `FILETYPE_PEM`, `FILETYPE_ASN1`, or `FILETYPE_TEXT`).
- **`crl`** (`CRL`) – The CRL to dump.

Returns The buffer with the CRL.

Return type *bytes*

`OpenSSL.crypto.`**`load_crl`**`(`*type*, *buffer*`)`

Load Certificate Revocation List (CRL) data from a string *buffer*. *buffer* encoded with the type *type*. The type *type* must either *`FILETYPE_PEM`* or *`FILETYPE_ASN1`*).

`OpenSSL.crypto.`**`load_pkcs7_data`**`(`*type*, *buffer*`)`

Load pkcs7 data from the string *buffer* encoded with the type *type*. The type *type* must either *`FILETYPE_PEM`* or *`FILETYPE_ASN1`*).

`OpenSSL.crypto.`**`load_pkcs12`**`(`*buffer*[, *passphrase*]`)`

Load pkcs12 data from the string *buffer*. If the pkcs12 structure is encrypted, a *passphrase* must be included. The MAC is always checked and thus required.

See also the man page for the C function `PKCS12_parse()`.

Signing and verifying signatures

`OpenSSL.crypto.`**`sign`**`(`*key*, *data*, *digest*`)`

Sign a data string using the given key and message digest.

key is a `PKey` instance. *data* is a `str` instance. *digest* is a `str` naming a supported message digest type, for example `b"sha256"`.

New in version 0.11.

`OpenSSL.crypto.`**`verify`**`(`*certificate*, *signature*, *data*, *digest*`)`

Verify the signature for a data string.

certificate is a `X509` instance corresponding to the private key which generated the signature. *signature* is a *str* instance giving the signature itself. *data* is a *str* instance giving the data to which the signature applies. *digest* is a *str* instance naming the message digest type of the signature, for example `b"sha256"`.

New in version 0.11.

X509 objects

class `OpenSSL.crypto.`**`X509`**

An X.509 certificate.

`add_extensions``(`*extensions*`)`

Add extensions to the certificate.

Parameters **`extensions`** (An iterable of `X509Extension` objects.) – The extensions to add.

Returns `None`

`digest``(`*digest_name*`)`

Return the digest of the X509 object.

Parameters **`digest_name`** (`bytes`) – The name of the digest algorithm to use.

Returns The digest of the object, formatted as `b":"`-delimited hex pairs.

Return type `bytes`

`get_extension``(`*index*`)`

Get a specific extension of the certificate by index.

Extensions on a certificate are kept in order. The index parameter selects which extension will be returned.

Parameters **`index`** (`int`) – The index of the extension to retrieve.

Returns The extension at the specified index.

Return type `X509Extension`

Raises **`IndexError`** – If the extension index was out of bounds.

New in version 0.12.

`get_extension_count``()`

Get the number of extensions on this certificate.

Returns The number of extensions.

Return type `int`

New in version 0.12.

get_issuer()

Return the issuer of this certificate.

This creates a new `X509Name` that wraps the underlying issuer name field on the certificate. Modifying it will modify the underlying certificate, and will have the effect of modifying any other `X509Name` that refers to this issuer.

Returns The issuer of this certificate.

Return type `X509Name`

get_notAfter()

Get the timestamp at which the certificate stops being valid.

The timestamp is formatted as an ASN.1 GENERALIZEDTIME:

```
YYYYMMDDhhmmssZ
YYYYMMDDhhmmss+hhmm
YYYYMMDDhhmmss-hhmm
```

Returns A timestamp string, or `None` if there is none.

Return type *bytes* or NoneType

get_notBefore()

Get the timestamp at which the certificate starts being valid.

The timestamp is formatted as an ASN.1 GENERALIZEDTIME:

```
YYYYMMDDhhmmssZ
YYYYMMDDhhmmss+hhmm
YYYYMMDDhhmmss-hhmm
```

Returns A timestamp string, or `None` if there is none.

Return type *bytes* or NoneType

get_pubkey()

Get the public key of the certificate.

Returns The public key.

Return type `PKey`

get_serial_number()

Return the serial number of this certificate.

Returns The serial number.

Return type int

get_signature_algorithm()

Return the signature algorithm used in the certificate.

Returns The name of the algorithm.

Return type `bytes`

Raises **`ValueError`** – If the signature algorithm is undefined.

New in version 0.13.

get_subject()

Return the subject of this certificate.

This creates a new *X509Name* that wraps the underlying subject name field on the certificate. Modifying it will modify the underlying certificate, and will have the effect of modifying any other *X509Name* that refers to this subject.

Returns The subject of this certificate.

Return type *X509Name*

get_version()

Return the version number of the certificate.

Returns The version number of the certificate.

Return type `int`

gmtime_adj_notAfter(*amount*)

Adjust the time stamp on which the certificate stops being valid.

Parameters **amount** (*int*) – The number of seconds by which to adjust the timestamp.

Returns `None`

gmtime_adj_notBefore(*amount*)

Adjust the timestamp on which the certificate starts being valid.

Parameters **amount** – The number of seconds by which to adjust the timestamp.

Returns `None`

has_expired()

Check whether the certificate has expired.

Returns `True` if the certificate has expired, `False` otherwise.

Return type bool

set_issuer(*issuer*)

Set the issuer of this certificate.

Parameters **issuer** (*X509Name*) – The issuer.

Returns `None`

set_notAfter(*when*)

Set the timestamp at which the certificate stops being valid.

The timestamp is formatted as an ASN.1 GENERALIZEDTIME:

```
YYYYMMDDhhmmssZ
YYYYMMDDhhmmss+hhmm
YYYYMMDDhhmmss-hhmm
```

Parameters **when** (`bytes`) – A timestamp string.

Returns `None`

set_notBefore(*when*)

Set the timestamp at which the certificate starts being valid.

The timestamp is formatted as an ASN.1 GENERALIZEDTIME:

```
YYYYMMDDhhmmssZ
YYYYMMDDhhmmss+hhmm
YYYYMMDDhhmmss-hhmm
```

Parameters **when** (bytes) – A timestamp string.

Returns None

set_pubkey (*pkey*)

Set the public key of the certificate.

Parameters **pkey** (*PKey*) – The public key.

Returns None

set_serial_number (*serial*)

Set the serial number of the certificate.

Parameters **serial** (int) – The new serial number.

Returns :py:data'None'

set_subject (*subject*)

Set the subject of this certificate.

Parameters **subject** (*X509Name*) – The subject.

Returns None

set_version (*version*)

Set the version number of the certificate.

Parameters **version** (int) – The version number of the certificate.

Returns None

sign (*pkey*, *digest*)

Sign the certificate with this key and digest type.

Parameters

- **pkey** (*PKey*) – The key to sign with.
- **digest** (bytes) – The name of the message digest to use.

Returns None

subject_name_hash ()

Return the hash of the X509 subject.

Returns The hash of the subject.

Return type bytes

X509Name objects

class OpenSSL.crypto.**X509Name** (*name*)

An X.509 Distinguished Name.

Variables

- **countryName** – The country of the entity.
- **C** – Alias for countryName.

- **stateOrProvinceName** – The state or province of the entity.
- **ST** – Alias for `stateOrProvinceName`.
- **localityName** – The locality of the entity.
- **L** – Alias for `localityName`.
- **organizationName** – The organization name of the entity.
- **O** – Alias for `organizationName`.
- **organizationalUnitName** – The organizational unit of the entity.
- **OU** – Alias for `organizationalUnitName`
- **commonName** – The common name of the entity.
- **CN** – Alias for `commonName`.
- **emailAddress** – The e-mail address of the entity.

__init__(*name*)

Create a new X509Name, copying the given X509Name instance.

Parameters **name** (*X509Name*) – The name to copy.

der()

Return the DER encoding of this name.

Returns The DER encoded form of this name.

Return type `bytes`

get_components()

Returns the components of this name, as a sequence of 2-tuples.

Returns The components of this name.

Return type `list` of `name, value` tuples.

hash()

Return an integer representation of the first four bytes of the MD5 digest of the DER representation of the name.

This is the Python equivalent of OpenSSL's `X509_NAME_hash`.

Returns The (integer) hash of this name.

Return type `int`

X509Req objects

class OpenSSL.crypto.**X509Req**

An X.509 certificate signing requests.

add_extensions(*extensions*)

Add extensions to the certificate signing request.

Parameters **extensions** (iterable of *X509Extension*) – The X.509 extensions to add.

Returns `None`

get_extensions()

Get X.509 extensions in the certificate signing request.

Returns The X.509 extensions in this request.

Return type `list` of *`X509Extension`* objects.

New in version 0.15.

`get_pubkey`()

Get the public key of the certificate signing request.

Returns The public key.

Return type *`PKey`*

`get_subject`()

Return the subject of this certificate signing request.

This creates a new *`X509Name`* that wraps the underlying subject name field on the certificate signing request. Modifying it will modify the underlying signing request, and will have the effect of modifying any other *`X509Name`* that refers to this subject.

Returns The subject of this certificate signing request.

Return type *`X509Name`*

`get_version`()

Get the version subfield (RFC 2459, section 4.1.2.1) of the certificate request.

Returns The value of the version subfield.

Return type `int`

`set_pubkey`(*pkey*)

Set the public key of the certificate signing request.

Parameters **`pkey`** (*`PKey`*) – The public key to use.

Returns `None`

`set_version`(*version*)

Set the version subfield (RFC 2459, section 4.1.2.1) of the certificate request.

Parameters **`version`** (*`int`*) – The version number.

Returns `None`

`sign`(*pkey*, *digest*)

Sign the certificate signing request with this key and digest type.

Parameters

- **`pkey`** (*`PKey`*) – The key pair to sign with.
- **`digest`** (`bytes`) – The name of the message digest to use for the signature, e.g. `b"sha256"`.

Returns `None`

`verify`(*pkey*)

Verifies the signature on this certificate signing request.

Parameters **`key`** (`PKey`) – A public key.

Returns `True` if the signature is correct.

Return type bool

Raises ***`OpenSSL.crypto.Error`*** – If the signature is invalid or there is a problem verifying the signature.

X509Store objects

class `OpenSSL.crypto.`**`X509Store`**

An X.509 store.

An X.509 store is used to describe a context in which to verify a certificate. A description of a context may include a set of certificates to trust, a set of certificate revocation lists, verification flags and more.

An X.509 store, being only a description, cannot be used by itself to verify a certificate. To carry out the actual verification process, see `X509StoreContext`.

`add_cert`(*cert*)

Adds a trusted certificate to this store.

Adding a certificate with this method adds this certificate as a *trusted* certificate.

Parameters **`cert`** (`X509`) – The certificate to add to this store.

Raises

- **`TypeError`** – If the certificate is not an `X509`.
- **`OpenSSL.crypto.Error`** – If OpenSSL was unhappy with your certificate.

Returns `None` if the certificate was added successfully.

`add_crl`(*crl*)

Add a certificate revocation list to this store.

The certificate revocation lists added to a store will only be used if the associated flags are configured to check certificate revocation lists.

New in version 16.1.0.

Parameters **`crl`** (`CRL`) – The certificate revocation list to add to this store.

Returns `None` if the certificate revocation list was added successfully.

`set_flags`(*flags*)

Set verification flags to this store.

Verification flags can be combined by oring them together.

Note: Setting a verification flag sometimes requires clients to add additional information to the store, otherwise a suitable error will be raised.

For example, in setting flags to enable CRL checking a suitable CRL must be added to the store otherwise an error will be raised.

New in version 16.1.0.

Parameters **`flags`** (`int`) – The verification flags to set on this store. See `X509StoreFlags` for available constants.

Returns `None` if the verification flags were successfully set.

`set_time`(*vfy_time*)

Set the time against which the certificates are verified.

Normally the current time is used.

Note: For example, you can determine if a certificate was valid at a given time.

New in version 17.0.0.

Parameters **vfy_time** (*datetime*) – The verification time to set on this store.

Returns None if the verification time was successfully set.

X509StoreContextError objects

class OpenSSL.crypto.**X509StoreContextError**(*message*, *certificate*)

An exception raised when an error occurred while verifying a certificate using *OpenSSL.X509StoreContext.verify_certificate*.

Variables **certificate** – The certificate which caused verificate failure.

X509StoreContext objects

class OpenSSL.crypto.**X509StoreContext**(*store*, *certificate*)

An X.509 store context.

An X.509 store context is used to carry out the actual verification process of a certificate in a described context. For describing such a context, see *X509Store*.

Variables

- **_store_ctx** – The underlying X509_STORE_CTX structure used by this instance. It is dynamically allocated and automatically garbage collected.
- **_store** – See the store __init__ parameter.
- **_cert** – See the certificate __init__ parameter.

Parameters

- **store** (X509Store) – The certificates which will be trusted for the purposes of any verifications.
- **certificate** (X509) – The certificate to be verified.

set_store(*store*)

Set the context's X.509 store.

New in version 0.15.

Parameters **store** (X509Store) – The store description which will be used for the purposes of any *future* verifications.

verify_certificate()

Verify a certificate in a context.

New in version 0.15.

Raises ***X509StoreContextError*** – If an error occurred when validating a certificate in the context. Sets certificate attribute to indicate which certificate caused the error.

X509StoreFlags constants

class OpenSSL.crypto.**X509StoreFlags**

Flags for X509 verification, used to change the behavior of *X509Store*.

See OpenSSL Verification Flags for details.

`CRL_CHECK`

`CRL_CHECK_ALL`

`IGNORE_CRITICAL`

`X509_STRICT`

`ALLOW_PROXY_CERTS`

`POLICY_CHECK`

`EXPLICIT_POLICY`

`INHIBIT_MAP`

`NOTIFY_POLICY`

`CHECK_SS_SIGNATURE`

`CB_ISSUER_CHECK`

PKey objects

class `OpenSSL.crypto.`**`PKey`**

A class representing an DSA or RSA public key or key pair.

`bits``()`

Returns the number of bits of the key

Returns The number of bits of the key.

`check``()`

Check the consistency of an RSA private key.

This is the Python equivalent of OpenSSL's `RSA_check_key`.

Returns `True` if key is consistent.

Raises

- ***`OpenSSL.crypto.Error`*** – if the key is inconsistent.
- **`TypeError`** – if the key is of a type which cannot be checked. Only RSA keys can currently be checked.

classmethod **`from_cryptography_key`**`(`*crypto_key*`)`

Construct based on a `cryptography` *crypto_key*.

Parameters **`crypto_key`** (One of `cryptography`'s key interfaces.) – A `cryptography` key.

Return type *PKey*

New in version 16.1.0.

`generate_key``(`*type*, *bits*`)`

Generate a key pair of the given type, with the given number of bits.

This generates a key "into" the this object.

Parameters

- **`type`** (*`TYPE_RSA`* or *`TYPE_DSA`*) – The key type.
- **`bits`** (`int >= 0`) – The number of bits.

Raises

- `TypeError` – If *type* or *bits* isn't of the appropriate type.
- `ValueError` – If the number of bits isn't an integer of the appropriate size.

Returns None

to_cryptography_key()

Export as a `cryptography` key.

Return type One of `cryptography`'s key interfaces.

New in version 16.1.0.

type()

Returns the type of the key

Returns The type of the key.

OpenSSL.crypto.**TYPE_RSA**

OpenSSL.crypto.**TYPE_DSA**

Key type constants.

PKCS7 objects

PKCS7 objects have the following methods:

PKCS7.**type_is_signed**()

FIXME

PKCS7.**type_is_enveloped**()

FIXME

PKCS7.**type_is_signedAndEnveloped**()

FIXME

PKCS7.**type_is_data**()

FIXME

PKCS7.**get_type_name**()

Get the type name of the PKCS7.

PKCS12 objects

class OpenSSL.crypto.**PKCS12**

A PKCS #12 archive.

export(*passphrase=None*, *iter=2048*, *maciter=1*)

Dump a PKCS12 object as a string.

For more information, see the `PKCS12_create()` man page.

Parameters

- **passphrase** (bytes) – The passphrase used to encrypt the structure. Unlike some other passphrase arguments, this *must* be a string, not a callback.
- **iter** (int) – Number of times to repeat the encryption step.
- **maciter** (int) – Number of times to repeat the MAC step.

Returns The string representation of the PKCS #12 structure.

Return type

get_ca_certificates()

Get the CA certificates in the PKCS #12 structure.

Returns A tuple with the CA certificates in the chain, or `None` if there are none.

Return type `tuple` of *X509* or `None`

get_certificate()

Get the certificate in the PKCS #12 structure.

Returns The certificate, or `None` if there is none.

Return type *X509* or `None`

get_friendlyname()

Get the friendly name in the PKCS# 12 structure.

Returns The friendly name, or `None` if there is none.

Return type `bytes` or `None`

get_privatekey()

Get the private key in the PKCS #12 structure.

Returns The private key, or `None` if there is none.

Return type *PKey*

set_ca_certificates(*cacerts*)

Replace or set the CA certificates within the PKCS12 object.

Parameters **cacerts** (An iterable of *X509* or `None`) – The new CA certificates, or `None` to unset them.

Returns `None`

set_certificate(*cert*)

Set the certificate in the PKCS #12 structure.

Parameters **cert** (*X509* or `None`) – The new certificate, or `None` to unset it.

Returns `None`

set_friendlyname(*name*)

Set the friendly name in the PKCS #12 structure.

Parameters **name** (`bytes` or `None`) – The new friendly name, or `None` to unset.

Returns `None`

set_privatekey(*pkey*)

Set the certificate portion of the PKCS #12 structure.

Parameters **pkey** (*PKey* or `None`) – The new private key, or `None` to unset it.

Returns `None`

X509Extension objects

class OpenSSL.crypto.**X509Extension**(*type_name*, *critical*, *value*, *subject=None*, *issuer=None*)

An X.509 v3 certificate extension.

__init__(*type_name*, *critical*, *value*, *subject=None*, *issuer=None*)

Initializes an X509 extension.

Parameters

- **type_name** (bytes) – The name of the type of extension to create.
- **critical** (*bool*) – A flag indicating whether this is a critical extension.
- **value** (bytes) – The value of the extension.
- **subject** (*X509*) – Optional X509 certificate to use as subject.
- **issuer** (*X509*) – Optional X509 certificate to use as issuer.

__str__()

Returns a nice text representation of the extension

get_critical()

Returns the critical field of this X.509 extension.

Returns The critical field.

get_data()

Returns the data of the X509 extension, encoded as ASN.1.

Returns The ASN.1 encoded data of this X509 extension.

Return type bytes

New in version 0.12.

get_short_name()

Returns the short type name of this X.509 extension.

The result is a byte string such as `b"basicConstraints"`.

Returns The short type name.

Return type bytes

New in version 0.12.

NetscapeSPKI objects

class OpenSSL.crypto.**NetscapeSPKI**

A Netscape SPKI object.

b64_encode()

Generate a base64 encoded representation of this SPKI object.

Returns The base64 encoded string.

Return type bytes

get_pubkey()

Get the public key of this certificate.

Returns The public key.

Return type *PKey*

set_pubkey(*pkey*)

Set the public key of the certificate

Parameters **pkey** – The public key

Returns None

sign(*pkey*, *digest*)
Sign the certificate request with this key and digest type.

Parameters

- **pkey** (`PKey`) – The private key to sign with.
- **digest** (`bytes`) – The message digest to use.

Returns `None`

verify(*key*)
Verifies a signature on a certificate request.

Parameters **key** (`PKey`) – The public key that signature is supposedly from.

Returns `True` if the signature is correct.

Return type bool

Raises **`OpenSSL.crypto.Error`** – If the signature is invalid, or there was a problem verifying the signature.

CRL objects

class `OpenSSL.crypto.`**CRL**
A certificate revocation list.

add_revoked(*revoked*)
Add a revoked (by value not reference) to the CRL structure

This revocation will be added by value, not by reference. That means it's okay to mutate it after adding: it won't affect this CRL.

Parameters **revoked** (`Revoked`) – The new revocation.

Returns `None`

export(*cert*, *key*, *type=1*, *days=100*, *digest=<object object>*)
Export the CRL as a string.

Parameters

- **cert** (`X509`) – The certificate used to sign the CRL.
- **key** (`PKey`) – The key used to sign the CRL.
- **type** (*`int`*) – The export format, either *`FILETYPE_PEM`*, *`FILETYPE_ASN1`*, or `FILETYPE_TEXT`.
- **days** (*`int`*) – The number of days until the next update of this CRL.
- **digest** (`bytes`) – The name of the message digest to use (eg `b"sha2566"`).

Return type *bytes*

get_issuer()
Get the CRL's issuer.

New in version 16.1.0.

Return type *X509Name*

get_revoked()

Return the revocations in this certificate revocation list.

These revocations will be provided by value, not by reference. That means it's okay to mutate them: it won't affect this CRL.

Returns The revocations in this CRL.

Return type `tuple` of `Revocation`

set_lastUpdate(*when*)

Set when the CRL was last updated.

The timestamp is formatted as an ASN.1 GENERALIZEDTIME:

```
YYYYMMDDhhmmssZ
YYYYMMDDhhmmss+hhmm
YYYYMMDDhhmmss-hhmm
```

New in version 16.1.0.

Parameters **when** (`bytes`) – A timestamp string.

Returns `None`

set_nextUpdate(*when*)

Set when the CRL will next be udpated.

The timestamp is formatted as an ASN.1 GENERALIZEDTIME:

```
YYYYMMDDhhmmssZ
YYYYMMDDhhmmss+hhmm
YYYYMMDDhhmmss-hhmm
```

New in version 16.1.0.

Parameters **when** (`bytes`) – A timestamp string.

Returns `None`

set_version(*version*)

Set the CRL version.

New in version 16.1.0.

Parameters **version** (*`int`*) – The version of the CRL.

Returns `None`

sign(*issuer_cert*, *issuer_key*, *digest*)

Sign the CRL.

Signing a CRL enables clients to associate the CRL itself with an issuer. Before a CRL is meaningful to other OpenSSL functions, it must be signed by an issuer.

This method implicitly sets the issuer's name based on the issuer certificate and private key used to sign the CRL.

New in version 16.1.0.

Parameters

- **issuer_cert** (`X509`) – The issuer's certificate.
- **issuer_key** (`PKey`) – The issuer's private key.

- **digest** (bytes) – The digest method to sign the CRL with.

Revoked objects

class `OpenSSL.crypto.`**`Revoked`**

A certificate revocation.

`all_reasons``()`

Return a list of all the supported reason strings.

This list is a copy; modifying it does not change the supported reason strings.

Returns A list of reason strings.

Return type `list` of `bytes`

`get_reason``()`

Get the reason of this revocation.

Returns The reason, or `None` if there is none.

Return type *bytes* or NoneType

See also:

`all_reasons()`, which gives you a list of all supported reasons this method might return.

`get_rev_date``()`

Get the revocation timestamp.

Returns The timestamp of the revocation, as ASN.1 GENERALIZEDTIME.

Return type *bytes*

`get_serial``()`

Get the serial number.

The serial number is formatted as a hexadecimal number encoded in ASCII.

Returns The serial number.

Return type *bytes*

`set_reason``(`*reason*`)`

Set the reason of this revocation.

If `reason` is `None`, delete the reason instead.

Parameters **reason** (`bytes` or `NoneType`) – The reason string.

Returns `None`

See also:

`all_reasons()`, which gives you a list of all supported reasons which you might pass to this method.

`set_rev_date``(`*when*`)`

Set the revocation timestamp.

Parameters **when** (`bytes`) – The timestamp of the revocation, as ASN.1 GENERALIZEDTIME.

Returns `None`

set_serial(*hex_str*)

Set the serial number.

The serial number is formatted as a hexadecimal number encoded in ASCII.

Parameters **hex_str** (bytes) – The new serial number.

Returns None

Exceptions

exception OpenSSL.crypto.**Error**

Generic exception used in the *crypto* module.

Digest names

Several of the functions and methods in this module take a digest name. These must be strings describing a digest algorithm supported by OpenSSL (by EVP_get_digestbyname, specifically). For example, b"sha256" or b"sha384".

More information and a list of these digest names can be found in the EVP_DigestInit(3) man page of your OpenSSL installation. This page can be found online for the latest version of OpenSSL: https://www.openssl.org/docs/manmaster/man3/EVP_DigestInit.html

Backwards compatible type names

When pyOpenSSL was originally written, the most current version of Python was 2.1. It made a distinction between classes and types. None of the versions of Python currently supported by pyOpenSSL still enforce that distinction: the type of an instance of an *X509* object is now simply *X509*. Originally, the type would have been X509Type. These days, X509Type and *X509* are literally the same object. pyOpenSSL maintains these old names for backwards compatibility.

Here's a table of these backwards-compatible names:

Type name	Backwards-compatible name
X509	X509Type
X509Name	X509NameType
X509Req	X509ReqType
X509Store	X509StoreType
X509Extension	X509ExtensionType
PKey	PKeyType
PKCS7	PKCS7Type
PKCS12	PKCS12Type
NetscapeSPKI	NetscapeSPKIType
CRL	CRLType

Some objects, such as *Revoked*, don't have Type equivalents, because they were added after the restriction had been lifted.

`rand` — An interface to the OpenSSL pseudo random number generator

> **Warning:** Functions from this module shouldn't be used. Use urandom instead.

This module handles the OpenSSL pseudo random number generator (PRNG) and declares the following:

`OpenSSL.rand.`**`add`**`(`*buffer*, *entropy*`)`

Mix bytes from *string* into the PRNG state.

The *entropy* argument is (the lower bound of) an estimate of how much randomness is contained in *string*, measured in bytes.

For more information, see e.g. **RFC 1750**.

Parameters

- **`buffer`** – Buffer with random data.
- **`entropy`** – The entropy (in bytes) measurement of the buffer.

Returns `None`

`OpenSSL.rand.`**`bytes`**`(`*num_bytes*`)`

Get some random bytes from the PRNG as a string.

This is a wrapper for the C function `RAND_bytes`.

Parameters **`num_bytes`** – The number of bytes to fetch.

Returns A string of random bytes.

`OpenSSL.rand.`**`cleanup`**`()`

Erase the memory used by the PRNG.

This is a wrapper for the C function `RAND_cleanup`.

Returns `None`

`OpenSSL.rand.`**`egd`**`(`*path*[, *bytes*]`)`

Query the system random source and seed the PRNG.

Does *not* actually query the EGD.

Deprecated since version 16.0.0: EGD was only necessary for some commercial UNIX systems that all reached their ends of life more than a decade ago. See pyca/cryptography#1636.

Parameters

- **`path`** – Ignored.
- **`bytes`** – (optional) The number of bytes to read, default is 255.

Returns `len(bytes)` or 255 if not specified.

`OpenSSL.rand.`**`load_file`**`(`*filename*[, *bytes*]`)`

Read *maxbytes* of data from *filename* and seed the PRNG with it.

Read the whole file if *maxbytes* is not specified or negative.

Parameters

- **`filename`** – The file to read data from (`bytes` or `unicode`).
- **`maxbytes`** – (optional) The number of bytes to read. Default is to read the entire file.

Returns The number of bytes read

`OpenSSL.rand.`**`seed`**`(`*buffer*`)`

Equivalent to calling `add()` with *entropy* as the length of *buffer*.

Parameters **`buffer`** – Buffer with random data

Returns `None`

`OpenSSL.rand.`**`status`**`()`

Check whether the PRNG has been seeded with enough data.

Returns 1 if the PRNG is seeded enough, 0 otherwise.

`OpenSSL.rand.`**`write_file`**`(`*filename*`)`

Write a number of random bytes (currently 1024) to the file *path*. This file can then be used with `load_file()` to seed the PRNG again.

Parameters **`filename`** – The file to write data to (`bytes` or `unicode`).

Returns The number of bytes written.

`OpenSSL.rand.`**`screen`**`()`

Add the current contents of the screen to the PRNG state.

Availability: Windows.

Returns `None`

exception `OpenSSL.rand.`**`Error`**

An error occurred in an `OpenSSL.rand` API.

If the current RAND method supports any errors, this is raised when needed. The default method does not raise this when the entropy pool is depleted.

Whenever this exception is raised directly, it has a list of error messages from the OpenSSL error queue, where each item is a tuple *(lib, function, reason)*. Here *lib*, *function* and *reason* are all strings, describing where and what the problem is.

See `err(3)` for more information.

`SSL` — An interface to the SSL-specific parts of OpenSSL

This module handles things specific to SSL. There are two objects defined: Context, Connection.

`OpenSSL.SSL.`**`SSLv2_METHOD`**
`OpenSSL.SSL.`**`SSLv3_METHOD`**
`OpenSSL.SSL.`**`SSLv23_METHOD`**
`OpenSSL.SSL.`**`TLSv1_METHOD`**
`OpenSSL.SSL.`**`TLSv1_1_METHOD`**
`OpenSSL.SSL.`**`TLSv1_2_METHOD`**

These constants represent the different SSL methods to use when creating a context object. If the underlying OpenSSL build is missing support for any of these protocols, constructing a `Context` using the corresponding `*_METHOD` will raise an exception.

`OpenSSL.SSL.`**`VERIFY_NONE`**
`OpenSSL.SSL.`**`VERIFY_PEER`**
`OpenSSL.SSL.`**`VERIFY_FAIL_IF_NO_PEER_CERT`**

These constants represent the verification mode used by the Context object's `set_verify()` method.

`OpenSSL.SSL.`**`FILETYPE_PEM`**

OpenSSL.SSL.**FILETYPE_ASN1**

File type constants used with the `use_certificate_file()` and `use_privatekey_file()` methods of Context objects.

OpenSSL.SSL.**OP_SINGLE_DH_USE**
OpenSSL.SSL.**OP_SINGLE_ECDH_USE**

Constants used with `set_options()` of Context objects.

When these options are used, a new key will always be created when using ephemeral (Elliptic curve) Diffie-Hellman.

OpenSSL.SSL.**OP_EPHEMERAL_RSA**

Constant used with `set_options()` of Context objects.

When this option is used, ephemeral RSA keys will always be used when doing RSA operations.

OpenSSL.SSL.**OP_NO_TICKET**

Constant used with `set_options()` of Context objects.

When this option is used, the session ticket extension will not be used.

OpenSSL.SSL.**OP_NO_COMPRESSION**

Constant used with `set_options()` of Context objects.

When this option is used, compression will not be used.

OpenSSL.SSL.**OP_NO_SSLv2**
OpenSSL.SSL.**OP_NO_SSLv3**
OpenSSL.SSL.**OP_NO_TLSv1**
OpenSSL.SSL.**OP_NO_TLSv1_1**
OpenSSL.SSL.**OP_NO_TLSv1_2**

Constants used with `set_options()` of Context objects.

Each of these options disables one version of the SSL/TLS protocol. This is interesting if you're using e.g. *SSLv23_METHOD* to get an SSLv2-compatible handshake, but don't want to use SSLv2. If the underlying OpenSSL build is missing support for any of these protocols, the `OP_NO_*` constant may be undefined.

OpenSSL.SSL.**SSLEAY_VERSION**
OpenSSL.SSL.**SSLEAY_CFLAGS**
OpenSSL.SSL.**SSLEAY_BUILT_ON**
OpenSSL.SSL.**SSLEAY_PLATFORM**
OpenSSL.SSL.**SSLEAY_DIR**

Constants used with *SSLeay_version()* to specify what OpenSSL version information to retrieve. See the man page for the *SSLeay_version()* C API for details.

OpenSSL.SSL.**SESS_CACHE_OFF**
OpenSSL.SSL.**SESS_CACHE_CLIENT**
OpenSSL.SSL.**SESS_CACHE_SERVER**
OpenSSL.SSL.**SESS_CACHE_BOTH**
OpenSSL.SSL.**SESS_CACHE_NO_AUTO_CLEAR**
OpenSSL.SSL.**SESS_CACHE_NO_INTERNAL_LOOKUP**
OpenSSL.SSL.**SESS_CACHE_NO_INTERNAL_STORE**
OpenSSL.SSL.**SESS_CACHE_NO_INTERNAL**

Constants used with *Context.set_session_cache_mode()* to specify the behavior of the session cache and potential session reuse. See the man page for the `SSL_CTX_set_session_cache_mode()` C API for details.

New in version 0.14.

OpenSSL.SSL.**OPENSSL_VERSION_NUMBER**

An integer giving the version number of the OpenSSL library used to build this version of pyOpenSSL. See the man page for the *SSLeay_version()* C API for details.

OpenSSL.SSL.**SSLeay_version**(*type*)
Retrieve a string describing some aspect of the underlying OpenSSL version. The type passed in should be one of the `SSLEAY_*` constants defined in this module.

OpenSSL.SSL.**ContextType**
See *Context*.

class OpenSSL.SSL.**Context**(*method*)
A class representing SSL contexts. Contexts define the parameters of one or more SSL connections.

method should be *SSLv2_METHOD*, *SSLv3_METHOD*, *SSLv23_METHOD*, *TLSv1_METHOD*, *TLSv1_1_METHOD*, or *TLSv1_2_METHOD*.

class OpenSSL.SSL.**Session**
A class representing an SSL session. A session defines certain connection parameters which may be re-used to speed up the setup of subsequent connections.

New in version 0.14.

OpenSSL.SSL.**ConnectionType**
See *Connection*.

class OpenSSL.SSL.**Connection**(*context*, *socket*)
A class representing SSL connections.

context should be an instance of *Context* and *socket* should be a socket[1] object. *socket* may be *None*; in this case, the Connection is created with a memory BIO: see the *bio_read()*, *bio_write()*, and *bio_shutdown()* methods.

exception OpenSSL.SSL.**Error**
This exception is used as a base class for the other SSL-related exceptions, but may also be raised directly.

Whenever this exception is raised directly, it has a list of error messages from the OpenSSL error queue, where each item is a tuple *(lib, function, reason)*. Here *lib*, *function* and *reason* are all strings, describing where and what the problem is. See *err(3)* for more information.

exception OpenSSL.SSL.**ZeroReturnError**
This exception matches the error return code `SSL_ERROR_ZERO_RETURN`, and is raised when the SSL Connection has been closed. In SSL 3.0 and TLS 1.0, this only occurs if a closure alert has occurred in the protocol, i.e. the connection has been closed cleanly. Note that this does not necessarily mean that the transport layer (e.g. a socket) has been closed.

It may seem a little strange that this is an exception, but it does match an `SSL_ERROR` code, and is very convenient.

exception OpenSSL.SSL.**WantReadError**
The operation did not complete; the same I/O method should be called again later, with the same arguments. Any I/O method can lead to this since new handshakes can occur at any time.

The wanted read is for **dirty** data sent over the network, not the **clean** data inside the tunnel. For a socket based SSL connection, **read** means data coming at us over the network. Until that read succeeds, the attempted *OpenSSL.SSL.Connection.recv()*, *OpenSSL.SSL.Connection.send()*, or *OpenSSL.SSL.Connection.do_handshake()* is prevented or incomplete. You probably want to `select()` on the socket before trying again.

exception OpenSSL.SSL.**WantWriteError**
See *WantReadError*. The socket send buffer may be too full to write more data.

[1] Actually, all that is required is an object that **behaves** like a socket, you could even use files, even though it'd be tricky to get the handshakes right!

exception `OpenSSL.SSL.`**`WantX509LookupError`**

The operation did not complete because an application callback has asked to be called again. The I/O method should be called again later, with the same arguments.

> **Note:** This won't occur in this version, as there are no such callbacks in this version.

exception `OpenSSL.SSL.`**`SysCallError`**

The *`SysCallError`* occurs when there's an I/O error and OpenSSL's error queue does not contain any information. This can mean two things: An error in the transport protocol, or an end of file that violates the protocol. The parameter to the exception is always a pair *(errnum, errstr)*.

Context objects

Context objects have the following methods:

`Context.`**`check_privatekey`**`()`

Check if the private key (loaded with *`use_privatekey()`*) matches the certificate (loaded with *`use_certificate()`*). Returns `None` if they match, raises *`Error`* otherwise.

`Context.`**`get_app_data`**`()`

Retrieve application data as set by *`set_app_data()`*.

`Context.`**`get_cert_store`**`()`

Retrieve the certificate store (a X509Store object) that the context uses. This can be used to add "trusted" certificates without using the *`load_verify_locations()`* method.

`Context.`**`get_timeout`**`()`

Retrieve session timeout, as set by *`set_timeout()`*. The default is 300 seconds.

`Context.`**`get_verify_depth`**`()`

Retrieve the Context object's verify depth, as set by *`set_verify_depth()`*.

`Context.`**`get_verify_mode`**`()`

Retrieve the Context object's verify mode, as set by *`set_verify()`*.

`Context.`**`load_client_ca`**`(`*cafile*`)`

Load the trusted certificates that will be sent to the client. Does not actually imply any of the certificates are trusted; that must be configured separately.

Parameters **`cafile`** (`bytes`) – The path to a certificates file in PEM format.

Returns None

`Context.`**`set_client_ca_list`**`(`*certificate_authorities*`)`

Replace the current list of preferred certificate signers that would be sent to the client when requesting a client certificate with the *certificate_authorities* sequence of *`OpenSSL.crypto.X509Name`*'s.

New in version 0.10.

`Context.`**`add_client_ca`**`(`*certificate_authority*`)`

Extract a *`OpenSSL.crypto.X509Name`* from the *certificate_authority* *`OpenSSL.crypto.X509`* certificate and add it to the list of preferred certificate signers sent to the client when requesting a client certificate.

New in version 0.10.

`Context.`**`load_verify_locations`**`(`*pemfile*, *capath*`)`

Specify where CA certificates for verification purposes are located. These are trusted certificates. Note that the certificates have to be in PEM format. If capath is passed, it must be a directory prepared using the `c_rehash` tool included with OpenSSL. Either, but not both, of *pemfile* or *capath* may be `None`.

`Context.`**`set_default_verify_paths`**`()`

Specify that the platform provided CA certificates are to be used for verification purposes. This method may not work properly on OS X.

`Context.`**`load_tmp_dh`**`(`*dhfile*`)`

Load parameters for Ephemeral Diffie-Hellman from *dhfile*.

`Context.`**`set_tmp_ecdh`**`(`*curve*`)`

Select a curve to use for ECDHE key exchange.

The valid values of *curve* are the objects returned by `OpenSSL.crypto.get_elliptic_curves()` or `OpenSSL.crypto.get_elliptic_curve()`.

`Context.`**`set_app_data`**`(`*data*`)`

Associate *data* with this Context object. *data* can be retrieved later using the `get_app_data()` method.

`Context.`**`set_cipher_list`**`(`*cipher_list*`)`

Set the list of ciphers to be used in this context.

See the OpenSSL manual for more information (e.g. `ciphers(1)`).

Parameters **`cipher_list`** (`bytes`) – An OpenSSL cipher string.

Returns None

`Context.`**`set_info_callback`**`(`*callback*`)`

Set the information callback to *callback*. This function will be called from time to time during SSL handshakes.

callback should take three arguments: a Connection object and two integers. The first integer specifies where in the SSL handshake the function was called, and the other the return code from a (possibly failed) internal function call.

`Context.`**`set_options`**`(`*options*`)`

Add SSL options. Options you have set before are not cleared! This method should be used with the `OP_*` constants.

`Context.`**`set_mode`**`(`*mode*`)`

Add SSL mode. Modes you have set before are not cleared! This method should be used with the `MODE_*` constants.

`Context.`**`set_passwd_cb`**`(`*callback*[, *userdata*]`)`

Set the passphrase callback to *callback*. This function will be called when a private key with a passphrase is loaded. *callback* must accept three positional arguments. First, an integer giving the maximum length of the passphrase it may return. If the returned passphrase is longer than this, it will be truncated. Second, a boolean value which will be true if the user should be prompted for the passphrase twice and the callback should verify that the two values supplied are equal. Third, the value given as the *userdata* parameter to `set_passwd_cb()`. If an error occurs, *callback* should return a false value (e.g. an empty string).

`Context.`**`set_session_cache_mode`**`(`*mode*`)`

Set the behavior of the session cache used by all connections using this Context. The previously set mode is returned. See `SESS_CACHE_*` for details about particular modes.

New in version 0.14.

`Context.`**`get_session_cache_mode`**`()`

Get the current session cache mode.

New in version 0.14.

`Context.`**`set_session_id`**`(`*buf*`)`

Set the session id to *buf* within which a session can be reused for this Context object. This is needed when doing session resumption, because there is no way for a stored session to know which Context object it is associated with.

Parameters **buf** (`bytes`) – The session id.

Returns None

`Context.`**`set_timeout`**(*timeout*)

Set the timeout for newly created sessions for this Context object to *timeout*. *timeout* must be given in (whole) seconds. The default value is 300 seconds. See the OpenSSL manual for more information (e.g. *`SSL_CTX_set_timeout(3)`*).

`Context.`**`set_verify`**(*mode*, *callback*)

Set the verification flags for this Context object to *mode* and specify that *callback* should be used for verification callbacks. *mode* should be one of *`VERIFY_NONE`* and *`VERIFY_PEER`*. If *`VERIFY_PEER`* is used, *mode* can be OR:ed with *`VERIFY_FAIL_IF_NO_PEER_CERT`* and `VERIFY_CLIENT_ONCE` to further control the behaviour.

callback should take five arguments: A Connection object, an X509 object, and three integer variables, which are in turn potential error number, error depth and return code. *callback* should return true if verification passes and false otherwise.

`Context.`**`set_verify_depth`**(*depth*)

Set the maximum depth for the certificate chain verification that shall be allowed for this Context object.

`Context.`**`use_certificate`**(*cert*)

Use the certificate *cert* which has to be a X509 object.

`Context.`**`add_extra_chain_cert`**(*cert*)

Adds the certificate *cert*, which has to be a X509 object, to the certificate chain presented together with the certificate.

`Context.`**`use_certificate_chain_file`**(*file*)

Load a certificate chain from *file* which must be PEM encoded.

`Context.`**`use_privatekey`**(*pkey*)

Use the private key *pkey* which has to be a PKey object.

`Context.`**`use_certificate_file`**(*file*[, *format*])

Load the first certificate found in *file*. The certificate must be in the format specified by *format*, which is either *`FILETYPE_PEM`* or *`FILETYPE_ASN1`*. The default is *`FILETYPE_PEM`*.

`Context.`**`use_privatekey_file`**(*file*[, *format*])

Load the first private key found in *file*. The private key must be in the format specified by *format*, which is either *`FILETYPE_PEM`* or *`FILETYPE_ASN1`*. The default is *`FILETYPE_PEM`*.

`Context.`**`set_tlsext_servername_callback`**(*callback*)

Specify a one-argument callable to use as the TLS extension server name callback. When a connection using the server name extension is made using this context, the callback will be invoked with the *`Connection`* instance.

New in version 0.13.

`Context.`**`set_npn_advertise_callback`**(*callback*)

Specify a callback function that will be called when offering Next Protocol Negotiation as a server.

callback should be the callback function. It will be invoked with one argument, the *`Connection`* instance. It should return a list of bytestrings representing the advertised protocols, like `[b'http/1.1', b'spdy/2']`.

New in version 0.15.

`Context.set_npn_select_callback(callback):`

Specify a callback function that will be called when a server offers Next Protocol Negotiation options.

callback should be the callback function. It will be invoked with two arguments: the *`Connection`*, and a list of offered protocols as bytestrings, e.g. `[b'http/1.1', b'spdy/2']`. It should return one of those bytestrings, the chosen protocol.

New in version 0.15.

`Context.`**`set_alpn_protos`**`(`*protos*`)`

Specify the protocols that the client is prepared to speak after the TLS connection has been negotiated using Application Layer Protocol Negotiation.

protos should be a list of protocols that the client is offering, each as a bytestring. For example, `[b'http/1.1', b'spdy/2']`.

`Context.`**`set_alpn_select_callback`**`(`*callback*`)`

Specify a callback function that will be called on the server when a client offers protocols using Application Layer Protocol Negotiation.

callback should be the callback function. It will be invoked with two arguments: the `Connection` and a list of offered protocols as bytestrings, e.g. `[b'http/1.1', b'spdy/2']`. It should return one of these bytestrings, the chosen protocol.

Session objects

Session objects have no methods.

Connection objects

Connection objects have the following methods:

`Connection.`**`accept`**`()`

Call the `accept()` method of the underlying socket and set up SSL on the returned socket, using the Context object supplied to this Connection object at creation. Returns a pair *(conn, address)*. where *conn* is the new Connection object created, and *address* is as returned by the socket's `accept()`.

`Connection.`**`bind`**`(`*address*`)`

Call the `bind()` method of the underlying socket.

`Connection.`**`close`**`()`

Call the `close()` method of the underlying socket. Note: If you want correct SSL closure, you need to call the `shutdown()` method first.

`Connection.`**`connect`**`(`*address*`)`

Call the `connect()` method of the underlying socket and set up SSL on the socket, using the Context object supplied to this Connection object at creation.

`Connection.`**`connect_ex`**`(`*address*`)`

Call the `connect_ex()` method of the underlying socket and set up SSL on the socket, using the Context object supplied to this Connection object at creation. Note that if the `connect_ex()` method of the socket doesn't return 0, SSL won't be initialized.

`Connection.`**`do_handshake`**`()`

Perform an SSL handshake (usually called after `renegotiate()` or one of `set_accept_state()` or `set_accept_state()`). This can raise the same exceptions as `send()` and `recv()`.

`Connection.`**`fileno`**`()`

Retrieve the file descriptor number for the underlying socket.

`Connection.`**`listen`**`(`*backlog*`)`

Call the `listen()` method of the underlying socket.

`Connection.`**`get_app_data`**`()`

Retrieve application data as set by `set_app_data()`.

`Connection.`**`get_cipher_list`**`()`

Retrieve the list of ciphers used by the Connection object.

Returns A list of native cipher strings.

`Connection.`**`get_protocol_version`**`()`

Retrieve the version of the SSL or TLS protocol used by the Connection. For example, it will return `0x769` for connections made over TLS version 1.

`Connection.`**`get_protocol_version_name`**`()`

Retrieve the version of the SSL or TLS protocol used by the Connection as a unicode string. For example, it will return `TLSv1` for connections made over TLS version 1, or `Unknown` for connections that were not successfully established.

`Connection.`**`get_client_ca_list`**`()`

Retrieve the list of preferred client certificate issuers sent by the server as *`OpenSSL.crypto.X509Name`* objects.

If this is a client *`Connection`*, the list will be empty until the connection with the server is established.

If this is a server *`Connection`*, return the list of certificate authorities that will be sent or has been sent to the client, as controlled by this *`Connection`*'s *`Context`*.

New in version 0.10.

`Connection.`**`get_context`**`()`

Retrieve the Context object associated with this Connection.

`Connection.`**`set_context`**`(`*context*`)`

Specify a replacement Context object for this Connection.

`Connection.`**`get_peer_certificate`**`()`

Retrieve the other side's certificate (if any)

`Connection.`**`get_peer_cert_chain`**`()`

Retrieve the tuple of the other side's certificate chain (if any)

`Connection.`**`getpeername`**`()`

Call the *`getpeername()`* method of the underlying socket.

`Connection.`**`getsockname`**`()`

Call the *`getsockname()`* method of the underlying socket.

`Connection.`**`getsockopt`**`(`*level*, *optname*[, *buflen*]`)`

Call the *`getsockopt()`* method of the underlying socket.

`Connection.`**`pending`**`()`

Retrieve the number of bytes that can be safely read from the SSL buffer (**not** the underlying transport buffer).

`Connection.`**`recv`**`(`*bufsize*[, *flags*]`)`

Receive data from the Connection. The return value is a string representing the data received. The maximum amount of data to be received at once, is specified by *bufsize*. The only supported flag is `MSG_PEEK`, all other flags are ignored.

`Connection.`**`recv_into`**`(`*buffer*[, *nbytes*[, *flags*]]`)`

Receive data from the Connection and copy it directly into the provided buffer. The return value is the number of bytes read from the connection. The maximum amount of data to be received at once is specified by *nbytes*. The only supported flag is `MSG_PEEK`, all other flags are ignored.

`Connection.`**`bio_write`**`(`*bytes*`)`

If the Connection was created with a memory BIO, this method can be used to add bytes to the read end of that memory BIO. The Connection can then read the bytes (for example, in response to a call to *`recv()`*).

Connection.**renegotiate**()

Renegotiate the session.

Returns True if the renegotiation can be started, False otherwise

Return type bool

Connection.**renegotiate_pending**()

Check if there's a renegotiation in progress, it will return False once a renegotiation is finished.

Returns Whether there's a renegotiation in progress

Return type bool

Connection.**total_renegotiations**()

Find out the total number of renegotiations.

Returns The number of renegotiations.

Return type int

Connection.**send**(*string*)

Send the *string* data to the Connection.

Connection.**bio_read**(*bufsize*)

If the Connection was created with a memory BIO, this method can be used to read bytes from the write end of that memory BIO. Many Connection methods will add bytes which must be read in this manner or the buffer will eventually fill up and the Connection will be able to take no further actions.

Connection.**sendall**(*string*)

Send all of the *string* data to the Connection. This calls `send()` repeatedly until all data is sent. If an error occurs, it's impossible to tell how much data has been sent.

Connection.**set_accept_state**()

Set the connection to work in server mode. The handshake will be handled automatically by read/write.

Connection.**set_app_data**(*data*)

Associate *data* with this Connection object. *data* can be retrieved later using the `get_app_data()` method.

Connection.**set_connect_state**()

Set the connection to work in client mode. The handshake will be handled automatically by read/write.

Connection.**setblocking**(*flag*)

Call the `setblocking()` method of the underlying socket.

Connection.**setsockopt**(*level*, *optname*, *value*)

Call the `setsockopt()` method of the underlying socket.

Connection.**shutdown**()

Send the shutdown message to the Connection. Returns true if the shutdown message exchange is completed and false otherwise (in which case you call `recv()` or `send()` when the connection becomes readable/writeable.

Connection.**get_shutdown**()

Get the shutdown state of the Connection. Returns a bitvector of either or both of *SENT_SHUTDOWN* and *RECEIVED_SHUTDOWN*.

Connection.**set_shutdown**(*state*)

Set the shutdown state of the Connection. *state* is a bitvector of either or both of *SENT_SHUTDOWN* and *RECEIVED_SHUTDOWN*.

Connection.**sock_shutdown**(*how*)

Call the `shutdown()` method of the underlying socket.

`Connection.`**`bio_shutdown`**`()`

If the Connection was created with a memory BIO, this method can be used to indicate that *end of file* has been reached on the read end of that memory BIO.

`Connection.`**`get_state_string`**`()`

Retrieve a verbose string detailing the state of the Connection.

Returns A string representing the state

Return type *bytes*

`Connection.`**`client_random`**`()`

Retrieve the random value used with the client hello message.

`Connection.`**`server_random`**`()`

Retrieve the random value used with the server hello message.

`Connection.`**`master_key`**`()`

Retrieve the value of the master key for this session.

`Connection.`**`want_read`**`()`

Checks if more data has to be read from the transport layer to complete an operation.

`Connection.`**`want_write`**`()`

Checks if there is data to write to the transport layer to complete an operation.

`Connection.`**`set_tlsext_host_name`**`(`*name*`)`

Specify the byte string to send as the server name in the client hello message.

New in version 0.13.

`Connection.`**`get_servername`**`()`

Get the value of the server name received in the client hello message.

New in version 0.13.

`Connection.`**`get_session`**`()`

Get a `Session` instance representing the SSL session in use by the connection, or `None` if there is no session.

New in version 0.14.

`Connection.`**`set_session`**`(`*session*`)`

Set a new SSL session (using a `Session` instance) to be used by the connection.

New in version 0.14.

`Connection.`**`get_finished`**`()`

Obtain latest TLS Finished message that we sent, or `None` if handshake is not completed.

New in version 0.15.

`Connection.`**`get_peer_finished`**`()`

Obtain latest TLS Finished message that we expected from peer, or `None` if handshake is not completed.

New in version 0.15.

`Connection.`**`get_cipher_name`**`()`

Obtain the name of the currently used cipher.

New in version 0.15.

`Connection.`**`get_cipher_bits`**`()`

Obtain the number of secret bits of the currently used cipher.

New in version 0.15.

`Connection.`**`get_cipher_version`**`()`

Obtain the protocol name of the currently used cipher.

New in version 0.15.

`Connection.get_next_proto_negotiated():`

Get the protocol that was negotiated by Next Protocol Negotiation. Returns a bytestring of the protocol name. If no protocol has been negotiated yet, returns an empty string.

New in version 0.15.

`Connection.`**`set_alpn_protos`**`(`*protos*`)`

Specify the protocols that the client is prepared to speak after the TLS connection has been negotiated using Application Layer Protocol Negotiation.

protos should be a list of protocols that the client is offering, each as a bytestring. For example, `[b'http/1.1', b'spdy/2']`.

`Connection.`**`get_alpn_proto_negotiated`**`()`

Get the protocol that was negotiated by Application Layer Protocol Negotiation. Returns a bytestring of the protocol name. If no protocol has been negotiated yet, returns an empty string.

Internals

We ran into three main problems developing this: Exceptions, callbacks and accessing socket methods. This is what this chapter is about.

Exceptions

We realized early that most of the exceptions would be raised by the I/O functions of OpenSSL, so it felt natural to mimic OpenSSL's error code system, translating them into Python exceptions. This naturally gives us the exceptions *`SSL.ZeroReturnError`*, *`SSL.WantReadError`*, *`SSL.WantWriteError`*, *`SSL.WantX509LookupError`* and *`SSL.SysCallError`*.

For more information about this, see section *SSL — An interface to the SSL-specific parts of OpenSSL*.

Callbacks

Callbacks were more of a problem when pyOpenSSL was written in C. Having switched to being written in Python using cffi, callbacks are now straightforward. The problems that originally existed no longer do (if you are interested in the details you can find descriptions of those problems in the version control history for this document).

Accessing Socket Methods

We quickly saw the benefit of wrapping socket methods in the *`SSL.Connection`* class, for an easy transition into using SSL. The problem here is that the `socket` module lacks a C API, and all the methods are declared static. One approach would be to have *`OpenSSL`* as a submodule to the `socket` module, placing all the code in `socketmodule.c`, but this is obviously not a good solution, since you might not want to import tonnes of extra stuff you're not going to use when importing the `socket` module. The other approach is to somehow get a pointer to the method to be called, either the C function, or a callable Python object. This is not really a good solution either, since there's a lot of lookups involved.

The way it works is that you have to supply a `socket`- **like** transport object to the *`SSL.Connection`*. The only requirement of this object is that it has a `fileno()` method that returns a file descriptor that's valid at the C level (i.e. you can use the system calls read and write). If you want to use the `connect()` or `accept()` methods of the *SSL.Connection* object, the transport object has to supply such methods too. Apart from them, any method lookups in the *SSL.Connection* object that fail are passed on to the underlying transport object.

Future changes might be to allow Python-level transport objects, that instead of having `fileno()` methods, have `read()` and `write()` methods, so more advanced features of Python can be used. This would probably entail some sort of OpenSSL **BIOs**, but converting Python strings back and forth is expensive, so this shouldn't be used unless necessary. Other nice things would be to be able to pass in different transport objects for reading and writing, but then the `fileno()` method of *SSL.Connection* becomes virtually useless. Also, should the method resolution be used on the read-transport or the write-transport?

There are also examples in the pyOpenSSL repository that may help you getting started.

Meta

Backward Compatibility

pyOpenSSL has a very strong backward compatibility policy. Generally speaking, you shouldn't ever be afraid of updating.

If breaking changes are needed do be done, they are:

1. . . . announced in the *Changelog*.
2. . . . the old behavior raises a `DeprecationWarning` for a year.
3. . . . are done with another announcement in the *Changelog*.

Changelog

Versions are year-based with a strict backward-compatibility policy. The third digit is only for regressions.

17.0.0 (2017-04-20)

Backward-incompatible changes:

none

Deprecations:

none

Changes:

- Added `OpenSSL.X509Store.set_time()` to set a custom verification time when verifying certificate chains. #567
- Added a collection of functions for working with OCSP stapling. None of these functions make it possible to validate OCSP assertions, only to staple them into the handshake and to retrieve the stapled assertion if provided. Users will need to write their own code to handle OCSP assertions. We specifically added: `Context.set_ocsp_server_callback`, `Context.set_ocsp_client_callback`, and `Connection.request_ocsp`. #580

- Changed the `SSL` module's memory allocation policy to avoid zeroing memory it allocates when unnecessary. This reduces CPU usage and memory allocation time by an amount proportional to the size of the allocation. For applications that process a lot of TLS data or that use very lage allocations this can provide considerable performance improvements. #578
- Automatically set `SSL_CTX_set_ecdh_auto()` on `OpenSSL.SSL.Context`. #575
- Fix empty exceptions from `OpenSSL.crypto.load_privatekey()`. #581

16.2.0 (2016-10-15)

Backward-incompatible changes:

none

Deprecations:

none

Changes:

- Fixed compatibility errors with OpenSSL 1.1.0.
- Fixed an issue that caused failures with subinterpreters and embedded Pythons. #552

16.1.0 (2016-08-26)

Backward-incompatible changes:

none

Deprecations:

- Dropped support for OpenSSL 0.9.8.

Changes:

- Fix memory leak in `OpenSSL.crypto.dump_privatekey()` with `FILETYPE_TEXT`. #496
- Enable use of CRL (and more) in verify context. #483
- `OpenSSL.crypto.PKey` can now be constructed from `cryptography` objects and also exported as such. #439
- Support newer versions of `cryptography` which use opaque structs for OpenSSL 1.1.0 compatibility.

16.0.0 (2016-03-19)

This is the first release under full stewardship of PyCA. We have made *many* changes to make local development more pleasing. The test suite now passes both on Linux and OS X with OpenSSL 0.9.8, 1.0.1, and 1.0.2. It has been moved to pytest, all CI test runs are part of tox and the source code has been made fully flake8 compliant.

We hope to have lowered the barrier for contributions significantly but are open to hear about any remaining frustrations.

Backward-incompatible changes:

- Python 3.2 support has been dropped. It never had significant real world usage and has been dropped by our main dependency `cryptography`. Affected users should upgrade to Python 3.3 or later.

Deprecations:

- The support for EGD has been removed. The only affected function `OpenSSL.rand.egd()` now uses `os.urandom()` to seed the internal PRNG instead. Please see pyca/cryptography#1636 for more background information on this decision. In accordance with our backward compatibility policy `OpenSSL.rand.egd()` will be *removed* no sooner than a year from the release of 16.0.0.

  Please note that you should use urandom for all your secure random number needs.

- Python 2.6 support has been deprecated. Our main dependency `cryptography` deprecated 2.6 in version 0.9 (2015-05-14) with no time table for actually dropping it. pyOpenSSL will drop Python 2.6 support once `cryptography` does.

Changes:

- Fixed `OpenSSL.SSL.Context.set_session_id`, `OpenSSL.SSL.Connection.renegotiate`, `OpenSSL.SSL.Connection.renegotiate_pending`, and `OpenSSL.SSL.Context.load_client_ca`. They were lacking an implementation since 0.14. #422
- Fixed segmentation fault when using keys larger than 4096-bit to sign data. #428
- Fixed `AttributeError` when `OpenSSL.SSL.Connection.get_app_data()` was called before setting any app data. #304
- Added `OpenSSL.crypto.dump_publickey()` to dump `OpenSSL.crypto.PKey` objects that represent public keys, and `OpenSSL.crypto.load_publickey()` to load such objects from serialized representations. #382
- Added `OpenSSL.crypto.dump_crl()` to dump a certificate revocation list out to a string buffer. #368
- Added `OpenSSL.SSL.Connection.get_state_string()` using the OpenSSL binding `state_string_long`. #358
- Added support for the `socket.MSG_PEEK` flag to `OpenSSL.SSL.Connection.recv()` and `OpenSSL.SSL.Connection.recv_into()`. #294
- Added `OpenSSL.SSL.Connection.get_protocol_version()` and `OpenSSL.SSL.Connection.get_protocol_version_name()`. #244
- Switched to `utf8string` mask by default. OpenSSL formerly defaulted to a `T61String` if there were UTF-8 characters present. This was changed to default to `UTF8String` in the config around 2005, but the actual code didn't change it until late last year. This will default us to the setting that actually works. To revert this you can call `OpenSSL.crypto._lib.ASN1_STRING_set_default_mask_asc(b"default")`. #234

Older Changelog Entries

The changes from before release 16.0.0 are preserved in the repository.

CHAPTER 2

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