pyOpenSSL Documentation

Release 16.1.0.dev0

The pyOpenSSL developers

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pyOpenSSL Documentation, Release 16.1.0.dev0

Release v16.1.0.dev0 (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.
1.1 Introduction

1.1.1 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.

1.1.2 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.

1.1.3 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.
- New tests should use pytest-style assertions instead of the old self.assertXYZ-style.
- 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.

```python
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.

### 1.2 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.

### 1.2.1 Documentation

The documentation is written in reStructuredText and built using Sphinx:

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

### 1.3 OpenSSL — Python interface to OpenSSL

This package provides a high-level interface to the functions in the OpenSSL library. The following modules are defined:
1.3.1 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 sha1.
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 sha1.
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.

1.3. OpenSSL — Python interface to OpenSSL
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:
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:

<table>
<thead>
<tr>
<th>YYYYMMDDhhmmssZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>YYYYMMDDhhmmss+hhmm</td>
</tr>
<tr>
<td>YYYYMMDDhhmmss-hhmm</td>
</tr>
</tbody>
</table>

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"sha1".

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 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.

• 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.

**X509StoreContextError objects**

```python
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 verification failure.

**X509StoreContext objects**

```python
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.

```python
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.

```python
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
            • 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.

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

get_short_name ()
Returns the short type name of this X.509 extension.
The result is a byte string such as b"basicConstraints".

NetscapeSPKI objects

class OpenSSL.crypto.NetscapeSPKI
A Netscape SPKI object.

b64_encode ()
Generate a base64 encoded representation of this SPKI object.

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 – The public key that signature is supposedly from.
Returns True if the signature is correct.
Return type bool
Raises 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 (e.g. b"sha1").

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 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_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.

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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

\textbf{set_serial}(\textit{hex\_str})

Set the serial number.

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

\textbf{Parameters} \textit{hex\_str} (\textit{bytes}) – The new serial number.

\textbf{Returns} None

\textbf{Exceptions}

\textbf{exception} \texttt{OpenSSL.crypto.Error}

Generic exception used in the \texttt{crypto} module.

\textbf{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 \texttt{EVP\_get\_digestbyname}, specifically). For example, \texttt{b"md5"} or \texttt{b"sha1"}.

More information and a list of these digest names can be found in the \texttt{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/crypto/EVP_DigestInit.html

\textbf{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 \texttt{X509} object is now simply \texttt{X509}. Originally, the type would have been \texttt{X509Type}. These days, \texttt{X509Type} and \texttt{X509} are literally the same object. pyOpenSSL maintains these old names for backwards compatibility.

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

<table>
<thead>
<tr>
<th>Type name</th>
<th>Backwards-compatible name</th>
</tr>
</thead>
<tbody>
<tr>
<td>X509</td>
<td>X509Type</td>
</tr>
<tr>
<td>X509Name</td>
<td>X509NameType</td>
</tr>
<tr>
<td>X509Req</td>
<td>X509ReqType</td>
</tr>
<tr>
<td>X509Store</td>
<td>X509StoreType</td>
</tr>
<tr>
<td>X509Extension</td>
<td>X509ExtensionType</td>
</tr>
<tr>
<td>PKey</td>
<td>PKeyType</td>
</tr>
<tr>
<td>PKCS7</td>
<td>PKCS7Type</td>
</tr>
<tr>
<td>PKCS12</td>
<td>PKCS12Type</td>
</tr>
<tr>
<td>NetscapeSPKI</td>
<td>NetscapeSPKIType</td>
</tr>
<tr>
<td>CRL</td>
<td>CRLType</td>
</tr>
</tbody>
</table>

Some objects, such as \texttt{Revoked}, don’t have Type equivalents, because they were added after the restriction had been lifted.

\textbf{1.3.2 \texttt{rand} — An interface to the OpenSSL pseudo random number generator}

\textbf{Warning}: Functions from this module shouldn’t be used. Use \texttt{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** True if the PRNG is seeded enough, False 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.

### 1.3.3 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.SESSION_CACHE_OFF**

**OpenSSL.SSL.SESSION_CACHE_CLIENT**

**OpenSSL.SSL.SESSION_CACHE_SERVER**

**OpenSSL.SSL.SESSION_CACHE_BOTH**

**OpenSSL.SSL.SESSION_CACHE_NO_AUTO_CLEAR**

**OpenSSL.SSL.SESSION_CACHE_NO_INTERNAL_LOOKUP**

**OpenSSL.SSL.SESSION_CACHE_NO_INTERNAL_STORE**

**OpenSSL.SSL.SESSION_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.

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.

\(^1\) 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.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(certificateAuthorities)`: Replace the current list of preferred certificate signers that would be sent to the client when requesting a client certificate with the `certificateAuthorities` sequence of `OpenSSL.crypto.X509Name`’s.

  New in version 0.10.

- `Context.add_client_ca(certificateAuthority)`: Extract a `OpenSSL.crypto.X509Name` from the `certificateAuthority 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.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_passwdCb()`. 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\texttt{.get\_protocol\_version()} (\texttt{(\)})  
Retrieve the version of the SSL or TLS protocol used by the Connection. For example, it will return \texttt{0x769} for connections made over TLS version 1.

Connection\texttt{.get\_protocol\_version\_name()} (\texttt{(\)})  
Retrieve the version of the SSL or TLS protocol used by the Connection as a unicode string. For example, it will return \texttt{TLSv1} for connections made over TLS version 1, or \texttt{Unknown} for connections that were not successfully established.

Connection\texttt{.get\_client\_ca\_list()} (\texttt{(\)})  
Retrieve the list of preferred client certificate issuers sent by the server as \texttt{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\texttt{.get\_context()} (\texttt{(\)})  
Retrieve the Context object associated with this Connection.

Connection\texttt{.set\_context(context)} (\texttt{(context)})  
Specify a replacement Context object for this Connection.

Connection\texttt{.get\_peer\_certificate()} (\texttt{(\)})  
Retrieve the other side’s certificate (if any)

Connection\texttt{.get\_peer\_cert\_chain()} (\texttt{(\)})  
Retrieve the tuple of the other side’s certificate chain (if any)

Connection\texttt{.getpeername()} (\texttt{(\)})  
Call the \texttt{getpeername()} method of the underlying socket.

Connection\texttt{.getsockname()} (\texttt{(\)})  
Call the \texttt{getsockname()} method of the underlying socket.

Connection\texttt{.getsockopt(level, optname[, buflen])} (\texttt{(level, optname[, buflen])})  
Call the \texttt{getsockopt()} method of the underlying socket.

Connection\texttt{.pending()} (\texttt{(\)})  
Retrieve the number of bytes that can be safely read from the SSL buffer (not the underlying transport buffer).

Connection\texttt{.recv(bufsize[, flags])} (\texttt{(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 \texttt{bufsize}. The only supported flag is \texttt{MSG\_PEEK}, all other flags are ignored.

Connection\texttt{.recv\_into(buffer[, nbytes[, flags]])} (\texttt{(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 \texttt{nbytes}. The only supported flag is \texttt{MSG\_PEEK}, all other flags are ignored.

Connection\texttt{.bio\_write(bytes)} (\texttt{(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 \texttt{recv()}).

Connection\texttt{.renegotiate()} (\texttt{(\)})  
Renegotiate the session.

\textbf{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.

1.4 Internals

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

1.4.1 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 natu-
rally 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.

1.4.2 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).

1.4.3 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.

1.5 Meta

1.5.1 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.

1.5.2 Changelog

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

16.1.0 (UNRELEASED)

Backward-incompatible changes:

none

Deprecations:

none

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
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 py.test, 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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