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# **pyOpenSSL Documentation**

*Release 20.0.1*

**The pyOpenSSL developers**

**Dec 15, 2020**



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Release v20.0.1 (*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 2.7 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.
- 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](mailto: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 Supported OpenSSL Versions

pyOpenSSL supports the same platforms and releases as the upstream cryptography project [does](#). Currently that means:

- 1.0.2
- 1.1.0
- 1.1.1

You can always find out the versions of pyOpenSSL, cryptography, and the linked OpenSSL by running `python -m OpenSSL.debug`.

## 1.2.2 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

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**Note:** [pyca/cryptography](#) is likely a better choice than using this module. It contains a complete set of cryptographic primitives as well as a significantly better and more powerful X509 API. If necessary you can convert to and from `cryptography` objects using the `to_cryptography` and `from_cryptography` methods on `X509`, `X509Req`, `CRL`, and `PKey`.

---

#### 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.

**Parameters** `name` (`unicode`) – The OpenSSL short name identifying the curve object to retrieve.

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 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*.

### Parameters

- **type** – The file type (one of FILETYPE\_PEM, FILETYPE\_ASN1, or FILETYPE\_TEXT)
- **cert** – The certificate to dump

**Returns** The buffer with the dumped certificate in

OpenSSL.crypto.**load\_certificate** (*type, buffer*)

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

### Parameters

- **type** – The file type (one of FILETYPE\_PEM, FILETYPE\_ASN1)
- **buffer** (*bytes*) – The buffer the certificate is stored in

**Returns** The X509 object

## Certificate signing requests

OpenSSL.crypto.**dump\_certificate\_request** (*type, req*)

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

### Parameters

- **type** – The file type (one of FILETYPE\_PEM, FILETYPE\_ASN1)
- **req** – The certificate request to dump

**Returns** The buffer with the dumped certificate request in

OpenSSL.crypto.**load\_certificate\_request** (*type, buffer*)

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

### Parameters

- **type** – The file type (one of FILETYPE\_PEM, FILETYPE\_ASN1)
- **buffer** – The buffer the certificate request is stored in

**Returns** The X509Req object

## 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=None*)

Load a private key (PKey) from the string *buffer* encoded with the type *type*.

### Parameters

- **type** – The file type (one of *FILETYPE\_PEM*, *FILETYPE\_ASN1*)
- **buffer** – The buffer the key is stored in
- **passphrase** – (optional) if encrypted PEM format, this can be either the passphrase to use, or a callback for providing the passphrase.

**Returns** The PKey object

## 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*.

### Parameters

- **type** – The file type (one of `FILETYPE_PEM`, `FILETYPE_ASN1`)
- **buffer** – The buffer the CRL is stored in

**Returns** The PKey object

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

Load pkcs7 data from the string *buffer* encoded with the type *type*.

### Parameters

- **type** – The file type (one of `FILETYPE_PEM` or `FILETYPE_ASN1`)
- **buffer** – The buffer with the pkcs7 data.

**Returns** The PKCS7 object

`OpenSSL.crypto.load_pkcs12` (*buffer*, *passphrase=None*)

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()`.

### Parameters

- **buffer** – The buffer the certificate is stored in
- **passphrase** – (Optional) The password to decrypt the PKCS12 lump

**Returns** The PKCS12 object

## Signing and verifying signatures

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

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

### Parameters

- **pkey** – PKey to sign with
- **data** – data to be signed
- **digest** – message digest to use

**Returns** signature

New in version 0.11.

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

Verify the signature for a data string.

**Parameters**

- **cert** – signing certificate (X509 object) corresponding to the private key which generated the signature.
- **signature** – signature returned by sign function
- **data** – data to be verified
- **digest** – message digest to use

**Returns** `None` if the signature is correct, raise exception otherwise.

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`

**classmethod** **from\_cryptography** (*crypto\_cert*)

Construct based on a `cryptography` *crypto\_cert*.

**Parameters** **crypto\_key** (`cryptography.x509.Certificate`) – A `cryptography` X.509 certificate.

**Return type** `X509`

New in version 17.1.0.

**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 TIME:

```
YYYYMMDDhhmmssZ
```

**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 TIME:

```
YYYYMMDDhhmmssZ
```

**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 TIME:

YYYYMMDDhhmmssZ
-----------------

**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 TIME:



```
YYYYMMDDhhmmssZ
```

**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. Note that the version value is zero-based, eg. a value of 0 is V1.

**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`

**to\_cryptography** ()

Export as a cryptography certificate.

**Return type** `cryptography.x509.Certificate`

New in version 17.1.0.

### 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.

`__setattr__` (*name, value*)

`x.__setattr__('name', value) <==> x.name = value`

`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.

`__init__` ()

`x.__init__(...)` initializes `x`; see `help(type(x))` for signature

**add\_extensions** (*extensions*)

Add extensions to the certificate signing request.

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

**Returns** None

**classmethod from\_cryptography** (*crypto\_req*)

Construct based on a cryptography *crypto\_req*.

**Parameters** **crypto\_req** (*cryptography.x509.CertificateSigningRequest*)  
– A cryptography X.509 certificate signing request

**Return type** *X509Req*

New in version 17.1.0.

**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`**to\_cryptography()**

Export as a cryptography certificate signing request.

**Return type** `cryptography.x509.CertificateSigningRequest`

New in version 17.1.0.

**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.

**load\_locations** (*cafile*, *capath=None*)

Let X509Store know where we can find trusted certificates for the certificate chain. 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 *cafile* or *capath* may be `None`.

---

**Note:** Both *cafile* and *capath* may be set simultaneously.

Call this method multiple times to add more than one location. For example, CA certificates, and certificate revocation list bundles may be passed in *cafile* in subsequent calls to this method.

---

New in version 20.0.

**Parameters**

- **cafile** – In which file we can find the certificates (`bytes` or `unicode`).
- **capath** – In which directory we can find the certificates (`bytes` or `unicode`).

**Returns** `None` if the locations were set successfully.

**Raises** `OpenSSL.crypto.Error` – If both *cafile* and *capath* is `None` or the locations could not be set for any reason.

**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, chain=None*)

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.
- `_chain` – See the `chain __init__` parameter.

#### Parameters

- `store` (*X509Store*) – The certificates which will be trusted for the purposes of any verifications.
- `certificate` (*X509*) – The certificate to be verified.
- `chain` (*list of X509*) – List of untrusted certificates that may be used for building the certificate chain. May be `None`.

**get\_verified\_chain** ()

Verify a certificate in a context and return the complete validated chain.

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

New in version 20.0.

**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:

**class** OpenSSL.crypto.**PKCS7**

**get\_type\_name** ()

Returns the type name of the PKCS7 structure

**Returns** A string with the typename

**type\_is\_data** ()

Check if this NID\_pkcs7\_data object

**Returns** True if the PKCS7 is of type data

**type\_is\_enveloped** ()

Check if this NID\_pkcs7\_enveloped object

**Returns** True if the PKCS7 is of type enveloped

**type\_is\_signed** ()

Check if this NID\_pkcs7\_signed object

**Returns** True if the PKCS7 is of type signed

**type\_is\_signedAndEnveloped** ()

Check if this NID\_pkcs7\_signedAndEnveloped object

**Returns** True if the PKCS7 is of type signedAndEnveloped



## 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.

`__init__()`

`x.__init__(...)` initializes `x`; see `help(type(x))` for signature

`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.

`__init__()`

`x.__init__(...)` initializes `x`; see `help(type(x))` for signature

`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"sha256"`).

**Return type** *bytes*

**classmethod** `from_cryptography` (*crypto\_crl*)

Construct based on a *cryptography crypto\_crl*.

**Parameters** `crypto_crl` (*cryptography.x509.CertificateRevocationList*)  
– A *cryptography* certificate revocation list

**Return type** *CRL*

New in version 17.1.0.

**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 TIME:

YYYYMMDDhhmmssZ
-----------------

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 TIME:

```
YYYYMMDDhhmmssZ
```

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.

**to\_cryptography** ()

Export as a cryptography CRL.

**Return type** `cryptography.x509.CertificateRevocationList`

New in version 17.1.0.

## 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 TIME.

**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 TIME.

**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](https://www.openssl.org/docs/manmaster/man3/EVP_DigestInit.html)

### 1.3.2 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

OpenSSL.SSL.OP\_NO\_TLSv1\_3

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.**NO\_OVERLAPPING\_PROTOCOLS**

A sentinel value that can be returned by the callback passed to `Context.set_alpn_select_callback()` to indicate that the handshake can continue without a specific application protocol.

New in version 19.1.

OpenSSL.SSL.**SSLeay\_version** (*type*)

Return a string describing the version of OpenSSL in use.

**Parameters** *type* – One of the `SSLEAY_` constants defined in this module.

OpenSSL.SSL.**ContextType**

See `Context`.

**class** OpenSSL.SSL.**Context** (*method*)

`OpenSSL.SSL.Context` instances define the parameters for setting up new SSL connections.

**Parameters** *method* – One of `SSLv2_METHOD`, `SSLv3_METHOD`, `SSLv23_METHOD`, or `TLSv1_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<sup>1</sup> 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.

---

<sup>1</sup> 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.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.

---

**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 (*errno*, *errstr*).

## Context objects

Context objects have the following methods:

**class** `OpenSSL.SSL.Context` (*method*)

`OpenSSL.SSL.Context` instances define the parameters for setting up new SSL connections.

**Parameters** `method` – One of `SSLv2_METHOD`, `SSLv3_METHOD`, `SSLv23_METHOD`, or `TLSv1_METHOD`.

**add\_client\_ca** (*certificate\_authority*)

Add the CA certificate to the list of preferred signers for this context.

The list of certificate authorities will be sent to the client when the server requests a client certificate.

**Parameters** `certificate_authority` – certificate authority's X509 certificate.

**Returns** `None`

New in version 0.10.

**add\_extra\_chain\_cert** (*certobj*)

Add certificate to chain

**Parameters** *certobj* – The X509 certificate object to add to the chain

**Returns** None

**check\_privatekey** ()

Check if the private key (loaded with *use\_privatekey()*) matches the certificate (loaded with *use\_certificate()*)

**Returns** None (raises *Error* if something's wrong)

**get\_app\_data** ()

Get the application data (supplied via *set\_app\_data()*)

**Returns** The application data

**get\_cert\_store** ()

Get the certificate store for the context. This can be used to add “trusted” certificates without using the *load\_verify\_locations()* method.

**Returns** A X509Store object or None if it does not have one.

**get\_session\_cache\_mode** ()

Get the current session cache mode.

**Returns** The currently used cache mode.

New in version 0.14.

**get\_timeout** ()

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

**Returns** The session timeout

**get\_verify\_depth** ()

Retrieve the Context object's verify depth, as set by *set\_verify\_depth()*.

**Returns** The verify depth

**get\_verify\_mode** ()

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

**Returns** The verify mode

**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

**load\_tmp\_dh** (*dhfile*)

Load parameters for Ephemeral Diffie-Hellman

**Parameters** *dhfile* – The file to load EDH parameters from (*bytes* or *unicode*).

**Returns** None

**load\_verify\_locations** (*cafile*, *capath=None*)

Let SSL know where we can find trusted certificates for the certificate chain. 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`.

**Parameters**

- **cafile** – In which file we can find the certificates (`bytes` or `unicode`).
- **capath** – In which directory we can find the certificates (`bytes` or `unicode`).

**Returns** `None`

**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.

**Parameters** **protos** – A list of the protocols to be offered to the server. This list should be a Python list of bytestrings representing the protocols to offer, e.g. `[b'http/1.1', b'spdy/2']`.

**set\_alpn\_select\_callback** (*callback*)

Specify a callback function that will be called on the server when a client offers protocols using ALPN.

**Parameters** **callback** – 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 can return one of those bytestrings to indicate the chosen protocol, the empty bytestring to terminate the TLS connection, or the `NO_OVERLAPPING_PROTOCOLS` to indicate that no offered protocol was selected, but that the connection should not be aborted.

**set\_app\_data** (*data*)

Set the application data (will be returned from `get_app_data()`)

**Parameters** **data** – Any Python object

**Returns** `None`

**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`

**set\_client\_ca\_list** (*certificate\_authorities*)

Set the list of preferred client certificate signers for this server context.

This list of certificate authorities will be sent to the client when the server requests a client certificate.

**Parameters** **certificate\_authorities** – a sequence of X509Names.

**Returns** `None`

New in version 0.10.

**set\_default\_verify\_paths** ()

Specify that the platform provided CA certificates are to be used for verification purposes. This method has some caveats related to the binary wheels that cryptography (pyOpenSSL's primary dependency) ships:

- macOS will only load certificates using this method if the user has the `openssl@1.1` Homebrew formula installed in the default location.
- Windows will not work.

- manylinux1 cryptography wheels will work on most common Linux distributions in pyOpenSSL 17.1.0 and above. pyOpenSSL detects the manylinux1 wheel and attempts to load roots via a fallback path.

**Returns** None

**set\_info\_callback** (*callback*)

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

**Parameters** **callback** – The Python callback to use. This 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.

**Returns** None

**set\_keylog\_callback** (*callback*)

Set the TLS key logging callback to *callback*. This function will be called whenever TLS key material is generated or received, in order to allow applications to store this keying material for debugging purposes.

**Parameters** **callback** – The Python callback to use. This should take two arguments: a Connection object and a bytestring that contains the key material in the format used by NSS for its SSLKEYLOGFILE debugging output.

**Returns** None

**set\_mode** (*mode*)

Add modes via bitmask. Modes set before are not cleared! This method should be used with the `MODE_*` constants.

**Parameters** **mode** – The mode to add.

**Returns** The new mode bitmask.

**set\_ocsp\_client\_callback** (*callback*, *data=None*)

Set a callback to validate OCSP data stapled to the TLS handshake on the client side.

**Parameters**

- **callback** – The callback function. It will be invoked with three arguments: the Connection, a bytestring containing the stapled OCSP assertion, and the optional arbitrary data you have provided. The callback must return a boolean that indicates the result of validating the OCSP data: `True` if the OCSP data is valid and the certificate can be trusted, or `False` if either the OCSP data is invalid or the certificate has been revoked.
- **data** – Some opaque data that will be passed into the callback function when called. This can be used to avoid needing to do complex data lookups or to keep track of what context is being used. This parameter is optional.

**set\_ocsp\_server\_callback** (*callback*, *data=None*)

Set a callback to provide OCSP data to be stapled to the TLS handshake on the server side.

**Parameters**

- **callback** – The callback function. It will be invoked with two arguments: the Connection, and the optional arbitrary data you have provided. The callback must return a bytestring that contains the OCSP data to staple to the handshake. If no OCSP data is available for this connection, return the empty bytestring.

- **data** – Some opaque data that will be passed into the callback function when called. This can be used to avoid needing to do complex data lookups or to keep track of what context is being used. This parameter is optional.

**set\_options** (*options*)

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

**Parameters** **options** – The options to add.

**Returns** The new option bitmask.

**set\_passwd\_cb** (*callback, userdata=None*)

Set the passphrase callback. This function will be called when a private key with a passphrase is loaded.

**Parameters**

- **callback** – The Python callback to use. This 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()`. The *callback* must return a byte string. If an error occurs, *callback* should return a false value (e.g. an empty string).
- **userdata** – (optional) A Python object which will be given as argument to the callback

**Returns** None

**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.

**Parameters** **mode** – One or more of the `SESS_CACHE_*` flags (combine using bitwise or)

**Returns** The previously set caching mode.

New in version 0.14.

**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

**set\_timeout** (*timeout*)

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

**Parameters** **timeout** – The timeout in (whole) seconds

**Returns** The previous session timeout

**set\_tlsext\_servername\_callback** (*callback*)

Specify a callback function to be called when clients specify a server name.

**Parameters** **callback** – The callback function. It will be invoked with one argument, the Connection instance.

New in version 0.13.

**set\_tlsext\_use\_srtp** (*profiles*)

Enable support for negotiating SRTP keying material.

**Parameters** `profiles` (*bytes*) – A colon delimited list of protection profile names, like `b'SRTP_AES128_CM_SHA1_80:SRTP_AES128_CM_SHA1_32'`.

**Returns** None

**set\_tmp\_ecdh** (*curve*)

Select a curve to use for ECDHE key exchange.

**Parameters** `curve` – A curve object to use as returned by either `OpenSSL.crypto.get_elliptic_curve()` or `OpenSSL.crypto.get_elliptic_curves()`.

**Returns** None

**set\_verify** (*mode*, *callback=None*)

Set the verification flags for this Context object to *mode* and specify that *callback* should be used for verification callbacks.

**Parameters**

- **mode** – The verify mode, this 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** – The optional Python verification callback to use. This 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. If omitted, OpenSSL's default verification is used.

**Returns** None

See `SSL_CTX_set_verify(3SSL)` for further details.

**set\_verify\_depth** (*depth*)

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

**Parameters** `depth` – An integer specifying the verify depth

**Returns** None

**use\_certificate** (*cert*)

Load a certificate from a X509 object

**Parameters** `cert` – The X509 object

**Returns** None

**use\_certificate\_chain\_file** (*certfile*)

Load a certificate chain from a file.

**Parameters** `certfile` – The name of the certificate chain file (*bytes* or *unicode*). Must be PEM encoded.

**Returns** None

**use\_certificate\_file** (*certfile*, *filetype=1*)

Load a certificate from a file

**Parameters**

- **certfile** – The name of the certificate file (*bytes* or *unicode*).
- **filetype** – (optional) The encoding of the file, which is either `FILETYPE_PEM` or `FILETYPE_ASN1`. The default is `FILETYPE_PEM`.

**Returns** None

**use\_privatekey** (*pkey*)

Load a private key from a PKey object

**Parameters** **pkey** – The PKey object

**Returns** None

**use\_privatekey\_file** (*keyfile*, *filetype*=<*object object*>)

Load a private key from a file

**Parameters**

- **keyfile** – The name of the key file (bytes or unicode)
- **filetype** – (optional) The encoding of the file, which is either `FILETYPE_PEM` or `FILETYPE_ASN1`. The default is `FILETYPE_PEM`.

**Returns** None

## Session objects

Session objects have no methods.

## Connection objects

Connection objects have the following methods:

**class** `OpenSSL.SSL.Connection` (*context*, *socket*=None)

**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 (*conn*, *addr*) pair where *conn* is the new `Connection` object created, and *address* is as returned by the socket's `accept()`.

**bio\_read** (*bufsiz*)

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.

**Parameters** **bufsiz** – The maximum number of bytes to read

**Returns** The string read.

**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.

**Returns** None

**bio\_write** (*buf*)

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()`).

**Parameters** **buf** – The string to put into the memory BIO.

**Returns** The number of bytes written

**client\_random** ()

Retrieve the random value used with the client hello message.

**Returns** A string representing the state

**connect** (*addr*)

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.

**Parameters** **addr** – A remote address

**Returns** What the socket’s connect method returns

**connect\_ex** (*addr*)

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.

**Parameters** **addr** – A remote address

**Returns** What the socket’s connect\_ex method returns

**do\_handshake** ()

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

**Returns** None.

**export\_keying\_material** (*label, olen, context=None*)

Obtain keying material for application use.

**Param** **label** - a disambiguating label string as described in RFC 5705

**Param** **olen** - the length of the exported key material in bytes

**Param** **context** - a per-association context value

**Returns** the exported key material bytes or None

**get\_alpn\_proto\_negotiated** ()

Get the protocol that was negotiated by ALPN.

**Returns** A bytestring of the protocol name. If no protocol has been negotiated yet, returns an empty string.

**get\_app\_data** ()

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

**Returns** The application data

**get\_certificate** ()

Retrieve the local certificate (if any)

**Returns** The local certificate

**get\_cipher\_bits** ()

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

**Returns** The number of secret bits of the currently used cipher or `None` if no connection has been established.

**Return type** `int` or `NoneType`

New in version 0.15.

**get\_cipher\_list** ()

Retrieve the list of ciphers used by the `Connection` object.

**Returns** A list of native cipher strings.



**get\_cipher\_name()**

Obtain the name of the currently used cipher.

**Returns** The name of the currently used cipher or `None` if no connection has been established.

**Return type** `unicode` or `NoneType`

New in version 0.15.

**get\_cipher\_version()**

Obtain the protocol version of the currently used cipher.

**Returns** The protocol name of the currently used cipher or `None` if no connection has been established.

**Return type** `unicode` or `NoneType`

New in version 0.15.

**get\_client\_ca\_list()**

Get CAs whose certificates are suggested for client authentication.

**Returns**

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

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

New in version 0.10.

**get\_context()**

Retrieve the *Context* object associated with this *Connection*.

**get\_finished()**

Obtain the latest TLS Finished message that we sent.

**Returns** The contents of the message or `None` if the TLS handshake has not yet completed.

**Return type** `bytes` or `NoneType`

New in version 0.15.

**get\_peer\_cert\_chain()**

Retrieve the other side's certificate (if any)

**Returns** A list of X509 instances giving the peer's certificate chain, or `None` if it does not have one.

**get\_peer\_certificate()**

Retrieve the other side's certificate (if any)

**Returns** The peer's certificate

**get\_peer\_finished()**

Obtain the latest TLS Finished message that we received from the peer.

**Returns** The contents of the message or `None` if the TLS handshake has not yet completed.

**Return type** `bytes` or `NoneType`

New in version 0.15.

**get\_protocol\_version()**

Retrieve the SSL or TLS protocol version of the current connection.

**Returns** The TLS version of the current connection. For example, it will return 0x769 for connections made over TLS version 1.

**Return type** `int`

**get\_protocol\_version\_name()**

Retrieve the protocol version of the current connection.

**Returns** The TLS version of the current connection, for example the value for TLS 1.2 would be `TLSv1.2` or `Unknown` for connections that were not successfully established.

**Return type** `unicode`

**get\_servername()**

Retrieve the servername extension value if provided in the client hello message, or `None` if there wasn't one.

**Returns** A byte string giving the server name or `None`.

New in version 0.13.

**get\_session()**

Returns the Session currently used.

**Returns** An instance of `OpenSSL.SSL.Session` or `None` if no session exists.

New in version 0.14.

**get\_shutdown()**

Get the shutdown state of the Connection.

**Returns** The shutdown state, a bitvector of `SENT_SHUTDOWN`, `RECEIVED_SHUTDOWN`.

**get\_state\_string()**

Retrieve a verbose string detailing the state of the Connection.

**Returns** A string representing the state

**Return type** `bytes`

**get\_verified\_chain()**

Retrieve the verified certificate chain of the peer including the peer's end entity certificate. It must be called after a session has been successfully established. If peer verification was not successful the chain may be incomplete, invalid, or `None`.

**Returns** A list of X509 instances giving the peer's verified certificate chain, or `None` if it does not have one.

New in version 20.0.

**makefile(\*args, \*\*kwargs)**

The `makefile()` method is not implemented, since there is no dup semantics for SSL connections

**Raise** `NotImplementedError`

**master\_key()**

Retrieve the value of the master key for this session.

**Returns** A string representing the state

**pending()**

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

**Returns** The number of bytes available in the receive buffer.

**read** (*bufsiz, flags=None*)

Receive data on the connection.

**Parameters**

- **bufsiz** – The maximum number of bytes to read
- **flags** – (optional) The only supported flag is `MSG_PEEK`, all other flags are ignored.

**Returns** The string read from the Connection

**recv** (*bufsiz, flags=None*)

Receive data on the connection.

**Parameters**

- **bufsiz** – The maximum number of bytes to read
- **flags** – (optional) The only supported flag is `MSG_PEEK`, all other flags are ignored.

**Returns** The string read from the Connection

**recv\_into** (*buffer, nbytes=None, flags=None*)

Receive data on the connection and copy it directly into the provided buffer, rather than creating a new string.

**Parameters**

- **buffer** – The buffer to copy into.
- **nbytes** – (optional) The maximum number of bytes to read into the buffer. If not present, defaults to the size of the buffer. If larger than the size of the buffer, is reduced to the size of the buffer.
- **flags** – (optional) The only supported flag is `MSG_PEEK`, all other flags are ignored.

**Returns** The number of bytes read into the buffer.

**renegotiate** ()

Renegotiate the session.

**Returns** True if the renegotiation can be started, False otherwise

**Return type** `bool`

**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`

**request\_ocsp** ()

Called to request that the server sends stapled OCSP data, if available. If this is not called on the client side then the server will not send OCSP data. Should be used in conjunction with `Context.set_ocsp_client_callback()`.

**send** (*buf, flags=0*)

Send data on the connection. NOTE: If you get one of the `WantRead`, `WantWrite` or `WantX509Lookup` exceptions on this, you have to call the method again with the SAME buffer.

**Parameters**

- **buf** – The string, buffer or memoryview to send
- **flags** – (optional) Included for compatibility with the socket API, the value is ignored

**Returns** The number of bytes written

**sendall** (*buf, flags=0*)

Send “all” data on 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.

**Parameters**

- **buf** – The string, buffer or memoryview to send
- **flags** – (optional) Included for compatibility with the socket API, the value is ignored

**Returns** The number of bytes written

**server\_random** ()

Retrieve the random value used with the server hello message.

**Returns** A string representing the state

**set\_accept\_state** ()

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

**Returns** None

**set\_alpn\_protos** (*protos*)

Specify the client’s ALPN protocol list.

These protocols are offered to the server during protocol negotiation.

**Parameters protos** – A list of the protocols to be offered to the server. This list should be a Python list of bytestrings representing the protocols to offer, e.g. [b'http/1.1', b'spdy/2'].

**set\_app\_data** (*data*)

Set application data

**Parameters data** – The application data

**Returns** None

**set\_connect\_state** ()

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

**Returns** None

**set\_context** (*context*)

Switch this connection to a new session context.

**Parameters context** – A *Context* instance giving the new session context to use.

**set\_session** (*session*)

Set the session to be used when the TLS/SSL connection is established.

**Parameters session** – A *Session* instance representing the session to use.

**Returns** None

New in version 0.14.

**set\_shutdown** (*state*)

Set the shutdown state of the Connection.

**Parameters state** – bitvector of SENT\_SHUTDOWN, RECEIVED\_SHUTDOWN.

**Returns** None

**set\_tlsext\_host\_name** (*name*)

Set the value of the servername extension to send in the client hello.

**Parameters** **name** – A byte string giving the name.

New in version 0.13.

**shutdown** ()

Send the shutdown message to the Connection.

**Returns** True if the shutdown completed successfully (i.e. both sides have sent closure alerts), False otherwise (in which case you call *recv()* or *send()* when the connection becomes readable/writable).

**sock\_shutdown** (\*args, \*\*kwargs)

Call the *shutdown()* method of the underlying socket. See *shutdown(2)*.

**Returns** What the socket's shutdown() method returns

**total\_renegotiations** ()

Find out the total number of renegotiations.

**Returns** The number of renegotiations.

**Return type** `int`

**want\_read** ()

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

**Returns** True iff more data has to be read

**want\_write** ()

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

**Returns** True iff there is data to write

**write** (*buf*, *flags=0*)

Send data on the connection. NOTE: If you get one of the WantRead, WantWrite or WantX509Lookup exceptions on this, you have to call the method again with the SAME buffer.

**Parameters**

- **buf** – The string, buffer or memoryview to send
- **flags** – (optional) Included for compatibility with the socket API, the value is ignored

**Returns** The number of bytes written

## 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 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*.

## 1.4.2 Callbacks

Callbacks were more of a problem when pyOpenSSL was written in C. Having switched to being written in Python using `ffi`, 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 **BI**Os, 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?

## 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.

#### 20.0.1 (2020-12-15)

##### Backward-incompatible changes:

**Deprecations:****Changes:**

- Fixed compatibility with OpenSSL 1.1.0.

**20.0.0 (2020-11-27)****Backward-incompatible changes:**

- The minimum cryptography version is now 3.2.
- Remove deprecated `OpenSSL.tsafe` module.
- Removed deprecated `OpenSSL.SSL.Context.set_npn_advertise_callback`, `OpenSSL.SSL.Context.set_npn_select_callback`, and `OpenSSL.SSL.Connection.get_next_proto_negotiated`.
- Drop support for Python 3.4
- Drop support for OpenSSL 1.0.1 and 1.0.2

**Deprecations:**

- Deprecated `OpenSSL.crypto.loads_pkcs7` and `OpenSSL.crypto.loads_pkcs12`.

**Changes:**

- Added a new `optional_chain` parameter to `OpenSSL.crypto.X509StoreContext()` where additional untrusted certificates can be specified to help chain building. [#948](#)
- Added `OpenSSL.crypto.X509Store.load_locations` to set trusted certificate file bundles and/or directories for verification. [#943](#)
- Added `Context.set_keylog_callback` to log key material. [#910](#)
- Added `OpenSSL.SSL.Connection.get_verified_chain` to retrieve the verified certificate chain of the peer. [#894](#).
- Make verification callback optional in `Context.set_verify`. If omitted, OpenSSL's default verification is used. [#933](#)
- Fixed a bug that could truncate or cause a zero-length key error due to a null byte in private key passphrase in `OpenSSL.crypto.load_privatekey` and `OpenSSL.crypto.dump_privatekey`. [#947](#)

**19.1.0 (2019-11-18)****Backward-incompatible changes:**

- Removed deprecated `ContextType`, `ConnectionType`, `PKeyType`, `X509NameType`, `X509ReqType`, `X509Type`, `X509StoreType`, `CRLType`, `PKCS7Type`, `PKCS12Type`, and `NetscapeSPKIType` aliases. Use the classes without the `Type` suffix instead. [#814](#)
- The minimum cryptography version is now 2.8 due to issues on macOS with a transitive dependency. [#875](#)

### Deprecations:

- Deprecated `OpenSSL.SSL.Context.set_npn_advertise_callback`, `OpenSSL.SSL.Context.set_npn_select_callback`, and `OpenSSL.SSL.Connection.get_next_proto_negotiated`. ALPN should be used instead. #820

### Changes:

- Support bytearray in `SSL.Connection.send()` by using cffi's `from_buffer`. #852
  - The `OpenSSL.SSL.Context.set_alpn_select_callback` can return a new `NO_OVERLAPPING_PROTOCOLS` sentinel value to allow a TLS handshake to complete without an application protocol.
- 

## 19.0.0 (2019-01-21)

### Backward-incompatible changes:

- `X509Store.add_cert` no longer raises an error if you add a duplicate cert. #787

### Deprecations:

*none*

### Changes:

- pyOpenSSL now works with OpenSSL 1.1.1. #805
  - pyOpenSSL now handles NUL bytes in `X509Name.get_components()` #804
- 

## 18.0.0 (2018-05-16)

### Backward-incompatible changes:

- The minimum `cryptography` version is now 2.2.1.
- Support for Python 2.6 has been dropped.

### Deprecations:

*none*



### Changes:

- Added `Connection.get_certificate` to retrieve the local certificate. #733
  - `OpenSSL.SSL.Connection` now sets `SSL_MODE_AUTO_RETRY` by default. #753
  - Added `Context.set_tlsext_use_srtp` to enable negotiation of SRTP keying material. #734
- 

### 17.5.0 (2017-11-30)

#### Backward-incompatible changes:

- The minimum cryptography version is now 2.1.4.

#### Deprecations:

*none*

#### Changes:

- Fixed a potential use-after-free in the verify callback and resolved a memory leak when loading PKCS12 files with `cacerts`. #723
  - Added `Connection.export_keying_material` for RFC 5705 compatible export of keying material. #725
- 

### 17.4.0 (2017-11-21)

#### Backward-incompatible changes:

*none*

#### Deprecations:

*none*

#### Changes:

- Re-added a subset of the `OpenSSL.rand` module. This subset allows conscientious users to reseed the OpenSSL CSPRNG after fork. #708
  - Corrected a use-after-free when reusing an issuer or subject from an `X509` object after the underlying object has been mutated. #709
-

### 17.3.0 (2017-09-14)

#### Backward-incompatible changes:

- Dropped support for Python 3.3. #677
- Removed the deprecated `OpenSSL.rand` module. This is being done ahead of our normal deprecation schedule due to its lack of use and the fact that it was becoming a maintenance burden. `os.urandom()` should be used instead. #675

#### Deprecations:

- Deprecated `OpenSSL.tsafe`. #673

#### Changes:

- Fixed a memory leak in `OpenSSL.crypto.CRL`. #690
  - Fixed a memory leak when verifying certificates with `OpenSSL.crypto.X509StoreContext`. #691
- 

### 17.2.0 (2017-07-20)

#### Backward-incompatible changes:

*none*

#### Deprecations:

- Deprecated `OpenSSL.rand` - callers should use `os.urandom()` instead. #658

#### Changes:

- Fixed a bug causing `Context.set_default_verify_paths()` to not work with cryptography manylinux1 wheels on Python 3.x. #665
  - Fixed a crash with (EC)DSA signatures in some cases. #670
- 

### 17.1.0 (2017-06-30)

#### Backward-incompatible changes:

- Removed the deprecated `OpenSSL.rand.egd()` function. Applications should prefer `os.urandom()` for random number generation. #630
  - Removed the deprecated default `digest` argument to `OpenSSL.crypto.CRL.export()`. Callers must now always pass an explicit `digest`. #652
-

- Fixed a bug with ASN1\_TIME casting in `X509.set_notBefore()`, `X509.set_notAfter()`, `Revoked.set_rev_date()`, `Revoked.set_nextUpdate()`, and `Revoked.set_lastUpdate()`. You must now pass times in the form `YYYYMMDDhhmmssZ`, `YYYYMMDDhhmmss+hhmm` and `YYYYMMDDhhmmss-hhmm` will no longer work. #612

### Deprecations:

- Deprecated the legacy “Type” aliases: `ContextType`, `ConnectionType`, `PKeyType`, `X509NameType`, `X509ExtensionType`, `X509ReqType`, `X509Type`, `X509StoreType`, `CRLType`, `PKCS7Type`, `PKCS12Type`, `NetscapeSPKIType`. The names without the “Type”-suffix should be used instead.

### Changes:

- Added `OpenSSL.crypto.X509.from_cryptography()` and `OpenSSL.crypto.X509.to_cryptography()` for converting X.509 certificate to and from `pyca/cryptography` objects. #640
- Added `OpenSSL.crypto.X509Req.from_cryptography()`, `OpenSSL.crypto.X509Req.to_cryptography()`, `OpenSSL.crypto.CRL.from_cryptography()`, and `OpenSSL.crypto.CRL.to_cryptography()` for converting X.509 CSRs and CRLs to and from `pyca/cryptography` objects. #645
- Added `OpenSSL.debug` that allows to get an overview of used library versions (including linked OpenSSL) and other useful runtime information using `python -m OpenSSL.debug`. #620
- Added a fallback path to `Context.set_default_verify_paths()` to accommodate the upcoming release of `cryptography` manylinux1 wheels. #633

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## 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 large 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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### Indices and tables

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