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Release v17.4.0 (What’s new?).

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

Patches

All patches to pyOpenSSL should be submitted in the form of pull requests to the main pyOpenSSL repository, pycas/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.

```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: 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: C2A04F86 ACE2 8ADC F817 DBB7 AE25 3622 7F69 F181). Feel free to cross-check this information with Keybase.

### 1.2 Installation

To install pyOpenSSL:

```bash
$ pip install pyopenssl
```

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

```bash
$ 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:

- 1.0.1
- 1.0.2
- 1.1.0

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

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

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

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

**Serialization and deserialization**

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

**OpenSSL.crypto.FILETYPE_PEM**

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

**OpenSSL.crypto.FILETYPE_ASN1**

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

**Certificates**

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

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

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

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

**Certificate signing requests**

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

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

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

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

**Private keys**

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

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

**Parameters**

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

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

**Return type** bytes
OpenSSL.crypto.load_privatekey(type, buffer[, passphrase])
Load a private key (PKey) from the string buffer encoded with the type type (must be one of FILETYPE_PEM and FILETYPE_ASN1).

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

Public keys

OpenSSL.crypto.dump_publickey(type, pkey)
Dump a public key to a buffer.

Parameters

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

Returns The buffer with the dumped key in it.
Return type bytes

OpenSSL.crypto.load_publickey(type, buffer)
Load a public key from a buffer.

Parameters

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

Returns The PKey object.
Return type PKey

Certificate revocation lists

OpenSSL.crypto.dump_crl(type, crl)
Dump a certificate revocation list to a buffer.

Parameters

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

Returns The buffer with the CRL.
Return type bytes

OpenSSL.crypto.load_crl(type, buffer)
Load Certificate Revocation List (CRL) data from a string buffer. buffer encoded with the type type. The type type must either FILETYPE_PEM or FILETYPE_ASN1).

OpenSSL.crypto.load_pkcs7_data(type, buffer)
Load pkcs7 data from the string buffer encoded with the type type. The type type must either FILETYPE_PEM or FILETYPE_ASN1).

OpenSSL.crypto.load_pkcs12(buffer[, passphrase])
Load pkcs12 data from the string buffer. If the pkcs12 structure is encrypted, a passphrase must be included. The MAC is always checked and thus required.
See also the man page for the C function `PKCS12_parse()`.

### Signing and verifying signatures

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

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

- **key** is a `PKey` instance. **data** is a `str` instance. **digest** is a `str` naming a supported message digest type, for example `b"sha256"`.
- New in version 0.11.

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

Verify the signature for a data string.

- **certificate** is a `X509` instance corresponding to the private key which generated the signature. **signature** is a `str` instance giving the signature itself. **data** is a `str` instance giving the data to which the signature applies. **digest** is a `str` instance naming the message digest type of the signature, for example `b"sha256"`.
- New in version 0.11.

### X509 objects

#### class OpenSSL.crypto.X509

An X.509 certificate.

- **add_extensions** *(extensions)*
  
  Add extensions to the certificate.
  
  **Parameters**
  
  - **extensions** (An iterable of `X509Extension` objects.) – The extensions to add.
  
  **Returns** None

- **digest** *(digest_name)*
  
  Return the digest of the X509 object.
  
  **Parameters**
  
  - **digest_name** *(bytes)* – The name of the digest algorithm to use.
  
  **Returns** The digest of the object, formatted as `b":-delimited hex pairs`.

  **Return type** `bytes`

- **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** `PKey`

- **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:

YYYYMMDDhhmmsZ

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.

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.

  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

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 PKey

    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

\textbf{sign}(pkey, digest)

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

Parameters

\begin{itemize}
  \item \textbf{pkey} (\texttt{PKey}) – The key pair to sign with.
  \item \textbf{digest} (\texttt{bytes}) – The name of the message digest to use for the signature, e.g.
    \texttt{b"sha256"}.
\end{itemize}

Returns None

\textbf{to\_cryptography}()

Export as a cryptography certificate signing request.

Return type cryptography.x509.CertificateSigningRequest

New in version 17.1.0.

\textbf{verify}(pkey)

Verifies the signature on this certificate signing request.

Parameters \textbf{key} (\texttt{PKey}) – A public key.

Returns True if the signature is correct.

Return type \texttt{bool}

Raises OpenSSL\_crypto\_Error – If the signature is invalid or there is a problem verifying
the signature.

\textbf{X509Store objects}

\textbf{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 \texttt{X509StoreContext}.

\textbf{add\_cert}(cert)

Adds a trusted certificate to this store.

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

Parameters \textbf{cert} (\texttt{X509}) – The certificate to add to this store.

Raises

\begin{itemize}
  \item \textbf{TypeError} – If the certificate is not an \texttt{X509}.
  \item OpenSSL\_crypto\_Error – If OpenSSL was unhappy with your certificate.
\end{itemize}

Returns None if the certificate was added successfully.

\textbf{add\_crl}(crl)

Add a certificate revocation list to this store.

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

New in version 16.1.0.
Parameters **crl** *(CRL)* – The certificate revocation list to add to this store.

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

**set_flags** *(flags)*
Set verification flags to this store.
Verification flags can be combined by oring them together.

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

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

New in version 16.1.0.

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

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

**set_time** *(vfy_time)*
Set the time against which the certificates are verified.
Normally the current time is used.

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

New in version 17.0.0.

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

**Returns** None if the verification time was successfully set.

### X509StoreContextError objects

**class** `OpenSSL.crypto.X509StoreContextError` *(message, certificate)*
An exception raised when an error occurred while verifying a certificate using `OpenSSL.X509StoreContext.verify_certificate`.

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

### X509StoreContext objects

**class** `OpenSSL.crypto.X509StoreContext` *(store, certificate)*
An X.509 store context.
An X.509 store context is used to carry out the actual verification process of a certificate in a described context. For describing such a context, see [X509Store](#).

**Variables**

- **_store_ctx** – The underlying X509_STORE_CTX structure used by this instance. It is dynamically allocated and automatically garbage collected.
  - **_store** – See the `store__init__` parameter.
  - **_cert** – See the `certificate__init__` parameter.
Parameters

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

```python
def 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.

def 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

```python
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

```python
class OpenSSL.crypto.PKey
    A class representing an DSA or RSA public key or key pair.
    `bits()`
    Returns the number of bits of the key
    ```
    Returns The number of bits of the key.
check()
Check the consistency of an RSA private key.

This is the Python equivalent of OpenSSL’s RSA_check_key.

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

classmethod from_cryptography_key(crypto_key)
Construct based on a cryptography crypto_key.

Parameters crypto_key (One of cryptography’s key interfaces.) – A cryptography key.

Return type PKey
New in version 16.1.0.

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

This generates a key “into” the this object.

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

Raises
- TypeError – If type or bits isn’t of the appropriate type.
- ValueError – If the number of bits isn’t an integer of the appropriate size.

Returns None

to_cryptography_key()
Export as a cryptography key.

Return type One of cryptography’s key interfaces.
New in version 16.1.0.

type()
Returns the type of the key

Returns The type of the key.

OpenSSL.crypto.TYPE_RSA
OpenSSL.crypto.TYPE_DSA
Key type constants.

PKCS7 objects
PKCS7 objects have the following methods:

PKCS7.type_is_signed()
FIXME
PKCS7.type_is_enveloped()
    FIXME
PKCS7.type_is_signedAndEnveloped()
    FIXME
PKCS7.type_is_data()
    FIXME
PKCS7.get_type_name()
    Get the type name of the PKCS7.

PKCS12 objects

class OpenSSL.crypto.PKCS12
    A PKCS #12 archive.
    export (passphrase=None, iter=2048, maciter=1)
        Dump a PKCS12 object as a string.
        For more information, see the PKCS12_create() man page.
        Parameters
            • passphrase (bytes) – The passphrase used to encrypt the structure. Unlike some
              other passphrase arguments, this must be a string, not a callback.
            • iter (int) – Number of times to repeat the encryption step.
            • maciter (int) – Number of times to repeat the MAC step.
        Returns The string representation of the PKCS #12 structure.
    Return type

get_ca_certificates()
    Get the CA certificates in the PKCS #12 structure.
    Returns A tuple with the CA certificates in the chain, or None if there are none.
    Return type tuple of X509 or None

get_certificate()
    Get the certificate in the PKCS #12 structure.
    Returns The certificate, or None if there is none.
    Return type X509 or None

get_friendlyname()
    Get the friendly name in the PKCS# 12 structure.
    Returns The friendly name, or None if there is none.
    Return type bytes or None

get_privatekey()
    Get the private key in the PKCS #12 structure.
    Returns The private key, or None if there is none.
    Return type PKey

set_ca_certificates(cacerts)
    Replace or set the CA certificates within the PKCS12 object.
Parameters cacerts (An iterable of X509 or None) – The new CA certificates, or None to unset them.

Returns None

set_certificate(cert)
Set the certificate in the PKCS #12 structure.

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

Returns None

set_friendlyname(name)
Set the friendly name in the PKCS #12 structure.

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

Returns None

set_privatekey(pkey)
Set the certificate portion of the PKCS #12 structure.

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

Returns None

X509Extension objects

class OpenSSL.crypto.X509Extension(type_name, critical, value, subject=None, issuer=None)
An X.509 v3 certificate extension.

__init__(type_name, critical, value, subject=None, issuer=None)
Initializes an X509 extension.

Parameters

• type_name (bytes) – The name of the type of extension to create.

• critical (bool) – A flag indicating whether this is a critical extension.

• value (bytes) – The value of the extension.

• subject (X509) – Optional X509 certificate to use as subject.

• issuer (X509) – Optional X509 certificate to use as issuer.

__str__()
Returns a nice text representation of the extension

get_critical()
Returns the critical field of this X.509 extension.

Returns The critical field.

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

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

Return type bytes
New in version 0.12.
get_short_name()
Returns the short type name of this X.509 extension.

The result is a byte string such as \texttt{b"basicConstraints"}.

- Returns: The short type name.
- Return type: bytes

New in version 0.12.

**NetscapeSPKI objects**

```python
class OpenSSL.crypto.NetscapeSPKI
A Netscape SPKI object.

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

- Returns: The base64 encoded string.
- Return type: bytes

get_pubkey()
Get the public key of this certificate.

- Returns: The public key.
- Return type: PKey

set_pubkey(pkey)
Set the public key of the certificate

Parameters:
- pkey (PKey) – The public key
- Returns: None

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

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

- Returns: None

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

Parameters:
- key (PKey) – The public key that signature is supposedly from.

- Returns: True if the signature is correct.
- Return type: bool

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

class OpenSSL.crypto.CRL
A certificate revocation list.

    add_revoked(revoked)
    Add a revoked (by value not reference) to the CRL structure
    This revocation will be added by value, not by reference. That means it’s okay to mutate it after adding: it
    won’t affect this CRL.
    Parameters revoked (Revoked) – The new revocation.
    Returns None

    export(cert, key, type=1, days=100, digest=<object object>)
    Export the CRL as a string.
    Parameters
    • cert (X509) – The certificate used to sign the CRL.
    • key (PKey) – The key used to sign the CRL.
    • type (int) – The export format, either FILETYPE_PEM, FILETYPE_ASN1, or
    FILETYPE_TEXT.
    • days (int) – The number of days until the next update of this CRL.
    • digest (bytes) – The name of the message digest to use (eg b"sha2566").
    Return type bytes

   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:
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

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.

```python
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.

```python
OpenSSL.SSLVERIFY_NONE
OpenSSL.SSLVERIFY_PEER
OpenSSL.SSLVERIFY_FAIL_IF_NO_PEER_CERT
```

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

```python
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.

```python
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.

```python
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.

```python
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.

```python
OpenSSL.SSL.OP_NO_COMPRESSION
```

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

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

```python
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.

**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:

```python
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.

```python
Context.get_app_data()
```

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

---

\(^1\) Actually, all that is required is an object that behaves like a socket, you could even use files, even though it’d be tricky to get the handshakes right!
Context.get_cert_store()  
Retrieves 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()  
Retrieves session timeout, as set by set_timeout(). The default is 300 seconds.

Context.get_verify_depth()  
Retrieves the Context object’s verify depth, as set by set_verify_depth().

Context.get_verify_mode()  
Retrieves the Context object’s verify mode, as set by set_verify().

Context.load_client_ca(cafile)  
Loads 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 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.

Context.load_tmp_dh(dhfile)

Load parameters for Ephemeral Diffie-Hellman from dhfile.

Context.set_tmp_ecdh(curve)

Select a curve to use for ECDHE key exchange.

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

Context.set_app_data(data)

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

Context.set_cipher_list(cipher_list)

Set the list of ciphers to be used in this context.
See the OpenSSL manual for more information (e.g. ciphers(1)).

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

Returns None

`Context.set_info_callback(callback)`
Set the information callback to `callback`. This function will be called from time to time during SSL handshakes.

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

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

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

`Context.set_passwd_cb(callback[, userdata])`
Set the passphrase callback to `callback`. This function will be called when a private key with a passphrase is loaded. `callback` must accept three positional arguments. First, an integer giving the maximum length of the passphrase it may return. If the returned passphrase is longer than this, it will be truncated. Second, a boolean value which will be true if the user should be prompted for the passphrase twice and the callback should verify that the two values supplied are equal. Third, the value given as the `userdata` parameter to `set_passwd_cb()`. The `callback` must return a byte string. 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\.__init__()  
Call the \.__init__() method of the underlying socket and set up SSL on the returned socket, using the Context object supplied to this Connection object at creation.

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

Connection.bind(address)  
Call the bind() method of the underlying socket.

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

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

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

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

Connection.fileno()  
Retrieve the file descriptor number for the underlying socket.

Connection.listen(backlog)  
Call the listen() method of the underlying socket.

Connection.get_app_data()  
Retrieve application data as set by set_app_data().

Connection.get_cipher_list()  
Retrieve the list of ciphers used by the Connection object.  

Returns  A list of native cipher strings.

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

Connection.get_protocol_version_name()  
Retrieve the version of the SSL or TLS protocol used by the Connection as a unicode string. For example, it will return TLSv1 for connections made over TLS version 1, or Unknown for connections that were not successfully established.
Connection.get_client_ca_list()
Retrieve the list of preferred client certificate issuers sent by the server as OpenSSL.crypto.X509Name objects.

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

New in version 0.10.

Connection.get_context()
Retrieve the Context object associated with this Connection.

Connection.set_context(context)
Specify a replacement Context object for this Connection.

Connection.get_peer_certificate()
Retrieve the other side's certificate (if any)

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

Connection.getpeername()
Call the getpeername() method of the underlying socket.

Connection.getsockname()
Call the getsockname() method of the underlying socket.

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

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

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

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

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

Connection.renegotiate()
Renegotiate the session.

Returns True if the renegotiation can be started, False otherwise
Return type bool

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

Returns Whether there's a renegotiation in progress
Return type bool
Connection.total_renegotiations()  
Find out the total number of renegotiations.

Returns The number of renegotiations.

Return type int

Connection.send(string)  
Send the string data to the Connection.

Connection.bioread(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.\texttt{server\_random}()
Retrieve the random value used with the server hello message.

Connection.\texttt{master\_key}()
Retrieve the value of the master key for this session.

Connection.\texttt{want\_read}()
Checks if more data has to be read from the transport layer to complete an operation.

Connection.\texttt{want\_write}()
Checks if there is data to write to the transport layer to complete an operation.

Connection.\texttt{set\_tlsext\_host\_name}(\texttt{name})
Specify the byte string to send as the server name in the client hello message.
New in version 0.13.

Connection.\texttt{get\_servername}()
Get the value of the server name received in the client hello message.
New in version 0.13.

Connection.\texttt{get\_session}()
Get a \texttt{Session} instance representing the SSL session in use by the connection, or \texttt{None} if there is no session.
New in version 0.14.

Connection.\texttt{set\_session}(\texttt{session})
Set a new SSL session (using a \texttt{Session} instance) to be used by the connection.
New in version 0.14.

Connection.\texttt{get\_finished}()
Obtain latest TLS Finished message that we sent, or \texttt{None} if handshake is not completed.
New in version 0.15.

Connection.\texttt{get\_peer\_finished}()
Obtain latest TLS Finished message that we expected from peer, or \texttt{None} if handshake is not completed.
New in version 0.15.

Connection.\texttt{get\_cipher\_name}()
Obtain the name of the currently used cipher.
New in version 0.15.

Connection.\texttt{get\_cipher\_bits}()
Obtain the number of secret bits of the currently used cipher.
New in version 0.15.

Connection.\texttt{get\_cipher\_version}()
Obtain the protocol name of the currently used cipher.
New in version 0.15.

Connection.\texttt{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.\texttt{set\_alpn\_protos}(\texttt{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 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 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.

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

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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