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# **django-ca Documentation**

*Release 1.6.2*

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## Contents

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|           |   |           |
|-----------|---|-----------|
| <b>1</b>  | <b>Installation</b>                                     | <b>3</b>  |
| <b>2</b>  | <b>Update</b>   | <b>7</b>  |
| <b>3</b>  | <b>Custom settings</b>                                  | <b>9</b>  |
| <b>4</b>  | <b>Command-line interface</b>                           | <b>13</b> |
| <b>5</b>  | <b>Web interface</b>                                    | <b>15</b> |
| <b>6</b>  | <b>Certificate authority management</b>                 | <b>17</b> |
| <b>7</b>  | <b>Host a Certificate Revocation List (CRL)</b>         | <b>19</b> |
| <b>8</b>  | <b>Run a OCSP responder</b>                             | <b>23</b> |
| <b>9</b>  | <b>Development</b>                                      | <b>27</b> |
| <b>10</b> | <b>Contribute</b>                                       | <b>31</b> |
| <b>11</b> | <b>x509 extensions in other CAs</b>                     | <b>33</b> |
| <b>12</b> | <b>ChangeLog</b>  | <b>45</b> |
| <b>13</b> | <b><code>django_ca.models</code> - django-ca models</b> | <b>51</b> |
| <b>14</b> | <b><code>django_ca.utils</code> - utility functions</b> | <b>53</b> |
| <b>15</b> | <b>Indices and tables</b>                               | <b>57</b> |
|           | <b>Python Module Index</b>                              | <b>59</b> |



**django-ca** is a tool to manage TLS certificate authorities and easily issue and revoke certificates. It is based [cryptography](#) and [Django](#). It can be used as an app in an existing Django project or stand-alone with the basic project included. Everything can be managed via the command line via *manage.py* commands - so no webserver is needed, if you're happy with the command-line.

Features:

- Create certificate authorities, issue and revoke certificates in minutes.
- Receive e-mail notifications of certificates about to expire.
- Certificate validation via the included OCSP responder and Certificate Revocation Lists (CRLs).
- Complete, consistent and powerful command line interface.
- Optional web interface for certificate handling (e.g. issuing, revoking, ...).
- Written in pure Python2.7/Python3.4+, using Django 1.8 or later.

Contents:



You can run **django-ca** as a regular app in any existing Django project of yours, but if you don't have any Django project running, you can run it as a *standalone project*.

## Requirements

- Python 2.7 or Python 3.4+
- Django 1.8+
- Any database supported by Django (sqlite3/MySQL/PostgreSQL/...)
- Python, OpenSSL and libffi development headers

## As Django app (in your existing Django project)

This chapter assumes that you have an already running Django project and know how to use it.

You need various development headers for pyOpenSSL, on Debian/Ubuntu systems, simply install these packages:

```
$ apt-get install gcc python3-dev libffi-dev libssl-dev
```

You can install **django-ca** simply via pip:

```
$ pip install django-ca
```

and add it to your `INSTALLED_APPS`:

```
INSTALLED_APPS = [  
    # ... your other apps...  
  
    'django_ca',  
]
```

... and configure the *other available settings* to your liking, then simply run:

```
$ python manage.py migrate
$ python manage.py collectstatic

# FINALLY, create the root certificates for your CA:
#   (replace parameters after init_ca with your local details)
$ python manage.py init_ca RootCA \
>   /C=AT/ST=Vienna/L=Vienna/O=Org/OU=OrgUnit/CN=ca.example.com
```

After that, **django-ca** should show up in your admin interface (see *Web interface*) and provide various `manage.py` commands (see *Command-line interface*).

## As standalone project

You can also install **django-ca** as a stand-alone project, if you install it via git. The project provides a *command-line interface* that provides complete functionality. The *web interface* is optional.

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**Note:** If you don't want the private keys of your CAs on the same machine as the web interface, you can also host the web interface on a second server that accesses the same database (CA private keys are hosted on the filesystem, not in the database). You obviously will not be able to sign certificates using the web interface, but you can still e.g. revoke certificates or run a *OCSP responder*.

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In the following code-snippet, you'll do all necessary steps to get a basic setup:

```
# install dependencies (adapt to your distro):
$ apt-get install gcc git python3-dev libffi-dev libssl-dev virtualenv

# clone git repository:
$ git clone https://github.com/mathiasertl/django-ca.git

# create virtualenv:
$ cd django-ca
$ virtualenv -p /usr/bin/python3 .
$ source bin/activate

# install Python dependencies:
$ pip install -U pip setuptools
$ pip install -r requirements.txt
```

In the above script, you have created a *virtualenv*, meaning that all libraries you install with `pip install` are installed in the *virtualenv* (and don't pollute your system). It also means that before you execute any `manage.py` commands, you'll have to activate your *virtualenv*, by doing, in the directory of the git checkout:

```
$ source bin/activate
```

## Configure django-ca

Before you continue, you have to configure **django-ca**. Django uses a file called `settings.py`, but so you don't have to change any files managed by git, it includes `localsettings.py` in the same directory. So copy the example file and edit it with your favourite editor:



```
$ cp ca/ca/localsettings.py.example ca/ca/localsettings.py
```

The most important settings are documented there, but you can of course use any setting provided by Django.

**Warning:** The `SECRET_KEY` and `DATABASES` settings are absolutely mandatory. If you use the *Web interface*, the `STATIC_ROOT` setting is also mandatory.

## Initialize the project

After you have configured **django-ca**, you need to initialize the project by running a few `manage.py` commands:

```
$ python ca/manage.py migrate

# If you intend to run the webinterface (requires STATIC_ROOT setting!)
$ python ca/manage.py collectstatic

# FINALLY, create a certificate authority:
#   (replace parameters after init_ca with your local details)
$ python manage.py init_ca /C=AT/ST=Vienna/L=Vienna/O=Org/CN=ca.example.com
```

Please also see *Certificate authority management* for further information on how to create certificate authorities. You can also run `init_ca` with the `-h` parameter for available arguments.

## Create manage.py shortcut

If you don't want to always `chdir` to the git checkout, activate the `virtualenv` and only then run `manage.py`, you might want to create a shortcut shell script somewhere in your `PATH` (e.g. `/usr/local/bin`):

```
#!/bin/bash

# BASEDIR is the location of your git checkout
BASEDIR=/usr/local/share/ca
PYTHON=${BASEDIR}/bin/python
MANAGE=${BASEDIR}/ca/manage.py

${PYTHON} ${MANAGE} "$@"
```

## Setup a webserver

Setting up a webserver and all that comes with it is really out of scope of this document. The WSGI file is located in `ca/ca/wsgi.py`. Django itself provides some info for using Apache and `mod_wsgi`, or you could use `uWSGI` and `nginx`, or any of the many other options available.

## Apache and mod\_wsgi

Github user [Raoul Thill](#) notes that you need some special configuration variable if you use Apache together with `mod_wsgi` (see [here](#)):

```
WSGIDaemonProcess django_ca processes=1 python-path=/opt/django-ca/ca:/opt/django-ca/
↳ca/ca:/opt/django-ca/lib/python2.7/site-packages threads=5
WSGIProcessGroup django_ca
WSGIApplicationGroup %{GLOBAL}
WSGIScriptAlias / /opt/django-ca/ca/ca/wsgi.py
```

## Regular cronjobs

Some `manage.py` commands are intended to be run as cronjobs:

```
# assuming you cloned the repo at /root/:
HOME=/root/django-ca
PATH=/root/django-ca/bin

# m h dom mon dow user command

# notify watchers about certificates about to expire
* 8 * * * root python ca/manage.py notify_expiring_certs

# recreate the CRL and the OCSP index
12 * * * * root python ca/manage.py dump_crl
14 * * * * root python ca/manage.py dump_ocsp_index
```

Since 1.0.0, this project updates like any other project. First, update the source code, if you use git:

```
git pull origin master
```

or if you installed **django-ca** via pip:

```
pip install -U django-ca
```

then upgrade with these commands:

```
pip install -U -r requirements.txt
python ca/manage.py migrate

# if you use the webinterface
python ca/manage.py collectstatic
```

**Warning:** If you installed **django-ca** in a virtualenv, don't forget to activate it before executing any python or pip commands using:

```
source bin/activate
```

## Update from 1.0.0b2

If you're updating from a version earlier than 1.0.0 (which was the first real release), you have to first update to 1.0.0.b1 (see below), then to 1.0.0.b2, apply all migrations and reset existing migrations. Since all installed instances were probably private, it made sense to start with a clean state.

To update from an earlier git-checkout, to:

- Upgrade to version 1.0.0b2

- Apply all migrations.
- Upgrade to version 1.0.0
- Remove old migrations from the database:

```
python manage.py dbshell
> DELETE FROM django_migrations WHERE app='django_ca';
```

- Fake the first migration:  
python manage.py migrate django\_ca 0001 --fake

## Update from pre 1.0.0b1

Prior to 1.0.0, this app was not intended to be reusable and so had a generic name. The app was renamed to *django\_ca*, so it can be used in other Django projects (or hopefully stand-alone, someday). Essentially, the upgrade path should work something like this:

```
# backup old data:
python manage.py dumpdata certificate --indent=4 > certs.json

# update source code
git pull origin master

# create initial models in the new app, but only the initial version!
python manage.py migrate django_ca 0001

# update JSON with new model name
sed 's/"certificate.certificate"/"django_ca.certificate"/' > certs-updated.json

# load data
python manage.py loaddata certs-updated.json

# apply any other migrations
python manage.py migrate
```

---

## Custom settings

---

You can use any of the settings understood by Django and **django-ca** provides some of its own settings.

From Django's settings, you especially need to configure `DATABASES`, `SECRET_KEY`, `ALLOWED_HOSTS` and `STATIC_ROOT`.

All settings used by **django-ca** start with the `CA_` prefix. Settings are also documented at `ca/ca/localsettings.py.example` ([view on git](#)).

**CA\_DEFAULT\_EXPIRES** Default: 730

The default time, in days, that any signed certificate expires.

**CA\_DEFAULT\_PROFILE** Default: `webserver`

The default profile to use.

**CA\_DEFAULT\_SUBJECT** Default: `{}`

The default subject to use. The keys of this dictionary are the valid fields in X509 certificate subjects. Example:

```
CA_DEFAULT_SUBJECT = {
    'C': 'AT',
    'ST': 'Vienna',
    'L': 'Vienna',
    'O': 'HTU Wien',
    'OU': 'Fachschaft Informatik',
    'emailAddress': 'user@example.com',
}
```

**CA\_DIGEST\_ALGORITHM** Default: `"sha512"`

The default digest algorithm used to sign certificates. You may want to use `"sha256"` for older (pre-2010) clients. Note that this setting is also used by the `init_ca` command, so if you have any clients that do not understand sha512 hashes, you should change this beforehand.

**CA\_DIR** Default: `"ca/files"`

Where the root certificate is stored. The default is a `files` directory in the same location as your `manage.py` file.

**CA\_NOTIFICATION\_DAYS** Default: [14, 7, 3, 1, ]

Days before expiry that certificate watchers will receive notifications. By default, watchers will receive notifications 14, seven, three and one days before expiry.

**CA\_OCSP\_URLS** Default: {}

Configuration for OCSP responders. See *Run a OCSP responder* for more information.

**CA\_PROFILES** Default: {}

Profiles determine the default values for the `keyUsage`, `extendedKeyUsage` x509 extensions. In short, they determine how your certificate can be used, be it for server and/or client authentication, e-mail signing or anything else. By default, **django-ca** provides these profiles:

| Profile    | keyUsage  | extendedKeyUsage                         |
|------------|---|--|
| client     | digitalSignature                                    | clientAuth                               |
| server     | digitalSignature, keyAgreement keyEncipherment      | clientAuth, serverAuth                   |
| web-server | digitalSignature, keyAgreement keyEncipherment      | serverAuth                               |
| enduser    | dataEncipherment, digitalSignature, keyEncipherment | clientAuth, emailProtection, codeSigning |
| ocsp       | nonRepudiation, talSignature, keyEncipherment       | OCSPSigning                              |

Further more,

- The `keyUsage` attribute is marked as critical.
- The `extendedKeyUsage` attribute is marked as non-critical.

This should be fine for most usecases. But you can use the `CA_PROFILES` setting to either update or disable existing profiles or add new profiles that you like. For that, set `CA_PROFILES` to a dictionary with the keys defining the profile name and the value being either:

- None to disable an existing profile.
- A dictionary defining the profile. If the name of the profile is an existing profile, the dictionary is updated, so you can omit a value to leave it as the default. The possible keys are:

| key                | Description   |
|--------------------|---|
| "keyUsage"         | The <code>keyUsage</code> X509 extension.   |
| "extendedKeyUsage" | The <code>extendedKeyUsage</code> X509 extension.   |
| "desc"             | A human-readable description, shows up with “ <code>sig_cert -h</code> ” and in the webinterface profile selection.               |
| "subject"          | The default subject to use. If omitted, <code>CA_DEFAULT_SUBJECT</code> is used.  |
| "cn_in_san"        | If to include the <code>CommonName</code> in the <code>subjectAltName</code> by default. The default value is <code>True</code> . |

Here is a full example:

```
CA_PROFILES = {
    'client': {
        'desc': _('Nice description.'),
        'keyUsage': {
            'critical': True,
            'value': [
                'digitalSignature',
            ],
        },
        'extendedKeyUsage': {
            'critical': False,
            'value': [
```

```
        'clientAuth',
    ],
},
'subject': {
    'C': 'AT',
    'L': 'Vienna',
}
},

# We really don't like the "ocsp" profile, so we remove it.
'ocsp': None,
}
```

**CA\_PROVIDE\_GENERIC\_CRL** Default: True

If set to `False`, `django_ca.urls` will not add a CRL view. See [Use generic view to host a CRL](#) for more information.

This setting only has effect if you use `django_ca` as a full project or you include the `django_ca.urls` module somewhere in your URL configuration.





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## Command-line interface

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**django-ca** provides a complete command-line interface for all functionality. It is implemented as subcommands of Django's `manage.py` script. You can use it for all certificate management operations, and *Certificate authority management* is only possible via the command-line interface for security reasons.

In general, run `manage.py` without any parameters for available subcommands:

```
$ python manage.py
...
[django_ca]
  cert_watchers
  dump_cert
  dump_crl
  ...
```

**Warning:** Remember to use the `virtualenv` if you installed **django-ca** in one.

Execute `manage.py <subcommand> -h` to get help on the subcommand.

`manage.py` subcommands for *certificate authority management*:

| Command               | Description  |
|-----------------------|--|
| <code>dump_ca</code>  | Write the CA certificate to a file.                |
| <code>edit_ca</code>  | Edit an existing certificate authority.            |
| <code>init_ca</code>  | Create a new certificate authority.                |
| <code>list_cas</code> | List currently configured certificate authorities. |
| <code>view_ca</code>  | View details of a certificate authority.           |

`manage.py` subcommands for certificate management:

| Command               | Description   |
|-----------------------|---|
| cert_watchers         | Add/remove addresses to be notified of an expiring certificate. |
| dump_cert             | Dump a certificate to a file.                                   |
| list_certs            | List all certificates.  |
| notify_expiring_certs | Send notifications about expiring certificates to watchers.     |
| revoke_cert           | Revoke a certificate.   |
| sign_cert             | Sign a certificate.   |
| view_cert             | View a certificate.   |

Miscellaneous `manage.py` subcommands:

| Command         | Description  |
|-----------------|--|
| dump_crl        | Write the certificate revocation list (CRL), see <i>Host a Certificate Revocation List (CRL)</i> . |
| dump_ocsp_index | Write an OCSP index file, see <i>Run a OCSP responder</i> .  |

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## Web interface

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The web interface allows you to perform the most common tasks necessary when running certificate authority. It is implemented using Django's admin interface. You can:

- Issue and revoke certificates.
- Modify the x509 extensions used when signing certificates.
- Modify who is notified about expiring certificates.

The django project in the git repository (e.g. if you installed **django-ca** as *a standalone project*) already enables the admin interface and it's usable as soon as you enabled the webserver (tip: Create a user for login using `manage.py createsuperuser`). If you installed **django-ca** as an app, the admin interface is automatically included.



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## Certificate authority management

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**django-ca** supports managing multiple certificate authorities as well as child certificate authorities.

The only way to create certificate authorities is via the *command-line interface*. It is obviously most important that the private keys of the certificate authorities are never exposed to any attacker, and any web interface would pose an unnecessary risk.

For the same reason, the private key of a certificate authority is stored on the filesystem and not in the database. The initial location of the private key is configured by the *CA\_DIR setting*. This also means that you can run your **django-ca** on two hosts, where one host has the private key and only uses the command line, and one with the webinterface that can still be used to revoke certificates.

To manage certificate authorities, use the following *manage.py* commands:

| Command               | Description  |
|-----------------------|--|
| <code>init_ca</code>  | Create a new certificate authority.                    |
| <code>list_cas</code> | List all currently configured certificate authorities. |
| <code>edit_ca</code>  | Edit a certificate authority.                          |
| <code>view_ca</code>  | View details of a certificate authority.               |
| <code>dump_ca</code>  | Write the CA certificate to a file.                    |

Various details of the certificate authority, mostly the x509 extensions used when signing a certificate, can also be managed via the webinterface.

Here is a shell session that illustrates the respective *manage.py* commands:

```
$ python manage.py init_ca --pathlen=2
> --crl-url=http://ca.example.com/crl \
> --ocsp-url=http://ocsp.ca.example.com \
> --issuer-url=http://ca.example.com/ca.crt \
> TestCA /C=AT/L=Vienna/L=Vienna/O=Example/OU=ExampleUnit/CN=ca.example.com
$ python manage.py list_cas
BD:5B:AB:5B:A2:1C:49:0D:9A:B2:AA:BC:68:ED:ED:7D - TestCA

$ python manage.py view_ca BD:5B:AB:5B:A2
...
* OCSP URL: http://ocsp.ca.example.com
```

```
$ python manage.py edit_ca --ocsp-url=http://new-ocsp.ca.example.com \  
> BD:5B:AB:5B:A2  
$ python manage.py view_ca BD:5B:AB:5B:A2  
...  
* OCSP URL: http://new-ocsp.ca.example.com
```

Note that you can just use the start of a serial to identify the CA, as long as that still uniquely identifies the CA.

## Create intermediate CAs

Intermediate CAs are created, just like normal CAs, using `manage.py init_ca`. For intermediate CAs to be valid, CAs however must have a correct `pathlen` x509 extension. Its value is an integer describing how many levels of intermediate CAs a CA may have. A `pathlen` of “0” means that a CA cannot have any intermediate CAs, if it is not present, a CA may have an infinite number of intermediate CAs.

---

**Note:** `django-ca` by default sets a `pathlen` of “0”, as it aims to be secure by default. The `pathlen` attribute cannot be changed in hindsight (not without resigning the CA). If you plan to create intermediate CAs, you have to consider this when creating the root CA.

---

So for example, if you want two levels of intermediate CAs, , you’d need the following `pathlen` values (the `pathlen` value is the minimum value, it could always be a larger number):

| index | CA                   | pathlen | description                                       |
|-------|----------------------|---------|---|
| 1     | example.com          | 2       | Your root CA.                                     |
| 2     | sub1.example.com     | 1       | Your first intermediate CA, a sub-CA from (1).    |
| 3     | sub2.example.com     | 0       | A second intermediate CA, also a sub-CA from (1). |
| 4     | sub.sub1.example.com | 0       | An intermediate CA of (2).                        |

If in the above example, CA (1) had `pathlen` of “1” or CA (2) had a `pathlen` of “0”, CA (4) would no longer be a valid CA.

By default, `django-ca` sets a `pathlen` of 0, so CAs will not be able to have any intermediate CAs. You can configure the value by passing `--pathlen` to `init_ca`:

```
$ python manage.py init_ca --pathlen=2 ...
```

When creating a sub-ca, you must name its parent using the `--parent` parameter:

```
$ python manage.py list_cas  
BD:5B:AB:5B:A2:1C:49:0D:9A:B2:AA:BC:68:ED:ED:7D - Root CA  
$ python manage.py init_ca --parent=BD:5B:AB:5B ...
```

---

**Note:** Just like throughout the system, you can always just give the start of the serial, as long as it still is a unique identifier for the CA.

---

---

## Host a Certificate Revocation List (CRL)

---

A Certificate Revocation List (CRL) contains all revoked certificates signed by a certificate authority. Having a CRL is completely optional (e.g. [Let's Encrypt](#) certificates don't have one).

A URL to the CRL is usually included in the certificates (in the `crlDistributionPoints` x509 extension) so clients can fetch the CRL and verify that the certificate has not been revoked. Some services (e.g. OpenVPN) also just keep a local copy of a CRL.

---

**Note:** CRLs are usually hosted via HTTP, **not** HTTPS. CRLs are always signed, so hosting them via HTTP is not a security vulnerability. On the other hand, you cannot verify the the certificate used when fetching the CRL anyway, since you would need the CRL for that.

---

### Add CRL URL to new certificates

To include the URL to a CRL in newly issued certificates (you cannot add it to already issued certificates, obviously), either set it in the admin interface or via the command line:

```
$ python manage.py list_cas
34:D6:02:B5:B8:27:4F:51:9A:16:0C:B8:56:B7:79:3F - Root CA
$ python manage.py edit_ca --crl-url=http://ca.example.com/crl.pem \
> 34:D6:02:B5:B8:27:4F:51:9A:16:0C:B8:56:B7:79:3F
```

### Use generic view to host a CRL

**django-ca** provides the generic view `CertificateRevocationListView` to provide CRLs via HTTP.

If you installed **django-ca** as a full project, a default CRL is already available for all CAs. If you installed **django-ca** on “ca.example.com”, the CRL is available at `http://ca.example.com/django_ca/crl/<serial>/`. If

you installed django-ca as an app, you only need to include `django_ca.urls` in your URL conf at the appropriate location.

The default CRL is in the ASN1/DER format, signed with sha512 and refreshed every ten minutes. This is fine for TLS clients that use CRLs and is in fact similar to what public CAs use (see [crlDistributionPoints](#)). If you want to change any of these settings, you can override them as parameters in a URL conf:

```
from OpenSSL import crypto
from django_ca.views import CertificateRevocationListView

urlpatterns = [
    # ... your other patterns

    # We need a CRL in PEM format with a sha256 digest
    url(r'^crl/(?P<serial>[0-9A-F:]+)/$',
        CertificateRevocationListView.as_view(
            type=crypto.FILETYPE_PEM,
            digest='sha256',
            content_type='text/plain',
        ),
        name='sha256-crl'),
]
```

If you do not want to include the automatically hosted CRL, please set `CA_PROVIDE_GENERIC_CRL` to `False` in your settings.

**class** `django_ca.views.CertificateRevocationListView` (\*\*kwargs)

Generic view that provides Certificate Revocation Lists (CRLs).

**content\_type = 'application/pkix-crl'**

The value of the Content-Type header used in the response. For CRLs in PEM format, use "text/plain".

**digest = <cryptography.hazmat.primitives.hashes.SHA512 object>**

Digest used for generating the CRL.

**expires = 600**

CRL expires in this many seconds.

**password = None**

Password used to load the private key of the certificate authority. If not set, the private key is assumed to be unencrypted.

**type = 'DER'**

Filetype for CRL, one of the `OpenSSL.crypto.FILETYPE_*` variables. The default is `OpenSSL.crypto.FILETYPE_ASN1`.

## Write a CRL to a file

You can generate the CRL with the `manage.py dump_crl` command:

```
$ python manage.py dump_crl -f PEM /var/www/crl.pem
```

---

**Note:** The `dump_crl` command uses the first enabled CA by default, you can force a particular CA with `--ca=<serial>`.

---



CRLs expire after a certain time (default: one day, configure with `--expires=SECS`), so you must periodically regenerate it, e.g. via a cron-job.

How and where to host the file is entirely up to you. If you run a Django project with a webserver already, one possibility is to dump it to your `MEDIA_ROOT` directory.



---

## Run a OCSP responder

---

OCSP, or the [Online Certificate Status Protocol](#) provides a second method (besides *CRLs*) for a client to find out if a certificate has been revoked.

**Warning:** The OCSP responder included in **django-ca** is still very experimental. Expect problems when using it. Please also expect major changes in how it is configured in future versions.

## Configure OCSP with django-ca

**django-ca** provides generic HTTP endpoints for an OCSP service for your certificate authorities. The setup involves:

1. *Creating a responder certificate*
2. *Configure generic views*
3. *Add a OCSP URL to the new certificate*

New in version 1.2: Before version 1.2, **django-ca** was not able to host its own OCSP responder.

### Create an OCSP responder certificate

To run an OCSP responder, you first need a certificate with some special properties. Luckily, **django-ca** has a profile predefined for you:

```
$ openssl genrsa -out ocspp.key 4096
$ openssl req -new -key ocspp.key -out ocspp.csr -utf8 -batch
$ python manage.py sign_cert --csr=ocspp.csr --out=ocspp.pem \
> --subject /CN=ocspp.example.com --ocspp
```

**Warning:** The CommonName in the certificates subject must match the domain where you host your **django-ca** installation.

## Configure generic views

The final step in configuring an OCSP responder for the CA is configuring the HTTP endpoint. If you've installed django-ca as a full project or include `django_ca.urls` in your root URL config, configure the `CA_OCSP_URLS` setting. It's a dictionary configuring instances of `OCSPView`. Keys become part of the URL pattern, the value is a dictionary for the arguments of the view. For example:

```
CA_OCSP_URLS = {
    'root': {
        'ca': '34:D6:02:B5:B8:27:4F:51:9A:16:0C:B8:56:B7:79:3F',
        'responder_key': '/usr/share/django-ca/ocsp.key',
        'responder_cert': 'F2:5F:7F:31:E1:91:4F:D7:9A:D4:19:65:17:3D:43:88',
        # optional: How long OCSP responses are valid
        #'expires': 3600,
    },
}
```

This would mean that your OCSP responder would be located at `/django_ca/ocsp/root/` at whatever domain you have configured your WSGI daemon. If you're using your own URL configuration, pass the same parameters to the `as_view()` method.

**class** `django_ca.views.OCSPView` (\*\*kwargs)

View to provide an OCSP responder.

**See also:**

This is heavily inspired by [https://github.com/threema-ch/ocspresponder/blob/master/ocspresponder/\\_\\_init\\_\\_.py](https://github.com/threema-ch/ocspresponder/blob/master/ocspresponder/__init__.py).

**ca = None**

The serial of your certificate authority.

**expires = 600**

Time in seconds that the responses remain valid. The default is 600 seconds or ten minutes.

**responder\_cert = None**

Absolute path or key itself used for signing OCSP responses.

**responder\_key = None**

Absolute path to the private key used for signing OCSP responses.

## Add OCSP URL to new certificates

To include the URL to an OCSP service to newly issued certificates (you cannot add it to already issued certificates, obviously), either set it in the admin interface or via the command line:

```
$ python manage.py list_cas
34:D6:02:B5:B8:27:4F:51:9A:16:0C:B8:56:B7:79:3F - Root CA
$ python manage.py edit_ca --ocsp-url=http://ocsp.example.com/ \
> 34:D6:02:B5:B8:27:4F:51:9A:16:0C:B8:56:B7:79:3F
```

## Run an OCSP responder with `openssl ocs`

OpenSSL ships with the `openssl ocs` command that allows you to run an OCSP responder, but note that the manpage says “**only useful for test and demonstration purposes**”.

To use the command, generate an index:

```
$ python manage.py dump_ocsp_index ocs.index
```

OpenSSL itself allows you to run an OCSP responder with this command:

```
$ openssl ocs -index ocs.index -port 8888 -rsigner ocs.pem \  
> -rkey ocs.example.com.key -CA files/ca.crt -text
```

Development documentation:



### Setup demo

You can set up a demo using `fab init_demo`. First create a minimal `localsettings.py` file (in `ca/ca/localsettings.py`):

```
DEBUG = True
SECRET_KEY = "whatever"
```

And then simply run `fab init_demo` from the root directory of your project.

### Run test-suite

To run the test-suite, simply execute:

```
python setup.py test
```

... or just run some of the tests:

```
python setup.py test --suite=tests_command_dump_crl
```

To generate a coverage report:

```
python setup.py coverage
```

### Useful OpenSSL commands

#### Verification

Verify a certificate signed by a root CA (`cert.crt` could also be an intermediate CA):

```
openssl verify -CAfile ca.crt cert.crt
```

If you have an intermediate CA:

```
openssl verify -CAfile ca.crt -untrusted intermediate.crt cert.crt
```

## CRLs

Convert a CRL to text on stdout:

```
openssl crl -inform der -in sfscacrl.crl -noout -text
```

Convert a CRL to PEM to a file:

```
openssl crl -inform der -in sfscacrl.crl -outform pem -out test.pem
```

Verify a certificate using a CRL:

```
openssl verify -CAfile files/ca_crl.pem -crl_check cert.pem
```

## OCSP

Run a OCSP responder:

```
openssl ocsprun -index files/ocsp_index.txt -port 8888 \
  -rsigner files/localhost.pem -rkey files/localhost.key \
  -CA ca.pem -text
```

Verify a certificate using OCSP:

```
openssl ocsplint -CAfile ca.pem -issuer ca.pem -cert cert.pem \
  -url http://localhost:8888 -resp_text
```

## Conversion

Convert a PEM formatted public key to DER:

```
openssl x509 -in pub.pem -outform der -out pub.der
```

Convert a PEM formatted **private** key to DER:

```
openssl rsa -in priv.pem -outform der -out priv.der
```

Convert a p7c/pkcs7 file to PEM (Let's Encrypt CA Issuer field) (see also *pkcs7 (1SSL)* - online):

```
openssl pkcs7 -inform der -in letsencrypt.p7c -print_certs \
  -outform pem -out letsencrypt.pem
```



## Development webserver via SSL

To test a certificate in your webserver, first install the root certificate authority in your browser, then run `stunnel4` and `manage.py runserver` in two separate shells:

```
stunnel4
HTTPS=1 python manage.py runserver 8001
```

Then visit <https://localhost:8443>.



Please also see *Development* for how to setup a development environment.

To contribute to **django-ca** simply do a fork on [on github](#) and submit a pull request when you're happy.

When doing a pull request, please make sure to explain what your improvement does or what bug is fixed by it and how to reproduce this locally.

## Code quality

This project is very rigorous about code quality standards. That means that the source code is checked with [Flake8](#) and import order is checked with [isort](#). Before you submit a pull request, please make sure that all tests pass by executing:

```
python setup.py code_quality
```

Naturally, I also expect the test suite to still pass. Please make sure you test in at least your local Python2 and Python3 environments:

```
python setup.py test
```

## Write tests

Please write tests for any new functionality. If you provide a bugfix, write a test that tests the fix, which means that the test should fail on current master and pass on your pull request.

If a function is also covered with doctests, please consider adding an example there as well, if it affects handling a parameter or something.

## Code coverage

Generate a coverage report and make sure that your code is covered by tests.

**Warning:** Code coverage is not a catch all tool for “yes, this code is well-tested”. It’s a tool to catch missed spots, but you must still think for yourself about what and how to test.

---

x509 extensions in other CAs

---

This page documents the x509 extensions (e.g. for CRLs, etc.) set by other CAs. The information here is used by **django-ca** to initialize and sign certificate authorities and certificates.

Helpful descriptions of the meaning of various extensions can also be found in *x509v3\_config(5SSL)* ([online](#)).

## CommonName

Of course not an extension, but included here for completeness.

| CA               | Value  |
|------------------|--|
| Let's Encrypt X1 | C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X1   |
| Let's Encrypt X3 | C=US, O=Let's Encrypt, CN=Let's Encrypt Authority X3   |
| StartSSL         | C=IL, O=StartCom Ltd., OU=Secure Digital Certificate Signing, CN=StartCom Certification Authority                |
| StartSSL Class 2 | C=IL, O=StartCom Ltd., OU=Secure Digital Certificate Signing, CN=StartCom Class 2 Primary Intermediate Server CA |
| StartSSL Class 3 | C=IL, O=StartCom Ltd., OU=StartCom Certification Authority, CN=StartCom Class 3 OV Server CA                     |
| GeoTrust Global  | C=US, O=GeoTrust Inc., CN=GeoTrust Global CA   |
| RapidSSL G3      | C=US, O=GeoTrust Inc., CN=RapidSSL SHA256 CA - G3  |
| Comodo           | C=GB, ST=Greater Manchester, L=Salford, O=COMODO CA Limited, CN=COMODO RSA Certification Authority               |
| Comodo DV        | C=GB, ST=Greater Manchester, L=Salford, O=COMODO CA Limited, CN=COMODO RSA Domain Validation Secure Server CA    |
| GlobalSign       | C=BE, O=GlobalSign nv-sa, OU=Root CA, CN=GlobalSign Root CA  |
| GlobalSign DV    | C=BE, O=GlobalSign nv-sa, CN=GlobalSign Domain Validation CA - SHA256 - G2                                       |

## authorityInfoAccess

### See also:

<https://tools.ietf.org/html/rfc5280#section-4.2.2.1>

The “CA Issuers” is a URI pointing to the signing certificate. The certificate is in DER/ASN1 format and has a Content-Type: application/x-x509-ca-cert header (except where noted).

### In CA certificates

Let’s Encrypt is notable here because its CA Issuers field points to a pkcs7 file and the HTTP response returns a Content-Type: application/x-pkcs7-mime header.

The certificate pointed to by the CA Issuers field is the root certificate (so the Comodo DV CA points to the AddTrust CA that signed the Comodo Root CA).

| CA               | Value  |
|------------------|--|
| Let’s Encrypt X1 | <ul style="list-style-type: none"> <li>OCSP - URI: <a href="http://isrg.trustid.ocsp.identrust.com">http://isrg.trustid.ocsp.identrust.com</a></li> <li>CA Issuers - URI: <a href="http://apps.identrust.com/roots/dstrootcax3.p7c">http://apps.identrust.com/roots/dstrootcax3.p7c</a></li> </ul> |
| Let’s Encrypt X3 | <ul style="list-style-type: none"> <li>OCSP - URI: <a href="http://isrg.trustid.ocsp.identrust.com">http://isrg.trustid.ocsp.identrust.com</a></li> <li>CA Issuers - URI: <a href="http://apps.identrust.com/roots/dstrootcax3.p7c">http://apps.identrust.com/roots/dstrootcax3.p7c</a></li> </ul> |
| StartSSL         | (not present)  |
| StartSSL Class 2 | <ul style="list-style-type: none"> <li>OCSP - URI: <a href="http://ocsp.startssl.com/ca">http://ocsp.startssl.com/ca</a></li> <li>CA Issuers - URI: <a href="http://aia.startssl.com/certs/ca.crt">http://aia.startssl.com/certs/ca.crt</a></li> </ul>   |
| StartSSL Class 3 | <ul style="list-style-type: none"> <li>OCSP - URI: <a href="http://ocsp.startssl.com">http://ocsp.startssl.com</a></li> <li>CA Issuers - URI: <a href="http://aia.startssl.com/certs/ca.crt">http://aia.startssl.com/certs/ca.crt</a></li> </ul>   |
| GeoTrust Global  | (not present)  |
| RapidSSL G3      | OCSP - URI: <a href="http://g.symcd.com">http://g.symcd.com</a>  |
| Comodo           | OCSP - URI: <a href="http://ocsp.usertrust.com">http://ocsp.usertrust.com</a>  |
| Comodo DV        | <ul style="list-style-type: none"> <li>CA Issuers - URI: <a href="http://crt.comodoca.com/COMODORSAAAddTrust">http://crt.comodoca.com/COMODORSAAAddTrust</a></li> <li>OCSP - URI: <a href="http://ocsp.comodoca.com">http://ocsp.comodoca.com</a></li> </ul>                                       |
| GlobalSign       | (not present)  |
| GlobalSign DV    | OCSP - URI: <a href="http://ocsp.globalsign.com/rootr1">http://ocsp.globalsign.com/rootr1</a>  |

### In signed certificates

Let’s Encrypt is again special in that the response has a Content-Type: application/pkix-cert header (but at least it’s in DER format like every other certificate). RapidSSL uses Content-Type: text/plain.

The CA Issuers field sometimes points to the signing certificate (e.g. StartSSL) or to the root CA (e.g. Comodo DV, which points to the AddTrust Root CA)

| CA               | Value   |
|------------------|---|
| Let's Encrypt X1 | <ul style="list-style-type: none"> <li>• OCSP - URI:http://ocsp.int-x1.letsencrypt.org/</li> <li>• CA Issuers - URI:http://cert.int-x1.letsencrypt.org</li> </ul>                               |
| Let's Encrypt X3 | <ul style="list-style-type: none"> <li>• OCSP - URI:http://ocsp.int-x3.letsencrypt.org/</li> <li>• CA Issuers - URI:http://cert.int-x3.letsencrypt.org/</li> </ul>                              |
| StartSSL Class 2 | <ul style="list-style-type: none"> <li>• OCSP - URI:http://ocsp.startssl.com/sub/class2/server/ca</li> <li>• CA Issuers - URI:http://aia.startssl.com/certs/sub.class2.server.ca.crt</li> </ul> |
| StartSSL Class 3 | <ul style="list-style-type: none"> <li>• OCSP - URI:http://ocsp.startssl.com</li> <li>• CA Issuers - URI:http://aia.startssl.com/certs/sca.server3.crt</li> </ul>                               |
| RapidSSL G3      | <ul style="list-style-type: none"> <li>• OCSP - URI:http://gv.symcd.com</li> <li>• CA Issuers - URI:http://gv.symcb.com/gv.crt</li> </ul>   |
| Comodo DV        | <ul style="list-style-type: none"> <li>• CA Issuers - URI:http://crt.comodoca.com/COMODORSADomainVa</li> <li>• OCSP - URI:http://ocsp.comodoca.com</li> </ul>                                   |
| GlobalSign DV    | <ul style="list-style-type: none"> <li>• CA Issuers - URI:http://secure.globalsign.com/cacert/gsdomainvalsha</li> <li>• OCSP - URI:http://ocsp2.globalsign.com/gsdomainvalsha2g2</li> </ul>     |

## authorityKeyIdentifier

### See also:

<https://tools.ietf.org/html/rfc5280#section-4.2.1.1>

A hash identifying the CA used to sign the certificate. In theory the identifier may also be based on the issuer name and serial number, but in the wild, all certificates reference the *subjectKeyIdentifier*. Self-signed certificates (e.g. Root CAs, like StartSSL and Comodo below) will reference themselves, while signed certificates reference the signed CA, e.g.:

| Name            | subjectKeyIdentifier | authorityKeyIdentifier |
|-----------------|----------------------|------------------------|
| Root CA         | foo                  | keyid:foo              |
| Intermediate CA | bar                  | keyid:foo              |
| Client Cert     | bla                  | keyid:bar              |

## In CA certificates

| CA               | Value   |
|------------------|---|
| Let's Encrypt X1 | keyid:C4:A7:B1:A4:7B:2C:71:FA:DB:E1:4B:90:75:FF:C4:15:60:85:89:10 |
| Let's Encrypt X3 | keyid:C4:A7:B1:A4:7B:2C:71:FA:DB:E1:4B:90:75:FF:C4:15:60:85:89:10 |
| StartSSL         | keyid:4E:0B:EF:1A:A4:40:5B:A5:17:69:87:30:CA:34:68:43:D0:41:AE:F2 |
| StartSSL Class 2 | keyid:4E:0B:EF:1A:A4:40:5B:A5:17:69:87:30:CA:34:68:43:D0:41:AE:F2 |
| StartSSL Class 3 | keyid:4E:0B:EF:1A:A4:40:5B:A5:17:69:87:30:CA:34:68:43:D0:41:AE:F2 |
| GeoTrust Global  | keyid:C0:7A:98:68:8D:89:FB:AB:05:64:0C:11:7D:AA:7D:65:B8:CA:CC:4E |
| RapidSSL G3      | keyid:C0:7A:98:68:8D:89:FB:AB:05:64:0C:11:7D:AA:7D:65:B8:CA:CC:4E |
| Comodo           | keyid:AD:BD:98:7A:34:B4:26:F7:FA:C4:26:54:EF:03:BD:E0:24:CB:54:1A |
| Comodo DV        | keyid:BB:AF:7E:02:3D:FA:A6:F1:3C:84:8E:AD:EE:38:98:EC:D9:32:32:D4 |
| GlobalSign       | (not present)   |
| GlobalSign DV    | keyid:60:7B:66:1A:45:0D:97:CA:89:50:2F:7D:04:CD:34:A8:FF:FC:FD:4B |

## In signed certificates

| CA               | Value   |
|------------------|---|
| Let's Encrypt X1 | keyid:A8:4A:6A:63:04:7D:DD:BA:E6:D1:39:B7:A6:45:65:EF:F3:A8:EC:A1 |
| Let's Encrypt X3 | keyid:A8:4A:6A:63:04:7D:DD:BA:E6:D1:39:B7:A6:45:65:EF:F3:A8:EC:A1 |
| StartSSL Class 2 | keyid:11:DB:23:45:FD:54:CC:6A:71:6F:84:8A:03:D7:BE:F7:01:2F:26:86 |
| StartSSL Class 3 | keyid:B1:3F:1C:92:7B:92:B0:5A:25:B3:38:FB:9C:07:A4:26:50:32:E3:51 |
| RapidSSL G3      | keyid:C3:9C:F3:FC:D3:46:08:34:BB:CE:46:7F:A0:7C:5B:F3:E2:08:CB:59 |
| Comodo DV        | keyid:90:AF:6A:3A:94:5A:0B:D8:90:EA:12:56:73:DF:43:B4:3A:28:DA:E7 |
| GlobalSign DV    | keyid:EA:4E:7C:D4:80:2D:E5:15:81:86:26:8C:82:6D:C0:98:A4:CF:97:0F |

## basicConstraints

### See also:

<https://tools.ietf.org/html/rfc5280#section-4.2.1.9>

The `basicConstraints` extension specifies if the certificate can be used as a certificate authority. It is always marked as critical. The `pathlen` attribute specifies the levels of possible intermediate CAs. If not present, the level of intermediate CAs is unlimited, a `pathlen:0` means that the CA itself can not issue certificates with `CA:TRUE` itself.



## In CA certificates

| CA               | Value                         |
|------------------|-------------------------------|
| Let's Encrypt X1 | (critical) CA:TRUE, pathlen:0 |
| Let's Encrypt X3 | (critical) CA:TRUE, pathlen:0 |
| StartSSL         | (critical) CA:TRUE            |
| StartSSL Class 2 | (critical) CA:TRUE, pathlen:0 |
| StartSSL Class 3 | (critical) CA:TRUE, pathlen:0 |
| GeoTrust Global  | (critical) CA:TRUE            |
| RapidSSL G3      | (critical) CA:TRUE, pathlen:0 |
| Comodo           | (critical) CA:TRUE            |
| Comodo DV        | (critical) CA:TRUE, pathlen:0 |
| GlobalSign       | (critical) CA:TRUE            |
| GlobalSign DV    | (critical) CA:TRUE, pathlen:0 |

## In signed certificates

| CA               | Value               |
|------------------|---------------------|
| Let's Encrypt X1 | (critical) CA:FALSE |
| Let's Encrypt X3 | (critical) CA:FALSE |
| StartSSL Class 2 | (critical) CA:FALSE |
| StartSSL Class 3 | CA:FALSE            |
| RapidSSL G3      | (critical) CA:FALSE |
| Comodo DV        | (critical) CA:FALSE |
| GlobalSign DV    | CA:FALSE            |

## crlDistributionPoints

### See also:

<https://tools.ietf.org/html/rfc5280#section-4.2.1.13>

In theory a complex multi-valued extension, this extension usually just holds a URI pointing to a Certificate Revocation List (CRL).

Root certificate authorities (StartSSL, GeoTrust Global, GlobalSign) do not set this field. This usually isn't a problem since clients have a list of trusted root certificates anyway, and browsers and distributions should get regular updates on the list of trusted certificates.

All CRLs linked here are all in DER/ASN1 format, and the `Content-Type` header in the response is set to `application/pkix-crl`. Only Comodo uses `application/x-pkcs7-crl`, but it is also in DER/ASN1 format.

## In CA certificates

| CA               | Value   | Content-Type            |
|------------------|---|-------------------------|
| Let's Encrypt X1 | URI:http://crl.identrust.com/DSTROOTCAX3CRL.crl                 | application/pkix-crl    |
| Let's Encrypt X3 | URI:http://crl.identrust.com/DSTROOTCAX3CRL.crl                 | application/pkix-crl    |
| StartSSL         | (not present)   |                         |
| StartSSL Class 2 | URI:http://crl.startssl.com/sfsca.crl                           | application/pkix-crl    |
| StartSSL Class 3 | URI:http://crl.startssl.com/sfsca.crl                           | application/pkix-crl    |
| GeoTrust Global  | (not present)   |                         |
| RapidSSL G3      | URI:http://g.symcb.com/crls/gtglobal.crl                        | application/pkix-crl    |
| Comodo           | URI:http://crl.usertrust.com/AddTrustExternalCARoot.crl         | application/x-pkcs7-crl |
| Comodo DV        | URI:http://crl.comodoca.com/COMODORSACertificationAuthority.crl | application/x-pkcs7-crl |
| GlobalSign       | (not present)   |                         |
| GlobalSign DV    | URI:http://crl.globalsign.net/root.crl                          | application/pkix-crl    |

## In signed certificates

Let's Encrypt is so far the only CA that does not maintain a CRL for signed certificates. Major CAs usually don't fancy CRLs much because they are a large file (e.g. Comodos CRL is 1.5MB) containing all certificates and cause major traffic for CAs. OCSP is just better in every way.

| CA               | Value  | Content-Type            |
|------------------|--|-------------------------|
| Let's Encrypt    | (not present)  |                         |
| StartSSL Class 2 | URI:http://crl.startssl.com/crt2-crl.crl   | application/pkix-crl    |
| StartSSL Class 3 | URI:http://crl.startssl.com/sca-server3.crl                                      | application/pkix-crl    |
| RapidSSL G3      | URI:http://gv.symcb.com/gv.crl   | application/pkix-crl    |
| Comodo DV        | URI:http://crl.comodoca.com/COMODORSADomainValidationSecureServerCertificate.crl | application/x-pkcs7-crl |
| GlobalSign DV    | URI:http://crl.globalsign.com/gsgdomainvalsha2g2.crl                             | application/pkix-crl    |

## extendedKeyUsage

A list of purposes for which the certificate can be used for. CA certificates usually do not set this field.

## In CA certificates

| CA               | Value  |
|------------------|--|
| Let's Encrypt X1 | (not present)  |
| Let's Encrypt X3 | (not present)  |
| StartSSL         | (not present)  |
| StartSSL Class 2 | (not present)  |
| StartSSL Class 3 | TLS Web Client Authentication, TLS Web Server Authentication |
| GeoTrust Global  | (not present)  |
| RapidSSL G3      | (not present)  |
| Comodo           | (not present)  |
| Comodo DV        | TLS Web Server Authentication, TLS Web Client Authentication |
| GlobalSign       | (not present)  |
| GlobalSign DV    | (not present)  |

## In signed certificates

| CA               | Value  |
|------------------|--|
| Let's Encrypt X1 | TLS Web Server Authentication, TLS Web Client Authentication |
| Let's Encrypt X3 | TLS Web Server Authentication, TLS Web Client Authentication |
| StartSSL Class 2 | TLS Web Client Authentication, TLS Web Server Authentication |
| StartSSL Class 3 | TLS Web Client Authentication, TLS Web Server Authentication |
| RapidSSL G3      | TLS Web Server Authentication, TLS Web Client Authentication |
| Comodo DV        | TLS Web Server Authentication, TLS Web Client Authentication |
| GlobalSign DV    | TLS Web Server Authentication, TLS Web Client Authentication |

## issuerAltName

### See also:

<https://tools.ietf.org/html/rfc5280#section-4.2.1.7>

Only StartSSL sets this field in its signed certificates. It's a URI pointing to their homepage.

## In CA certificates

| CA               | Value         |
|------------------|---------------|
| Let's Encrypt    | (not present) |
| StartSSL         | (not present) |
| StartSSL Class 2 | (not present) |
| StartSSL Class 3 | (not present) |
| GeoTrust Global  | (not present) |
| RapidSSL G3      | (not present) |
| Comodo           | (not present) |
| Comodo DV        | (not present) |
| GlobalSign       | (not present) |
| GlobalSign DV    | (not present) |

## In signed certificates

| CA               | Value                        |
|------------------|------------------------------|
| Let's Encrypt    | (not present)                |
| StartSSL Class 2 | URI:http://www.startssl.com/ |
| StartSSL Class 3 | URI:http://www.startssl.com/ |
| RapidSSL G3      | (not present)                |
| Comodo DV        | (not present)                |
| GlobalSign DV    | (not present)                |

## keyUsage

### See also:

<https://tools.ietf.org/html/rfc5280#section-4.2.1.3>

List of permitted key usages. Usually marked as critical, except for certificates signed by StartSSL.

## In CA certificates

| CA               | Value  |
|------------------|--|
| Let's Encrypt X1 | (critical) Digital Signature, Certificate Sign, CRL Sign |
| Let's Encrypt X3 | (critical) Digital Signature, Certificate Sign, CRL Sign |
| StartSSL         | (critical) Certificate Sign, CRL Sign                    |
| StartSSL Class 2 | (critical) Certificate Sign, CRL Sign                    |
| StartSSL Class 3 | (critical) Certificate Sign, CRL Sign                    |
| GeoTrust Global  | (critical) Certificate Sign, CRL Sign                    |
| RapidSSL G3      | (critical) Certificate Sign, CRL Sign                    |
| Comodo           | (critical) Digital Signature, Certificate Sign, CRL Sign |
| Comodo DV        | (critical) Digital Signature, Certificate Sign, CRL Sign |
| GlobalSign       | (critical) Certificate Sign, CRL Sign                    |
| GlobalSign DV    | (critical) Certificate Sign, CRL Sign                    |

## In signed certificates

| CA               | Value  |
|------------------|--|
| Let's Encrypt X1 | (critical) Digital Signature, Key Encipherment     |
| Let's Encrypt X3 | (critical) Digital Signature, Key Encipherment     |
| StartSSL Class 2 | Digital Signature, Key Encipherment, Key Agreement |
| StartSSL Class 3 | Digital Signature, Key Encipherment                |
| RapidSSL G3      | (critical) Digital Signature, Key Encipherment     |
| Comodo DV        | (critical) Digital Signature, Key Encipherment     |
| GlobalSign DV    | (critical) Digital Signature, Key Encipherment     |

## subjectAltName

The `subjectAltName` extension is not present in any CA certificate, and of course whatever the customer requests in signed certificates.

## In CA certificates

| CA               | Value |
|------------------|-------|
| Let's Encrypt    | •     |
| StartSSL         | •     |
| StartSSL Class 2 | •     |
| StartSSL Class 3 | •     |
| GeoTrust Global  | •     |
| RapidSSL G3      | •     |
| Comodo           | •     |
| Comodo DV        | •     |
| GlobalSign       | •     |
| GlobalSign DV    | •     |

## subjectKeyIdentifier

### See also:

<https://tools.ietf.org/html/rfc5280#section-4.2.1.2>

The `subjectKeyIdentifier` extension provides a means of identifying certificates. It is a mandatory extension for CA certificates. Currently only RapidSSL does not set this for signed certificates.

The value of the `subjectKeyIdentifier` extension reappears in the `authorityKeyIdentifier` extension (prefixed with `keyid:`).

## In CA certificates

| CA               | Value   |
|------------------|---|
| Let's Encrypt X1 | A8:4A:6A:63:04:7D:DD:BA:E6:D1:39:B7:A6:45:65:EF:F3:A8:EC:A1 |
| Let's Encrypt X3 | A8:4A:6A:63:04:7D:DD:BA:E6:D1:39:B7:A6:45:65:EF:F3:A8:EC:A1 |
| StartSSL         | 4E:0B:EF:1A:A4:40:5B:A5:17:69:87:30:CA:34:68:43:D0:41:AE:F2 |
| StartSSL Class 2 | 11:DB:23:45:FD:54:CC:6A:71:6F:84:8A:03:D7:BE:F7:01:2F:26:86 |
| StartSSL Class 3 | B1:3F:1C:92:7B:92:B0:5A:25:B3:38:FB:9C:07:A4:26:50:32:E3:51 |
| GeoTrust Global  | C0:7A:98:68:8D:89:FB:AB:05:64:0C:11:7D:AA:7D:65:B8:CA:CC:4E |
| RapidSSL G3      | C3:9C:F3:FC:D3:46:08:34:BB:CE:46:7F:A0:7C:5B:F3:E2:08:CB:59 |
| Comodo           | BB:AF:7E:02:3D:FA:A6:F1:3C:84:8E:AD:EE:38:98:EC:D9:32:32:D4 |
| Comodo DV        | 90:AF:6A:3A:94:5A:0B:D8:90:EA:12:56:73:DF:43:B4:3A:28:DA:E7 |
| GlobalSign       | 60:7B:66:1A:45:0D:97:CA:89:50:2F:7D:04:CD:34:A8:FF:FC:FD:4B |
| GlobalSign DV    | EA:4E:7C:D4:80:2D:E5:15:81:86:26:8C:82:6D:C0:98:A4:CF:97:0F |

## In signed certificates

| CA               | Value   |
|------------------|---|
| Let's Encrypt X1 | F4:F3:B8:F5:43:90:2E:A2:7F:DD:51:4A:5F:3E:AC:FB:F1:33:EE:95 |
| Let's Encrypt X3 | 71:57:F2:DC:D2:02:5C:00:5E:74:28:57:4C:7E:61:43:44:44:AF:84 |
| StartSSL Class 2 | C7:AA:D9:A4:F0:BC:D1:C1:1B:05:D2:19:71:0A:86:F8:58:0F:F0:99 |
| StartSSL Class 3 | F0:72:65:5E:21:AA:16:76:2C:6F:D0:63:53:0C:68:D5:89:50:2A:73 |
| RapidSSL G3      | (not present)   |
| Comodo DV        | F2:CB:1F:E9:6E:D5:43:E3:85:75:98:5F:97:7C:B0:59:7F:D5:C0:C0 |
| GlobalSign DV    | 52:5A:45:5B:D4:9D:AC:65:30:BD:67:80:6C:D1:A1:3E:09:F7:FD:92 |

## Other extensions

Extensions used by certificates encountered in the wild that django-ca does not (yet) support in any way.

## In CA certificates

| CA               | Value   |
|------------------|---|
| Let's Encrypt X1 | X509v3 Certificate Policies, X509v3 Name Constraints              |
| Let's Encrypt X3 | X509v3 Certificate Policies                                       |
| StartSSL         | X509v3 Certificate Policies, Netscape Cert Type, Netscape Comment |
| StartSSL Class 2 | X509v3 Certificate Policies                                       |
| StartSSL Class 3 | X509v3 Certificate Policies                                       |
| GeoTrust Global  | (none)  |
| RapidSSL G3      | X509v3 Certificate Policies                                       |
| Comodo           | X509v3 Certificate Policies                                       |
| Comodo DV        | X509v3 Certificate Policies                                       |
| GlobalSign       | (none)  |
| GlobalSign DV    | X509v3 Certificate Policies                                       |

## In signed certificates

| CA               | Value                       |
|------------------|-----------------------------|
| Let's Encrypt X1 | X509v3 Certificate Policies |
| Let's Encrypt X3 | X509v3 Certificate Policies |
| StartSSL Class 2 | X509v3 Certificate Policies |
| StartSSL Class 3 | X509v3 Certificate Policies |
| RapidSSL G3      | X509v3 Certificate Policies |
| Comodo DV        | X509v3 Certificate Policies |
| GlobalSign DV    | X509v3 Certificate Policies |





### 1.6.2 (2017-07-18)

- No longer require a strict cryptography version but only `>=1.8`. The previously pinned version is incompatible with Python 3.5.
- Update requirements files to newest versions.
- Update imports to `django.urls.reverse` so they are compatible with Django 2.0 and 1.8.
- Make sure that `manage.py check` exit status is not ignored for `setup.py code_quality`.
- Conform to new sorting restrictions for `isort`.

### 1.6.1 (2017-05-05)

- Fix signing of wildcard certificates (thanks [RedNixon](#)).
- Add new management commands `import_ca` and `import_cert` so users can import existing CAs and certificates.

### 1.6.0 (2017-04-21)

#### New features and improvements

- Support CSRs in DER format when signing a certificate via `manage.py sign_cert`.
- Support encrypting private keys of CAs with a password.
- Support Django 1.11.
- Allow creating CRLs of disabled CAs via `manage.py dump_crl`.

- Validate DNSNames when parsing general names. This means that signing a certificate with CommonName that is not a valid domain name fails if it should also be added as subjectAltName (see `--cn-in-san` option).
- When configuring `OCSPView`, the responder key and certificate are verified during configuration. An erroneous configuration thus throws an error on startup, not during runtime.
- The testsuite now tests certificate signatures itself via `pyOpenSSL`, so an independent library is used for verification.

### Bugfixes

- Fix the `authorityKeyIdentifier` extension when signing certificates with an intermediate CA.
- Fix creation of intermediate CAs.

### 1.5.1 (2017-03-07)

- Increase minimum field length of serial and common name fields.
- Tests now call `full_clean()` for created models. SQLite (which is used for testing) does not enforce the `max_length` parameter.

### 1.5.0 (2017-03-05)

- Completely remove `pyOpenSSL` and consistently use `cryptography`.
- Due to the transition to `cryptography`, some features have been removed:
  - The `tlsfeature` extension is no longer supported. It will be again once `cryptography` adds support.
  - The `msCodeInd`, `msCodeCom`, `msCTLSign`, `msEFS` values for the `ExtendedKeyUsage` extension are no longer supported. Support for these was largely academic anyway, so they most likely will not be added again.
  - `TEXT` is no longer a supported output format for dumping certificates.
- The `keyUsage` extension is now marked as critical for certificate authorities.
- Add the `privilegeWithdrawn` and `aACompromise` attributes for revocation lists.

### 1.4.1 (2017-02-26)

- Update requirements.
- Use `Travis CI` for continuous integration. `django-ca` is now tested with Python 2.7, 3.4, 3.5, 3.6 and nightly, using Django 1.8, 1.9 and 1.10.
- Fix a few test errors for Django 1.8.
- Examples now consistently use 4096 bit certificates.
- Some functionality is now migrated to `cryptography` in the ongoing process to deprecate `pyOpenSSL` (which is no longer maintained).
- `OCSPView` now supports directly passing the public key as bytes. As a consequence, a bad certificate is now only detected at runtime.

## 1.4.0 (2016-09-09)

- Make sure that Child CAs never expire after their parents. If the user specifies an expiry after that of the parent, it is silently changed to the parents expiry.
- Make sure that certificates never expire after their CAs. If the user specifies an expiry after that of the parent, throw an error.
- Rename the `--days` parameter of the `sign_cert` command to `--expires` to match what we use for `init_ca`.
- Improve help-output of `--init-ca` and `--sign-cert` by further grouping arguments into argument groups.
- Add ability to add CRL-, OCSP- and Issuer-URLs when creating CAs using the `--ca-*` options.
- Add support for the `nameConstraints X509` extension when creating CAs. The option to the `init_ca` command is `--name-constraint` and can be given multiple times to indicate multiple constraints.
- Add support for the `tlsfeature` extension, a.k.a. “TLS Must Staple”. Since OpenSSL 1.1 is required for this extension, support is currently totally untested.

## 1.3.0 (2016-07-09)

- Add links for downloading the certificate in PEM/ASN format in the admin interface.
- Add an extra chapter in documentation on how to create intermediate CAs.
- Correctly set the issuer field when generating intermediate CAs.
- `fab init_demo` now actually creates an intermediate CA.
- Fix help text for the `--parent` parameter for `manage.py init_ca`.

## 1.2.2 (2016-06-30)

- Rebuild to remove old migrations accidentally present in previous release.

## 1.2.1 (2016-06-06)

- Add the `CA_NOTIFICATION_DAYS` setting so that watchers don't receive too many emails.
- Fix changing a certificate in the admin interface (only watchers can be changed at present).

## 1.2.0 (2016-06-05)

- **django-ca** now provides a complete *OCSP responder*.
- Various tests are now run with a pre-computed CA, making tests much faster and output more predictable.
- Update lots of documentation.

### 1.1.1 (2016-06-05)

- Fix the `fab init_demo` command.
- Fix installation via `setup.py install`, fixes #2 and #4. Thanks to Jon McKenzie for the fixes!

### 1.1.0 (2016-05-08)

- The subject given in the `manage.py init_ca` and `manage.py sign_cert` is now given in the same form that is frequently used by OpenSSL, “/C=AT/L=...”.
- On the command line, both CAs and certificates can now be named either by their CommonName or with their serial. The serial can be given with only the first few letters as long as it’s unique, as it is matched as long as the serial starts with the given serial.
- Expiry time of CRLs can now be specified in seconds. `manage.py dump_crl` now uses the `--expires` instead of the old `--days` parameter.
- The admin interface now accounts for cases where some or all CAs are not useable because the private key is not accessible. Such a scenario might occur if the private keys are hosted on a different machine.
- The app now provides a generic view to generate CRLs. See *Use generic view to host a CRL* for more information.
- Fix the display of the default value of the `-ca` args.
- Move this ChangeLog from a top-level .md file to this location.
- Fix shell example when issuing certificates.

### 1.0.1 (2016-04-27)

- Officially support Python2.7 again.
- Make sure that certificate authorities cannot be removed via the web interface.

### 1.0.0 (2016-04-27)

This represents a massive new release (hence the big version jump). The project now has a new name (**django-ca** instead of just “certificate authority”) and is now installable via `pip`. Since versions prior to this release probably had no users (as it wasn’t advertised anywhere), it includes several incompatible changes.

#### General

- This project now runs under the name **django-ca** instead of just “certificate authority”.
- Move the git repository is now hosted at <https://github.com/mathiasertl/django-ca>.
- This version now absolutely assumes Python3. Python2 is no longer supported.
- Require Django 1.8 or later.
- `django-ca` is now usable as a stand-alone project (via `git`) or as a reusable app (via `pip`).

## Functionality

- The main app was renamed from `certificate` to `django_ca`. See below for how to upgrade.

## manage.py interface

- `manage.py` commands are now renamed to be more specific:
  - `init` -> `init_ca`
  - `sign` -> `sign_cert`
  - `list` -> `list_certs`
  - `revoke` -> `revoke_cert`
  - `crl` -> `dump_crl`
  - `view` -> `view_cert`
  - `watch` -> `notify_expiring_certs`
  - `watchers` -> `cert_watchers`
- Several new `manage.py` commands:
  - `dump_ca` to dump CA certificates.
  - `dump_cert` to dump certificates to a file.
  - `dump_ocsp_index` for an OCSP responder, `dump_crl` no longer outputs this file.
  - `edit_ca` to edit CA properties from the command line.
  - `list_cas` to list available CAs.
  - `view_ca` to view a CA.
- Removed the `manage.py remove` command.
- `dump_{ca, cert, crl}` can now output DER/ASN1 data to stdout.

### 0.2.1 (2015-05-24)

- Signed certificates are valid five minutes in the past to account for possible clock skew.
- Shell-scripts: Correctly pass quoted parameters to `manage.py`.
- Add documentation on how to test CRLs.
- Improve support for OCSP.

### 0.2 (2015-02-08)

- The `watchers` command now takes a serial, like any other command.
- Reworked `view` command for more robustness.
  - Improve output of certificate extensions.
  - Add the `-n/--no-pem` option.

- Add the `-e/--extensions` option to print all certificate extensions.
- Make output clearer.
- The `sign` command now has
  - a `--key-usage` option to override the `keyUsage` extended attribute.
  - a `--ext-key-usage` option to override the `extendedKeyUsage` extended attribute.
  - a `--ocsp` option to sign a certificate for an OCSP server.
- The default `extendedKeyUsage` is now `serverAuth`, not `clientAuth`.
- Update the `remove` command to take a serial.
- Ensure restrictive file permissions when creating a CA.
- Add `requirements-dev.txt`

## 0.1 (2015-02-07)

- Initial release

API documentation:

## CertificateAuthority

```
class django_ca.models.CertificateAuthority(id, created, expires, pub, cn, serial, name,
                                         enabled, parent, private_key_path, crl_url, is-
                                         suer_url, ocsp_url, issuer_alt_name)
```

### Manager methods

```
class django_ca.managers.CertificateAuthorityManager
```

```
init (name, key_size, key_type, algorithm, expires, parent, subject, pathlen=None, issuer_url=None,
       issuer_alt_name=None, crl_url=None, ocsp_url=None, ca_issuer_url=None, ca_crl_url=None,
       ca_ocsp_url=None, name_constraints=None, password=None, parent_password=None)
Create a new certificate authority.
```

**key\_size** [int] Integer, must be a power of two (e.g. 2048, 4096, ...)

**key\_type: str, optional** Either "RSA" or "DSA" for a RSA or DSA key, with "RSA" being the default.

**algorithm** [HashAlgorithm] Hash algorithm used when signing the certificate. Must be an instance of HashAlgorithm, e.g. SHA512.

**expires** [datetime] Datetime for when this certificate expires.

**parent** [CertificateAuthority, optional] Parent certificate authority for the new CA. This means that this CA will be an intermediate authority.

**subject** [str] Subject string, e.g. "/CN=example.com".

**pathlen** : int, optional **password** : bytes, optional

    Password to encrypt the private key with.

**parent\_password** [bytes, optional] Password that the private key of the parent CA is encrypted with.

## Certificate

```
class django_ca.models.Certificate(id, created, expires, pub, cn, serial, ca, csr, revoked, re-
    voked_date, revoked_reason)
```

```
get_revocation()
```

Get a crypto.Revoked object or None if the cert is not revoked.

## Manager methods

```
class django_ca.managers.CertificateManager
```

```
sign_cert(ca, csr, expires, algorithm, subject=None, cn_in_san=True, csr_format=<Encoding.PEM:
    'PEM'>, subjectAltName=None, keyUsage=None, extendedKeyUsage=None, pass-
    word=None)
```

Create a signed certificate from a CSR.

X509 extensions (*key\_usage*, *ext\_key\_usage*) may either be None (in which case they are not added) or a tuple with the first value being a bool indicating if the value is critical and the second value being a byte-array indicating the extension value. Example:

```
(True, b'value')
```

**ca** [*CertificateAuthority*] The certificate authority to sign the certificate with.

**csr** [str] A valid CSR. The format is given by the *csr\_format* parameter.

**expires** [int] When the certificate should expire (passed to *get\_cert\_builder()*).

**algorithm** [{‘sha512’, ‘sha256’, ...}] Algorithm used to sign the certificate. The default is the *CA\_DIGEST\_ALGORITHM* setting.

**subject** [dict, optional] The Subject to use in the certificate. The keys of this dict are the fields of an X509 subject, that is “C”, “ST”, “L”, “OU” and “CN”. If omitted or if the value does not contain a “CN” key, the first value of the *subjectAltName* parameter is used as CommonName (and is obviously mandatory in this case).

**cn\_in\_san** [bool, optional] Whether the CommonName should also be included as subjectAlternativeName. The default is *True*, but the parameter is ignored if no CommonName is given. This is typically set to *False* when creating a client certificate, where the subjects CommonName has no meaningful value as subjectAltName.

**csr\_format** [*Encoding*, optional] The format of the CSR. The default is *PEM*.

**subjectAltName** [list of str, optional] A list of values for the subjectAltName extension. Values are passed to *parse\_general\_name()*, see function documentation for how this value is parsed.

**keyUsage** [tuple or None] Value for the *keyUsage* X509 extension. See description for format details.

**extendedKeyUsage** [tuple or None] Value for the *extendedKeyUsage* X509 extension. See description for format details.

**password** [bytes, optional] Password used to load the private key of the certificate authority. If not passed, the private key is assumed to be unencrypted.

**cryptophy.x509.Certificate** The signed certificate.



---

 django\_ca.utils - utility functions
 

---

Central functions to load CA key and cert as PKey/X509 objects.

django\_ca.utils.**GENERAL\_NAME\_RE** = <\_sre.SRE\_Pattern object at 0x20c4e20>  
 Regular expression to match general names.

**class** django\_ca.utils.**LazyEncoder** (*skipkeys=False, ensure\_ascii=True, check\_circular=True, allow\_nan=True, sort\_keys=False, indent=None, separators=None, encoding='utf-8', default=None*)  
 Encoder that also encodes strings translated with ugettext\_lazy.

django\_ca.utils.**NAME\_RE** = <\_sre.SRE\_Pattern object at 0x2119410>  
 Regular expression to match RDNs out of a full x509 name.

django\_ca.utils.**add\_colons** (*s*)  
 Add colons after every second digit.

This function is used in functions to prettify serials.

```
>>> add_colons('teststring')
'te:st:st:ri:ng'
```

django\_ca.utils.**format\_general\_names** (*names*)  
 Format a list of general names.

```
>>> import ipaddress
>>> format_general_names ([x509.DNSName ('example.com')])
'DNS:example.com'
>>> format_general_names ([x509.IPAddress (ipaddress.IPv4Address ('127.0.0.1'))])
'IP:127.0.0.1'
>>> format_general_names ([x509.DirectoryName (
...     x509.Name ([x509.NameAttribute (x509.oid.NameOID.COMMON_NAME, 'example.com
↳')]))])
'dirname:/CN=example.com'
>>> format_general_names ([x509.DNSName ('example.com'), x509.DNSName ('example.net
↳')])
'DNS:example.com, DNS:example.net'
```

`django_ca.utils.format_name` (*subject*)

Convert a subject into the canonical form for distinguished names.

This function does not take care of sorting the subject in any meaningful order.

Examples:

```
>>> format_name([('CN', 'example.com'), ])
'/CN=example.com'
>>> format_name([('CN', 'example.com'), ('O', "My Organization"), ])
'/CN=example.com/O=My Organization'
```

`django_ca.utils.get_cert_builder` (*expires, now=None*)

Get a basic X509 cert object.

**expires** [datetime] When this certificate will expire.

**now** [datetime] The functions notion of “now”, used for testing.

`django_ca.utils.get_cert_profile_kwargs` (*name=None*)

Get kwargs suitable for `get_cert` X509 keyword arguments from the given profile.

`django_ca.utils.int_to_hex` (*i*)

Create a hex-representation of the given serial.

```
>>> int_to_hex(123456789)
'75:BC:D1'
```

`django_ca.utils.is_power2` (*num*)

Return True if num is a power of 2.

```
>>> is_power2(4)
True
>>> is_power2(3)
False
```

`django_ca.utils.multiline_url_validator` (*value*)

Validate that a TextField contains one valid URL per line.

**See also:**

<https://docs.djangoproject.com/en/1.9/ref/validators/>

`django_ca.utils.parse_general_name` (*name*)

Parse a general name from user input.

This function will do its best to detect the intended type of any value passed to it:

```
>>> parse_general_name('example.com')
<DNSName (value=example.com) >
>>> parse_general_name('*.example.com')
<DNSName (value=*.example.com) >
>>> parse_general_name('user@example.com')
<RFC822Name (value=user@example.com) >
>>> parse_general_name('https://example.com')
<UniformResourceIdentifier (value=https://example.com) >
>>> parse_general_name('1.2.3.4')
<IPAddress (value=1.2.3.4) >
>>> parse_general_name('/CN=example.com')
<DirectoryName (value=<Name ([<NameAttribute (oid=<ObjectIdentifier (oid=2.5.4.3,
↪name=commonName) >,
value='example.com') >]) > >
```

The default fallback is to assume a `DNSName`. If this doesn't work, an exception will be raised:

```
>>> parse_general_name('foo..bar`*123')
Traceback (most recent call last):
...
idna.core.IDNAError: The label b'' is not a valid A-label
>>> parse_general_name('foo bar')
Traceback (most recent call last):
...
idna.core.IDNAError: The label b'foo bar' is not a valid A-label
```

If you want to override detection, you can prefix the name to match `GENERAL_NAME_RE`:

```
>>> parse_general_name('email:user@example.com')
<RFC822Name (value=user@example.com)>
>>> parse_general_name('URI:https://example.com')
<UniformResourceIdentifier (value=https://example.com)>
>>> parse_general_name('dirname:/CN=example.com')
<DirectoryName (value=<Name ([<NameAttribute (oid=<ObjectIdentifier (oid=2.5.4.3,
↳name=commonName)>,
value='example.com')>])>>
```

Some more exotic values can only be generated by using this prefix:

```
>>> parse_general_name('rid:2.5.4.3')
<RegisteredID (value=<ObjectIdentifier (oid=2.5.4.3, name=commonName)>)>
>>> parse_general_name('otherName:2.5.4.3,example.com')
<OtherName (type_id=<ObjectIdentifier (oid=2.5.4.3, name=commonName)>, value=b
↳'example.com')>
```

If you give a prefixed value, this function is less forgiving of any typos and does not catch any exceptions:

```
>>> parse_general_name('email:foo@')
Traceback (most recent call last):
...
idna.core.IDNAError: Empty domain
```

`django_ca.utils.parse_name` (*name*)

Parses a subject string as used in OpenSSLS command line utilities.

The name is expected to be close to the subject format commonly used by OpenSSL, for example `/C=AT/L=Vienna/CN=example.com/emailAddress=user@example.com`. The function does its best to be lenient on deviations from the format, object identifiers are case-insensitive (e.g. `cn` is the same as `CN`), whitespace at the start and end is stripped and the subject does not have to start with a slash (`/`).

```
>>> parse_name('/CN=example.com')
OrderedDict([('CN', 'example.com')])
>>> parse_name('c=AT/l= Vienna/o="ex org"/CN=example.com')
OrderedDict([('C', 'AT'), ('L', 'Vienna'), ('O', 'ex org'), ('CN', 'example.com
↳')])
```

Dictionary keys are normalized to the values of `OID_NAME_MAPPINGS` and keys will be sorted based on x509 name specifications regardless of the given order:

```
>>> parse_name('L="Vienna / District"/EMAILAddress=user@example.com')
OrderedDict([('L', 'Vienna / District'), ('emailAddress', 'user@example.com')])
```

```
>>> parse_name('/C=AT/CN=example.com') == parse_name('/CN=example.com/C=AT')
True
```

Due to the magic of `NAME_RE`, the function even supports quoting strings and including slashes, so strings like `/OU="Org / Org Unit"/CN=example.com` will work as expected.

```
>>> parse_name('L="Vienna / District"/CN=example.com')
OrderedDict([('L', 'Vienna / District'), ('CN', 'example.com')])
```

But note that it's still easy to trick this function, if you really want to. The following example is *not* a valid subject, the location is just bogus, and whatever you were expecting as output, it's certainly different:

```
>>> parse_name('L="Vienna " District"/CN=example.com')
OrderedDict([('L', 'Vienna'), ('CN', 'example.com')])
```

Examples of where this string is used are:

```
# openssl req -new -key priv.key -out csr -utf8 -batch -sha256 -subj '/C=AT/
↳CN=example.com'
# openssl x509 -in cert.pem -noout -subject -nameopt compat
/C=AT/L=Vienna/CN=example.com
```

`django_ca.utils.sort_subject_dict(d)`

Returns an itemized dictionary in the correct order for a x509 subject.

`django_ca.utils.x509_name(name)`

Parses a subject string into a `x509.Name`.

If `name` is a string, `parse_name()` is used to parse it. A list of tuples or a dict (preferably an `OrderedDict`) is also supported.

```
>>> x509_name('/C=AT/CN=example.com')
<Name ([<NameAttribute(oid=<ObjectIdentifier(oid=2.5.4.6, name=countryName)>,
↳value='AT')>,
      <NameAttribute(oid=<ObjectIdentifier(oid=2.5.4.3, name=commonName)>, value=
↳'example.com')>])>
>>> x509_name([('C', 'AT'), ('CN', 'example.com')])
<Name ([<NameAttribute(oid=<ObjectIdentifier(oid=2.5.4.6, name=countryName)>,
↳value='AT')>,
      <NameAttribute(oid=<ObjectIdentifier(oid=2.5.4.3, name=commonName)>, value=
↳'example.com')>])>
>>> x509_name(OrderedDict([('C', 'AT'), ('CN', 'example.com')]))
<Name ([<NameAttribute(oid=<ObjectIdentifier(oid=2.5.4.6, name=countryName)>,
↳value='AT')>,
      <NameAttribute(oid=<ObjectIdentifier(oid=2.5.4.3, name=commonName)>, value=
↳'example.com')>])>
>>> x509_name(OrderedDict([('C', 'AT'), ('CN', 'example.com')]))
<Name ([<NameAttribute(oid=<ObjectIdentifier(oid=2.5.4.6, name=countryName)>,
↳value='AT')>,
      <NameAttribute(oid=<ObjectIdentifier(oid=2.5.4.3, name=commonName)>, value=
↳'example.com')>])>
```

# CHAPTER 15

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## Indices and tables

---

- `genindex`
- `modindex`
- `search`



**d**

`django_ca.utils`, 53





**A**

add\_colons() (in module django\_ca.utils), 53

**C**

ca (django\_ca.views.OCSPView attribute), 24

Certificate (class in django\_ca.models), 52

CertificateAuthority (class in django\_ca.models), 51

CertificateAuthorityManager (class in django\_ca.managers), 51

CertificateManager (class in django\_ca.managers), 52

CertificateRevocationListView (class in django\_ca.views), 20

content\_type (django\_ca.views.CertificateRevocationListView attribute), 20

**D**

digest (django\_ca.views.CertificateRevocationListView attribute), 20

django\_ca.utils (module), 53

**E**

expires (django\_ca.views.CertificateRevocationListView attribute), 20

expires (django\_ca.views.OCSPView attribute), 24

**F**

format\_general\_names() (in module django\_ca.utils), 53

format\_name() (in module django\_ca.utils), 53

**G**

GENERAL\_NAME\_RE (in module django\_ca.utils), 53

get\_cert\_builder() (in module django\_ca.utils), 54

get\_cert\_profile\_kwargs() (in module django\_ca.utils), 54

get\_revocation() (django\_ca.models.Certificate method), 52

**I**

init() (django\_ca.managers.CertificateAuthorityManager method), 51

int\_to\_hex() (in module django\_ca.utils), 54

is\_power2() (in module django\_ca.utils), 54

**L**

LazyEncoder (class in django\_ca.utils), 53

**M**

multiline\_url\_validator() (in module django\_ca.utils), 54

**N**

NAME\_RE (in module django\_ca.utils), 53

**O**

OCSPView (class in django\_ca.views), 24

**P**

parse\_general\_name() (in module django\_ca.utils), 54

parse\_name() (in module django\_ca.utils), 55

password (django\_ca.views.CertificateRevocationListView attribute), 20

**R**

responder\_cert (django\_ca.views.OCSPView attribute), 24

responder\_key (django\_ca.views.OCSPView attribute), 24

**S**

sign\_cert() (django\_ca.managers.CertificateManager method), 52

sort\_subject\_dict() (in module django\_ca.utils), 56

**T**

type (django\_ca.views.CertificateRevocationListView attribute), 20

**X**

x509\_name() (in module django\_ca.utils), 56