How To Use Traefik as a Reverse Proxy for Docker Containers on Ubuntu 18.04

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Introduction

Docker can be an efficient way to run web applications in production, but you may want to run multiple applications on the same Docker host. In this situation, you'll need to set up a reverse proxy since you only want to expose ports `80` and `443` to the rest of the world.

Traefik is a Docker-aware reverse proxy that includes its own monitoring dashboard. In this tutorial, you'll use Traefik to route requests to two different web application containers: a Wordpress container and an Adminer container, each talking to a MySQL database. You'll configure Traefik to serve everything over HTTPS using Let's Encrypt.

Prerequisites

To follow along with this tutorial, you will need the following:

- One Ubuntu 18.04 server set up by following the Ubuntu 18.04 initial server setup guide, including a sudo non-root user and a firewall.
- Docker installed on your server, which you can do by following How to Install and Use Docker on Ubuntu 18.04.
- Docker Compose installed with the instructions from How to Install Docker Compose on Ubuntu 18.04.
- A domain and three A records, `db-admin`, `blog` and `monitor`, that each point to the IP address of your server. You can learn how to point domains to DigitalOcean Droplets by reading through DigitalOcean's Domains and DNS documentation. Throughout this tutorial, substitute your domain for `your_domain` in the configuration files and examples.

Step 1 — Configuring and Running Traefik

The Traefik project has an official Docker image, so we will use that to run Traefik in a Docker container.

But before we get our Traefik container up and running, we need to create a configuration file and set up an encrypted password so we can access the monitoring dashboard.

We'll use the `htpasswd` utility to create this encrypted password. First, install the utility, which is included in the `apache2-utils` package:

```
sudo apt-get install apache2-utils
```

Then generate the password with `htpasswd`. Substitute `secure_password` with the password you'd like to use for the Traefik admin user:

```
htpasswd -nb admin secure_password
```

The output from the program will look like this:

```
Output

admin:$apr1$ruca84Hq$mbjdMZBAG.KWn7vfN/SNK/
```

You'll use this output in the Traefik configuration file to set up HTTP Basic Authentication for the Traefik health check and monitoring dashboard. Copy the entire output line so you can paste it later.

To configure the Traefik server, we'll create a new configuration file called `traefik.toml` using the TOML format. TOML is a configuration language similar to INI files, but standardized. This file lets us configure the Traefik server and various integrations, or *providers*, we want to use. In this tutorial, we will use three of Traefik's available providers: `api`, `docker`, and `acme`, which is used to support TLS using Let's Encrypt.

Open up your new file in `nano` or your favorite text editor:

```
nano traefik.toml
```

First, add two named entry points, `http` and `https`, that all backends will have access to by default:

traefik.toml

```
defaultEntryPoints = ["http", "https"]
```

We'll configure the `http` and `https` entry points later in this file.

Next, configure the `api` provider, which gives you access to a dashboard interface. This is where you'll paste the output from the `htpasswd` command:

traefik.toml

```
...
[entryPoints]
  [entryPoints.dashboard]
    address = ":8080"
    [entryPoints.dashboard.auth]
      [entryPoints.dashboard.auth.basic]
        users = ["admin:your_encrypted_password"]

[api]
entrypoint="dashboard"
```

The dashboard is a separate web application that will run within the Traefik container. We set the dashboard to run on port `8080`.

The `entrypoints.dashboard` section configures how we'll be connecting with with the `api` provider, and the `entrypoints.dashboard.auth.basic` section configures HTTP Basic Authentication for the dashboard. Use the output from the `htpasswd` command you just ran for the value of the `users` entry. You could specify additional logins by separating them with commas.

We've defined our first `entryPoint`, but we'll need to define others for standard HTTP and HTTPS communitcation that isn't directed towards the `api` provider. The `entryPoints` section configures the addresses that Traefik and the proxied containers can listen on. Add these lines to the file underneath the `entryPoints` heading:

traefik.toml

```
...
  [entryPoints.http]
    address = ":80"
      [entryPoints.http.redirect]
        entryPoint = "https"
  [entryPoints.https]
    address = ":443"
      [entryPoints.https.tls]
...
```

The `http` entry point handles port `80`, while the `https` entry point uses port `443` for TLS/SSL. We automatically redirect all of the traffic on port `80` to the `https` entry point to force secure connections for all requests.

Next, add this section to configure Let's Encrypt certificate support for Traefik:

traefik.toml

```
...
[acme]
email = "your_email@your_domain"
storage = "acme.json"
entryPoint = "https"
onHostRule = true
  [acme.httpChallenge]
  entryPoint = "http"
```

This section is called `acme` because ACME is the name of the protocol used to communicate with Let's Encrypt to manage certificates. The Let's Encrypt service requires registration with a valid email address, so in order to have Traefik generate certificates for our hosts, set the `email` key to your email address. We then specify that we will store the information that we will receive from Let's Encrypt in a JSON file called `acme.json`. The `entryPoint` key needs to point to the entry point handling port `443`, which in our case is the `https` entry point.

The key `onHostRule` dictates how Traefik should go about generating certificates. We want to fetch our certificates as soon as our containers with specified hostnames are created, and that's what the `onHostRule` setting will do.

The `acme.httpChallenge` section allows us to specify how Let's Encrypt can verify that the certificate should be generated. We're configuring it to serve a file as part of the challenge through the `http` entrypoint.

Finally, let's configure the `docker` provider by adding these lines to the file:

traefik.toml

```
...
[docker]
domain = "your_domain"
watch = true
network = "web"
```

The `docker` provider enables Traefik to act as a proxy in front of Docker containers. We've configured the provider to `watch` for new containers on the `web` network (that we'll create soon) and expose them as subdomains of `your_domain`.

At this point, `traefik.toml` should have the following contents:

traefik.toml

```
defaultEntryPoints = ["http", "https"]

[entryPoints]
  [entryPoints.dashboard]
    address = ":8080"
    [entryPoints.dashboard.auth]
      [entryPoints.dashboard.auth.basic]
        users = ["admin:your_encrypted_password"]
  [entryPoints.http]
    address = ":80"
      [entryPoints.http.redirect]
        entryPoint = "https"
  [entryPoints.https]
    address = ":443"
      [entryPoints.https.tls]

[api]
entrypoint="dashboard"

[acme]
email = "your_email@your_domain"
storage = "acme.json"
entryPoint = "https"
onHostRule = true
  [acme.httpChallenge]
  entryPoint = "http"

[docker]
domain = "your_domain"
watch = true
network = "web"
```

Save the file and exit the editor. With all of this configuration in place, we can fire up Traefik.

Step 2 – Running the Traefik Container

Next, create a Docker network for the proxy to share with containers. The Docker network is necessary so that we can use it with applications that are run using Docker Compose. Let's call this network `web`.

```
docker network create web
```

When the Traefik container starts, we will add it to this network. Then we can add additional containers to this network later for Traefik to proxy to.

Next, create an empty file which will hold our Let's Encrypt information. We'll share this into the container so Traefik can use it:

```
touch acme.json
```

Traefik will only be able to use this file if the root user inside of the container has unique read and write access to it. To do this, lock down the permissions on `acme.json` so that only the owner of the file has read and write permission.

```
chmod 600 acme.json
```

Once the file gets passed to Docker, the owner will automatically change to the **root** user inside the container.

Finally, create the Traefik container with this command:

- docker run -d \
- -v /var/run/docker.sock:/var/run/docker.sock \
- -v $PWD/traefik.toml:/traefik.toml \
- -v $PWD/acme.json:/acme.json \
- -p 80:80 \
- -p 443:443 \
- -l traefik.frontend.rule=Host:monitor.your_domain \
- -l traefik.port=8080 \
- --network web \
- --name traefik \
- traefik:1.7.2-alpine

The command is a little long so let's break it down.

We use the `-d` flag to run the container in the background as a daemon. We then share our `docker.sock` file into the container so that the Traefik process can listen for changes to containers. We also share the `traefik.toml` configuration file and the `acme.json` file we created into the container.

Next, we map ports `:80` and `:443` of our Docker host to the same ports in the Traefik container so Traefik receives all HTTP and HTTPS traffic to the server.

Then we set up two Docker labels that tell Traefik to direct traffic to the hostname `monitor.your_domain` to port `:8080` within the Traefik container, exposing the monitoring dashboard.

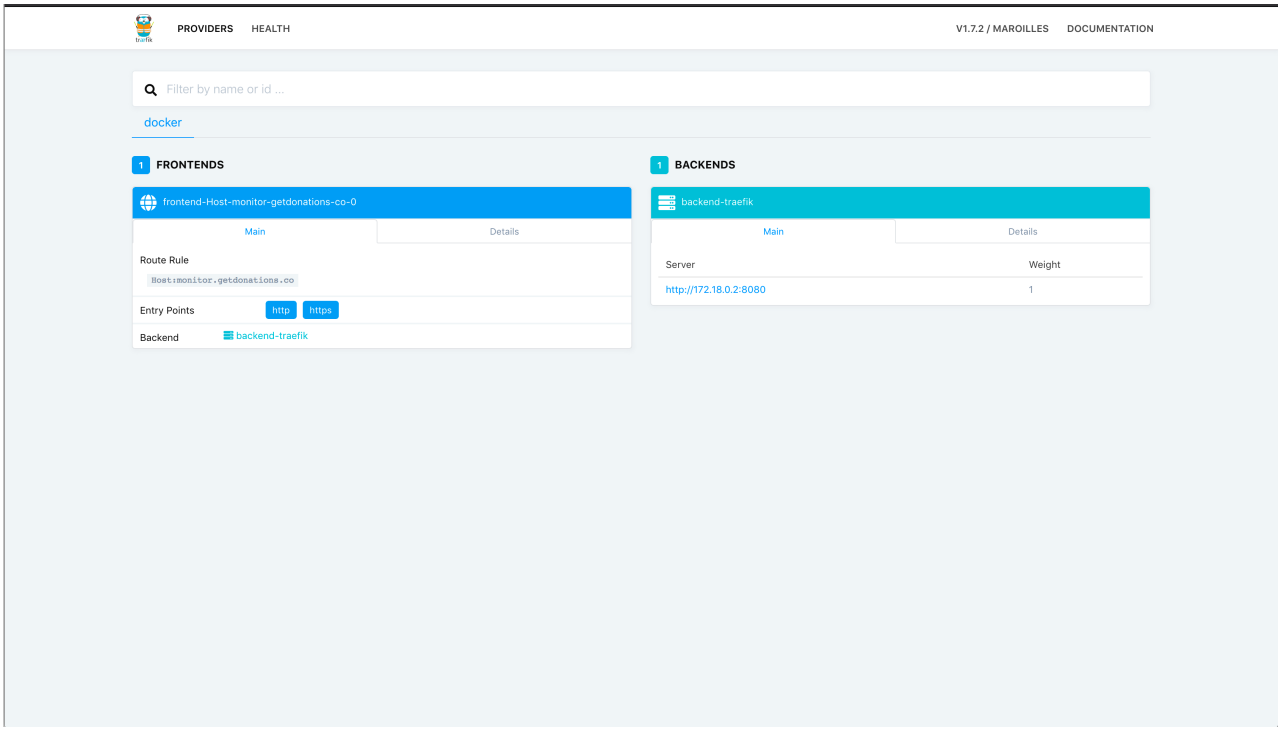
We set the network of the container to `web`, and we name the container `traefik`.

Finally, we use the `traefik:1.7.2-alpine` image for this container, because it's small.

A Docker image's `ENTRYPOINT` is a command that always runs when a container is created from the image. In this case, the command is the `traefik` binary within the container. You can pass additional arguments to that command when you launch the container, but we've configured all of our settings in the `traefik.toml` file.

With the container started, you now have a dashboard you can access to see the health of your containers. You can also use this dashboard to visualize the frontends and backends that Traefik has registered. Access the monitoring dashboard by pointing your browser to `https://monitor.your_domain`. You will be prompted for your username and password, which are **admin** and the password you configured in Step 1.

Once logged in, you'll see an interface similar to this:



There isn't much to see just yet, but leave this window open, and you will see the contents change as you add containers for Traefik to work with.

We now have our Traefik proxy running, configured to work with Docker, and ready to monitor other Docker containers. Let's start some containers for Traefik to act as a proxy for.

Step 3 — Registering Containers with Traefik

With the Traefik container running, you're ready to run applications behind it. Let's launch the following cotainers behind Traefik:

1. A blog using the official Wordpress image.
2. A database management server using the official Adminer image.

We'll manage both of these applications with Docker Compose using a `docker-compose.yml` file. Open the `docker-compose.yml` file in your editor:

```
nano docker-compose.yml
```

Add the following lines to the file to specify the version and the networks we'll use:

docker-compose.yml

```
version: "3"

networks:
  web:
    external: true
  internal:
    external: false
```

We use Docker Compose version `3` because it's the newest major version of the Compose file format.

For Traefik to recognize our applications, they must be part of the same network, and since we created the network manually, we pull it in by specifying the network name of `web` and setting `external` to `true`. Then we define another network so that we can connect our exposed containers to a database container that we won't expose through Traefik. We'll call this network `internal`.

Next, we"ll define each of our `services`, one at a time. Let's start with the `blog` container, which we'll base on the official WordPress image. Add this configuration to the file:

docker-compose.yml

```
version: "3"
...

services:
  blog:
    image: wordpress:4.9.8-apache
    environment:
      WORDPRESS_DB_PASSWORD:
    labels:
      - traefik.backend=blog
      - traefik.frontend.rule=Host:blog.your_domain
      - traefik.docker.network=web
      - traefik.port=80
    networks:
      - internal
      - web
    depends_on:
      - mysql
```

The `environment` key lets you specify environment variables that will be set inside of the container. By not setting a value for `WORDPRESS_DB_PASSWORD`, we're telling Docker Compose to get the value from our shell and pass it through when we create the container. We will define this environment variable in our shell before starting the containers. This way we don't hard-code passwords into the configuration file.

The `labels` section is where you specify configuration values for Traefik. Docker labels don't do anything by themselves, but Traefik reads these so it knows how to treat containers. Here's what each of these labels does:

- `traefik.backend` specifies the name of the backend service in Traefik (which points to the actual `blog` container).
- `traefik.frontend.rule=Host:blog.your_domain` tells Traefik to examine the host requested and if it matches the pattern of `blog.your_domain` it should route the traffic to the `blog` container.
- `traefik.docker.network=web` specifies which network to look under for Traefik to find the internal IP for this container. Since our Traefik container has access to all of the Docker info, it would potentially take the IP for the `internal` network if we didn't specify this.
- `traefik.port` specifies the exposed port that Traefik should use to route traffic to this container.

With this configuration, all traffic sent to our Docker host's port `80` will be routed to the `blog` container.

We assign this container to two different networks so that Traefik can find it via the `web` network and it can communicate with the database container through the `internal` network.

Lastly, the `depends_on` key tells Docker Compose that this container needs to start *after* its dependencies are running. Since WordPress needs a database to run, we must run our `mysql` container before starting our `blog` container.

Next, configure the MySQL service by adding this configuration to your file:

docker-compose.yml

```
services:
...
  mysql:
    image: mysql:5.7
    environment:
      MYSQL_ROOT_PASSWORD:
    networks:
      - internal
    labels:
      - traefik.enable=false
```

We're using the official MySQL 5.7 image for this container. You'll notice that we're once again using an `environment` item without a value. The `MYSQL_ROOT_PASSWORD` and `WORDPRESS_DB_PASSWORD` variables will need to be set to the same value to make sure that our WordPress container can communicate with the MySQL. We don't want to expose the `mysql` container to Traefik or the outside world, so we're only assigning this

container to the `internal` network. Since Traefik has access to the Docker socket, the process will still expose a frontend for the `mysql` container by default, so we'll add the label `traefik.enable=false` to specify that Traefik should not expose this container.

Finally, add this configuration to define the Adminer container:

docker-compose.yml

```
services:
...
  adminer:
    image: adminer:4.6.3-standalone
    labels:
      - traefik.backend=adminer
      - traefik.frontend.rule=Host:db-admin.your_domain
      - traefik.docker.network=web
      - traefik.port=8080
    networks:
      - internal
      - web
    depends_on:
      - mysql
```

This container is based on the official Adminer image. The `network` and `depends_on` configuration for this container exactly match what we're using for the `blog` container.

However, since we're directing all of the traffic to port `80` on our Docker host directly to the `blog` container, we need to configure this container differently in order for traffic to make it to our `adminer` container. The line `traefik.frontend.rule=Host:db-admin.your_domain` tells Traefik to examine the host requested. If it matches the pattern of `db-admin.your_domain`, Traefik will route the traffic to the `adminer` container.

At this point, `docker-compose.yml` should have the following contents:

docker-compose.yml

```
version: "3"

networks:
  web:
    external: true
  internal:
    external: false

services:
  blog:
    image: wordpress:4.9.8-apache
    environment:
      WORDPRESS_DB_PASSWORD:
    labels:
      - traefik.backend=blog
      - traefik.frontend.rule=Host:blog.your_domain
      - traefik.docker.network=web
      - traefik.port=80
    networks:
      - internal
      - web
    depends_on:
      - mysql
  mysql:
    image: mysql:5.7
    environment:
      MYSQL_ROOT_PASSWORD:
    networks:
      - internal
    labels:
      - traefik.enable=false
  adminer:
    image: adminer:4.6.3-standalone
    labels:
      - traefik.backend=adminer
      - traefik.frontend.rule=Host:db-admin.your_domain
      - traefik.docker.network=web
      - traefik.port=8080
    networks:
      - internal
      - web
    depends_on:
      - mysql
```

Save the file and exit the text editor.

Next, set values in your shell for the `WORDPRESS_DB_PASSWORD` and `MYSQL_ROOT_PASSWORD` variables before you start your containers:

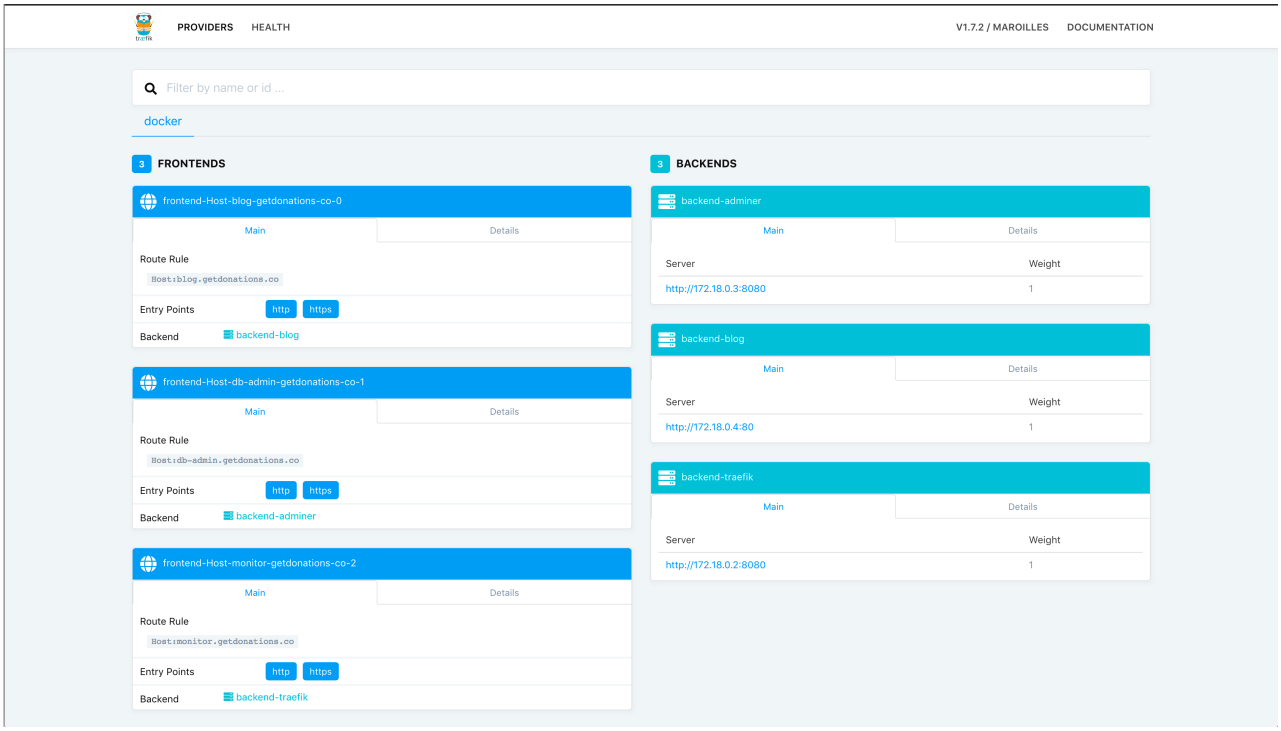
- export WORDPRESS_DB_PASSWORD=secure_database_password
- export MYSQL_ROOT_PASSWORD=secure_database_password

Substitute `secure_database_password` with your desired database password. Remember to use the same password for both `WORDPRESS_DB_PASSWORD` and `MYSQL_ROOT_PASSWORD`.

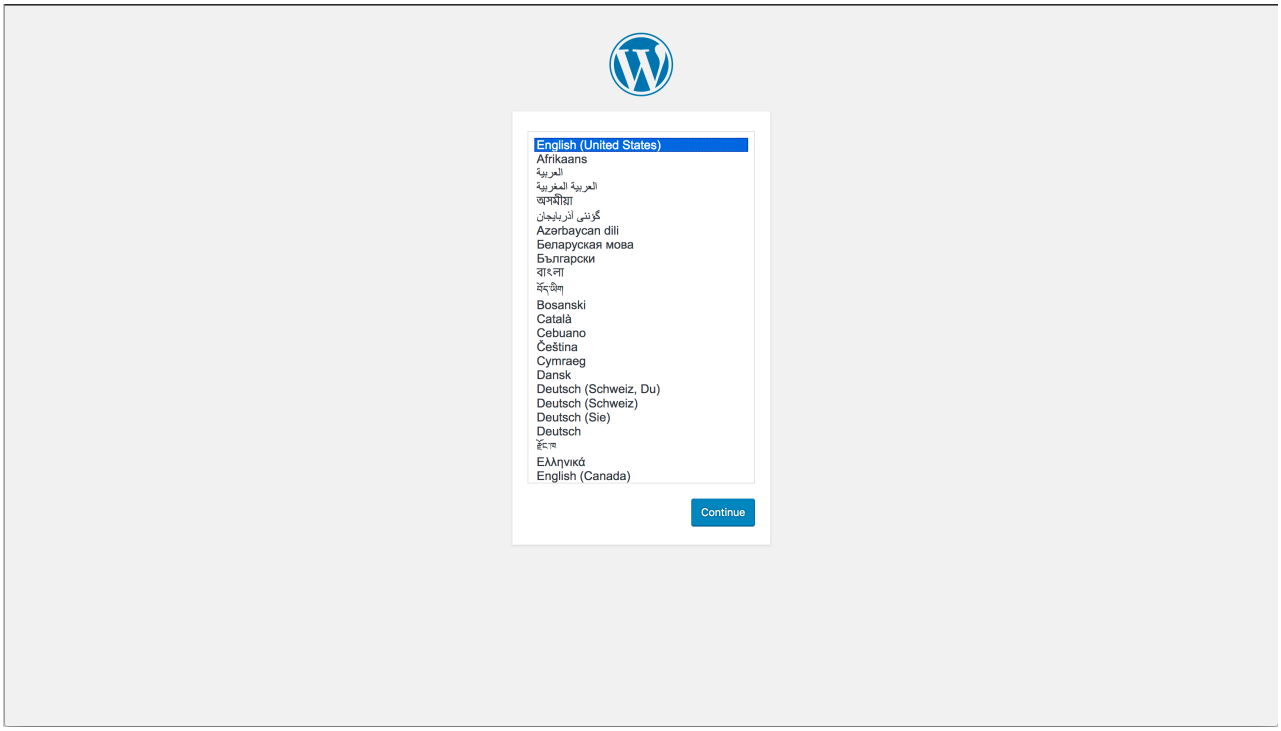
With these variables set, run the containers using `docker-compose`:

```
docker-compose up -d
```

Now take another look at the Traefik admin dashboard. You'll see that there is now a `backend` and a `frontend` for the two exposed servers:

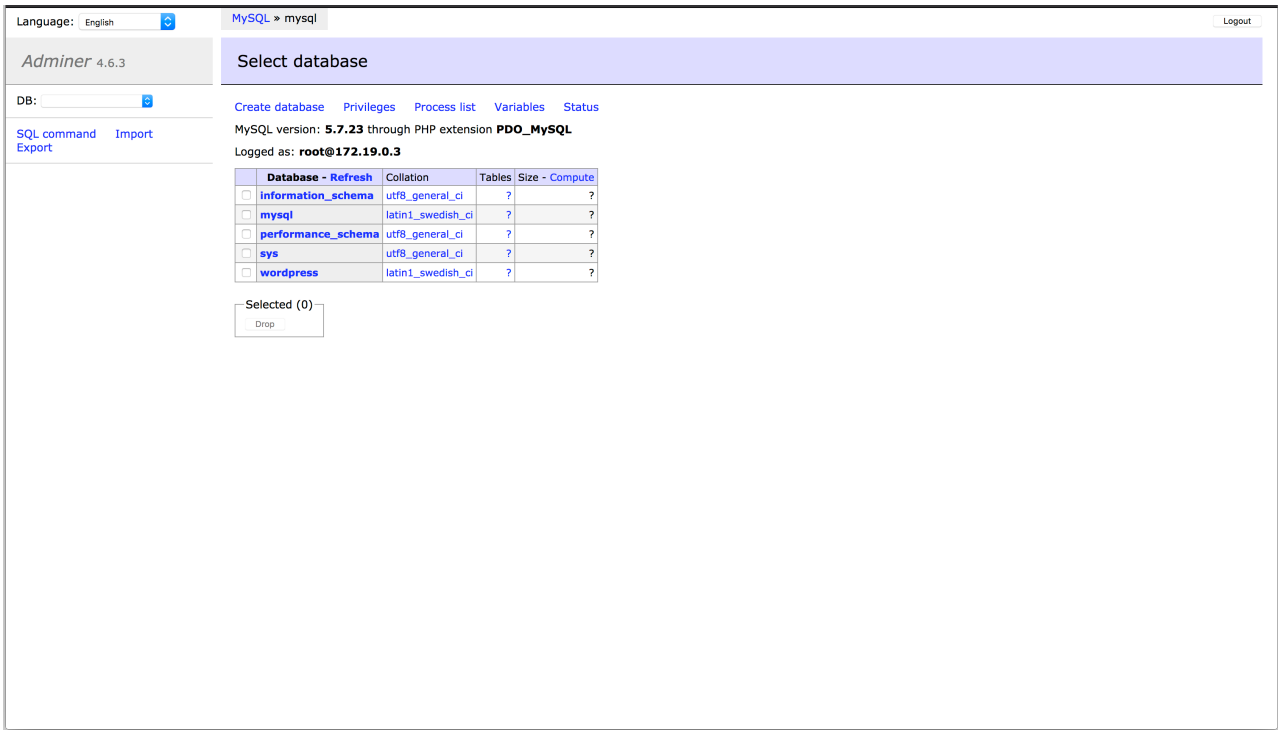


Navigate to `blog.your_domain`, substituting `your_domain` with your domain. You'll be redirected to a TLS connection and can now complete the Wordpress setup:



Now access Adminer by visiting `db-admin.your_domain` in your browser, again substituting `your_domain` with your domain. The `mysql` container isn't exposed to the outside world, but the `adminer` container has access to it through the `internal` Docker network that they share using the `mysql` container name as a host name.

On the Adminer login screen, use the username **root**, use `mysql` for the **server**, and use the value you set for `MYSQL_ROOT_PASSWORD` for the password. Once logged in, you'll see the Adminer user interface:



Both sites are now working, and you can use the dashboard at `monitor.your_domain` to keep an eye on your applications.

Conclusion

In this tutorial, you configured Traefik to proxy requests to other applications in Docker containers.

Traefik's declarative configuration at the application container level makes it easy to configure more services, and there's no need to restart the `traefik` container when you add new applications to proxy traffic to since Traefik notices the changes immediately through the Docker socket file it's monitoring.

To learn more about what you can do with Traefik, head over to the official Traefik documentation.