



DTaaS

**Digital Twin as a Service
(DTaaS)**

DTaaS Development Team

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1. What is DTaaS?


Failure

Please note that the development documentation is being rewritten heavily. This rework is being done to prepare the documentation for the next release. Please use [DTaaS v0.4](#) for installation and use. Thank you.

The Digital Twin as a Service (DTaaS) software platform is useful to **Build, Use and Share** digital twins (DTs).

 **Build:** The DTs are built on the software platform using the reusable DT components available on the platform.

 **Use:** Use the DTs on the software platform.

 **Share:** Share ready to use DTs with other users. It is also possible to share the services offered by one DT with other users.

There is an overview of the software available in the form of [slides](#), [video](#), and [feature walkthrough](#).

1.1 License

This software is owned by [The INTO-CPS Association](#) and is available under [the INTO-CPS License](#).

The DTaaS software platform uses [third-party](#) open-source software. These software components have their own licenses.

2. Admin

2.1 Overview

2.1.1 Goal

The goal is to set up the DTaaS infrastructure in order to enable your users to use the DTaaS.

2.1.2 Optional Requirements

There are three optional requirements for installing the DTaaS. These requirements are not needed for **localhost** installation. They are only required for installation of the DTaaS on a web server.

OAuth Provider

The DTaaS software uses OAuth for user authorization. It is possible to use either *gitlab.com* or your own OAuth service provider.

Domain name

The DTaaS software is a web application and is preferably hosted on a server with a domain name like *foo.com*. However, it is possible to install the software on your computer and use access it at *localhost*.

2.1.3 Install

The DTaaS can be installed in different ways. Each version serves a different purpose. Follow the installation that fits your usecase.

Installation Setup	Purpose
localhost	Install DTaaS on your computer for a single user; does not need a web server. <i>This setup does not require domain name.</i>
Server	Install DTaaS on server for multiple users.
One vagrant machine	Install DTaaS on a virtual machine; can be used for single or multiple users.
Two vagrant machines	Install DTaaS on two virtual machines; can be used for single or multiple users.
	The core DTaaS application is installed on the first virtual machine and all the services (RabbitMQ, MQTT, InfluxDB, Grafana and MongoDB) are installed on second virtual machine.
Independent Packages	Can be used independently; do not need full installation of DTaaS.

2.2 Authorization

2.2.1 OAuth for React Client

To enable user authorization on DTaaS React client website, you will use the OAuth authorization protocol, specifically the PKCE authorization flow. Here are the steps to get started:

1. Choose Your GitLab Server:

- You need to set up OAuth authorization on a GitLab server. The commercial gitlab.com is not suitable for multi-user authorization (DTaaS requires this), so you'll need an on-premise GitLab instance.
- You can use [GitLab Omnibus Docker for this purpose](#).
- Configure the OAuth application as an [instance-wide authorization type](#).

2. Determine Your Website's Hostname:

- Before setting up OAuth on GitLab, decide on the hostname for your website. It's recommended to use a self-hosted GitLab instance, which you will use in other parts of the DTaaS application.

3. Define Callback and Logout URLs:

- For the PKCE authorization flow to function correctly, you need two URLs: a callback URL and a logout URL.
- The callback URL informs the OAuth provider of the page where signed-in users should be redirected. It's different from the landing homepage of the DTaaS application.
- The logout URL is where users will be directed after logging out.

4. OAuth Application Creation:

- During the creation of the OAuth application on GitLab, you need to specify the scope. Choose `openid`, `profile`, `read_user`, `read_repository`, and `api` scopes.

Applications

Manage applications that can use GitLab as an OAuth provider, and applications that you've authorized to use your account.

Your applications  4

Add new application

Name

Redirect URI

Use one line per URI

☐

Confidential

Enable only for confidential applications exclusively used by a trusted backend server that can securely store the client secret. Do not enable for native-mobile, single-page, or other JavaScript applications because they cannot keep the client secret confidential.

5. Application ID:

- After successfully creating the OAuth application, GitLab generates an application ID. This is a long string of HEX values that you will need for your configuration files.

Scopes

- ☒ **api**
Grants complete read/write access to the API, including all groups and projects, the container registry, and the package registry.
- ☐ **read_api**
Grants read access to the API, including all groups and projects, the container registry, and the package registry.
- ☒ **read_user**
Grants read-only access to the authenticated user's profile through the /user API endpoint, which includes username, public email, and full name. Also grants access to read-only API endpoints under /users.
- ☐ **create_runner**
Grants create access to the runners.
- ☐ **k8s_proxy**
Grants permission to perform Kubernetes API calls using the agent for Kubernetes.
- ☒ **read_repository**
Grants read-only access to repositories on private projects using Git-over-HTTP or the Repository Files API.
- ☐ **write_repository**
Grants read-write access to repositories on private projects using Git-over-HTTP (not using the API).
- ☐ **read_observability**
Grants read-only access to GitLab Observability.
- ☐ **write_observability**
Grants write access to GitLab Observability.
- ☐ **ai_features**
Grants access to GitLab Duo related API endpoints.
- ☐ **sudo**
Grants permission to perform API actions as any user in the system, when authenticated as an admin user.
- ☐ **admin_mode**
Grants permission to perform API actions as an administrator, when Admin Mode is enabled.
- ☒ **openid**
Grants permission to authenticate with GitLab using OpenID Connect. Also gives read-only access to the user's profile and group memberships.
- ☒ **profile**
Grants read-only access to the user's profile data using OpenID Connect.
- ☐ **email**
Grants read-only access to the user's primary email address using OpenID Connect.

Save application

Cancel

6. Required Information from OAuth Application:

- You will need the following information from the OAuth application registered on GitLab:

GitLab Variable Name	Variable Name in Client env.js	Default Value
OAuth Provider	REACT_APP_AUTH_AUTHORITY	https://gitlab.foo.com/
Application ID	REACT_APP_CLIENT_ID	
Callback URL	REACT_APP_REDIRECT_URI	https://foo.com/Library
Scopes	REACT_APP_GITLAB_SCOPES	openid, profile, read_user, read_repository, api

 The application was created successfully.

Application: DTaaS Client Authorization

[illegible]

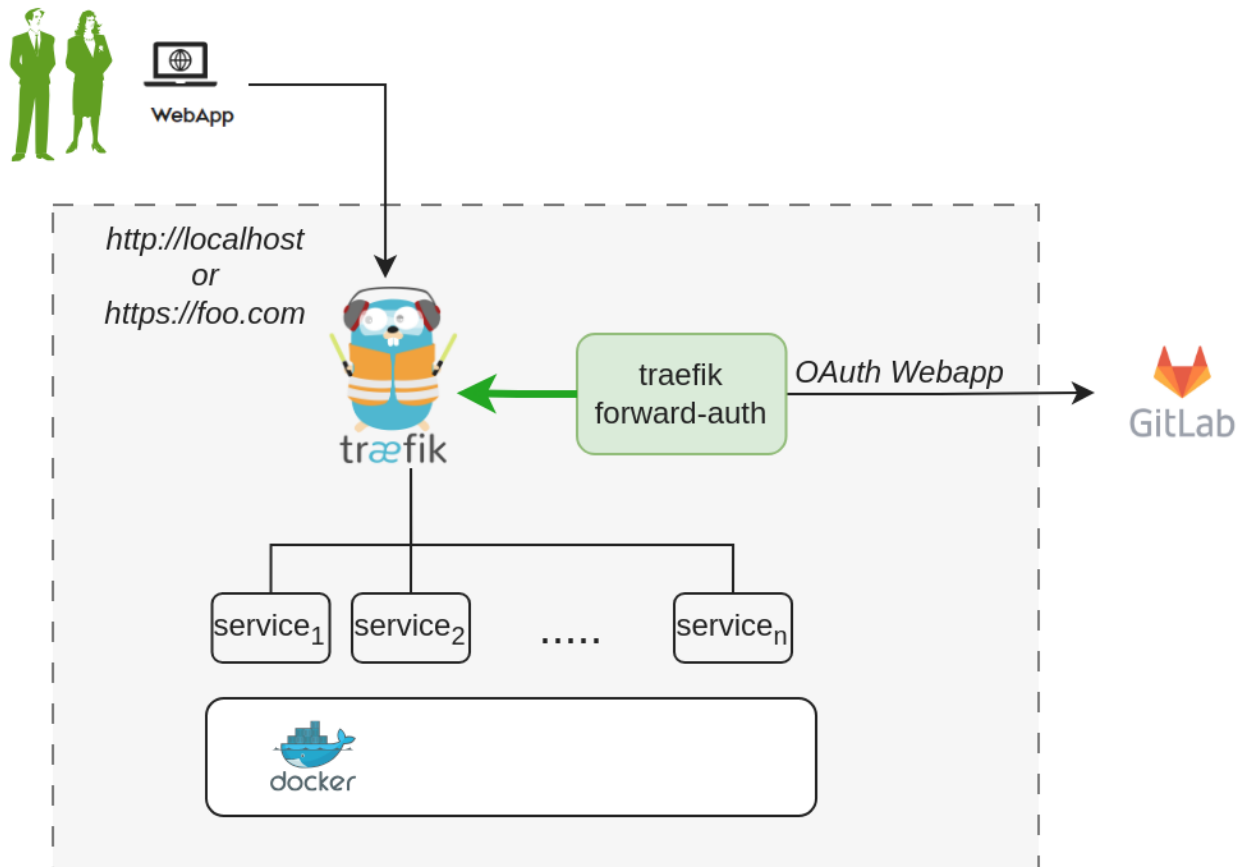
7. Create User Accounts:

Create user accounts in gitlab for all the usernames chosen during installation. The *trial* installation script comes with two default usernames - *user1* and *user2*. For all other installation scenarios, accounts with specific usernames need to be created on gitlab.

2.2.2 OAuth for Traefik Gateway

The traefik gateway is used to serve the DTaaS. All the services provided as part of the application are secured at the traefik gateway. The security is based on [Traefik forward-auth](#).

An illustration of the docker containers used and the authorization setup is shown here.



The **traefik forward-auth** can use any OAuth2 provider, but within the DTaaS gitlab is used as authorization provider. You will use the OAuth the web / server application authorization flow.

Here are the steps to get started:

1. Choose GitLab Server:

- You need to set up OAuth authorization on a GitLab server. The commercial gitlab.com is not suitable for multi-user authorization (DTaaS requires this), so you'll need an on-premise GitLab instance.
- You can use [GitLab Omnibus Docker for this purpose](#).
- Configure the OAuth application as an [instance-wide authorization type](#). Select option to generate client secret and also selection option for trusted application.

2. Determine Website Hostname:

Before setting up OAuth on GitLab, decide on the hostname for your website. It's recommended to use a self-hosted GitLab instance, which you will use in other parts of the DTaaS application.

3. Determine Callback and Logout URLs:

For the web / server authorization flow to function correctly, you need two URLs: a *callback URL* and a *logout URL*.

- The callback URL informs the OAuth provider of the page where signed-in users should be redirected. It is the landing homepage of the DTaaS application. (either http://foo.com/_oauth/ or http://localhost/_oauth/)
- The logout URL is the URL for signout of gitlab and clear authorization within traefik-forward auth. (either http://foo.com/_oauth/logout or http://localhost/_oauth/logout). The logout URL is to help users logout of traefik forward-auth. The logout URL should not be entered into Gitlab OAuth application setup.

4. Create OAuth Application:

During the creation of the OAuth application on GitLab, you need to specify the scope. Choose **read_user** scope.

User Settings > Applications

Applications

Add new application

Name

DTaaS Server Authorization

Redirect URI

http://foo.com/_oauth

Use one line per URI

☒ Confidential

Enable only for confidential applications exclusively used by a trusted backend server that can securely store the client secret. Do not enable for native-mobile, single-page, or other JavaScript applications because they cannot keep the client secret confidential.

Scopes

☐ api

Grants complete read/write access to the API, including all groups and projects, the container registry, and the package registry.

☐ read_api

Grants read access to the API, including all groups and projects, the container registry, and the package registry.


☒ read_user

Grants read-only access to the authenticated user's profile through the /user API endpoint, which includes username, public email, and full name. Also grants access to read-only API

5. Copy Application Credentials:

After successfully creating the OAuth application, GitLab generates an *application ID* and *client secret*.




Both these values are long string of HEX values that you will need for your configuration files.

 The application was created successfully.

✕

 Search page

Application: DTaaS Server Authorization

Application ID	c27516a0e515dfd1b161 
Secret	<div> <div>.....</div> <div></div> <div></div> </div> <div>Renew secret</div> <p>This is the only time the secret is accessible. Copy the secret and store it securely.</p>
Callback URL	http://foo.com/_oauth
Confidential	Yes
Scopes	<ul style="list-style-type: none"> • read_user (Read the authenticated user's personal information)
<div> <div>Continue</div> <div>Edit</div> <div>Destroy</div> </div>	

6. Checklist: Required Information from OAuth Application:

You will need the following information from the OAuth application registered on GitLab:

GitLab Variable Name	Variable Name in .env of docker compose file	Default Value
OAuth Provider	OAUTH_URL	https://gitlab.foo.com/
Application ID	CLIENT_ID	xx
Application Secret	CLIENT_SECRET	xx
Callback URL	(to be directly entered in Gitlab OAuth registration)	
Forward-auth secret	OAUTH_SECRET	<i>random-secret-string</i> (password for forward-auth, can be changed to your preferred string)
Scopes	read_user	

Development Environment

The development environment and server installation scenarios requires traefik forward-auth.

Configure Authorization Rules for Traefik Forward-Auth

The Traefik forward-auth microservices requires configuration rules to manage authorization for different URL paths. The *conf:** file can be used to configure the specific rules. There are broadly three kinds of URLs:

PUBLIC PATH WITHOUT AUTHORIZATION

To setup a public page, an example is shown below.

```
1 rule.noauth.action=allow
2 rule.noauth.rule=Path('/public')
```

Here, 'noauth' is the rule name, and should be changed to suit rule use. Rule names should be unique for each rule. The 'action' property is set to "allow" to make the resource public. The 'rule' property defines the path/route to reach the resource.

COMMON TO ALL USERS

To setup a common page that requires Gitlab OAuth, but is available to all users of the Gitlab instance:

```
1 rule.all.action=auth
2 rule.all.rule=Path('/common')
```

The 'action' property is set to "auth", to enable Gitlab OAuth before the resource can be accessed.

SELECTIVE ACCESS

Selective Access refers to the scenario of allowing access to a URL path for a few users. To setup selective access to a page:

```
1 rule.onlyu1.action=auth
2 rule.onlyu1.rule=Path('/user1')
3 rule.onlyu1.whitelist = user1@localhost
```

The 'whitelist' property of a rule defines a comma separated list of email IDs that are allowed to access the resource. While signing in users can sign in with either their username or email ID as usual, but the email ID corresponding to the account should be included in the whitelist.

This restricts access of the resource, allowing only users mentioned in the whitelist.

Limitation

The rules in `_conf_` file are not dynamically loaded into the `traefik-forward-auth` microservice. Any change in the `conf` file requires restart of `traefik-forward-auth` for the changes to take effect. All the existing user sessions get invalidated when the `traefik-forward-auth*` restarts.

Use a simple command on the terminal.

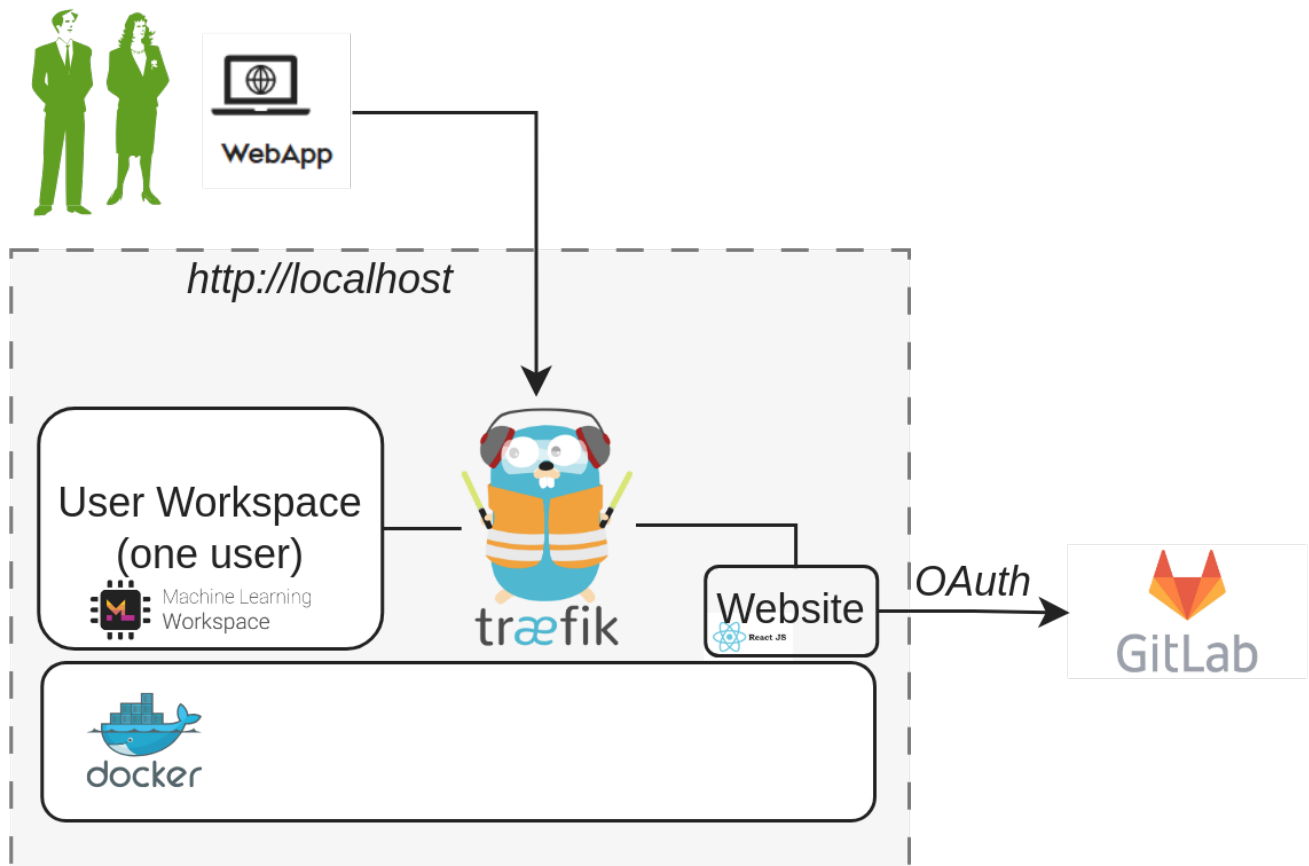
2.3 Docker

2.3.1 Install DTaaS on localhost

The installation instructions provided in this README are ideal for running the DTaaS on both localhost. This installation is ideal for single users intending to use DTaaS on their own computers.

Design

An illustration of the docker containers used and the authorization setup is shown here.



Requirements

The installation requirements to run this docker version of the DTaaS are:

- docker desktop / docker CLI with compose plugin
- User account on gitlab.com



The frontend website requires authorization. The default authorization configuration works for gitlab.com. If you desire to use locally hosted gitlab instance, please see the [client docs](#).

Clone Codebase

```
1 git clone https://github.com/INTO-CPS-Association/DTaaS.git
2 cd DTaaS
```



- 1. The filepaths shown here follow POSIX convention. The installation procedures also work with Windows paths.
- 2. The description below refers to filenames. All the file paths mentioned below are relatively to the top-level **DTaaS** directory.

Configuration

DOCKER COMPOSE

The docker compose configuration is in `deploy/docker/.env.local` ; it is a sample file. It contains environment variables that are used by the docker compose files. It can be updated to suit your local installation scenario. It contains the following environment variables.

Edit all the fields according to your specific case.

URL Path	Example Value	Explanation
DTAAS_DIR	'/home/Desktop/DTaaS'	Full path to the DTaaS directory. This is an absolute path with no trailing slash.
username1	'user1'	Your gitlab username
CLIENT_CONFIG	'/home/Desktop/DTaaS/deploy/config/client/env.local.js'	Full path to env.js file for client



The path examples given here are for Linux OS. These paths can be Windows OS compatible paths as well.

CREATE USER WORKSPACE

The existing filesystem for installation is setup for `user1` . A new filesystem directory needs to be created for the selected user. Please execute the following commands from the top-level directory of the DTaaS project.

```
1 cp -R files/user1 files/username
```

where *username* is the selected username registered on <https://gitlab.com>.

Run

The commands to start and stop the appliation are:

```
1 docker compose -f compose.local.yml --env-file .env.local up -d
2 docker compose -f compose.local.yml --env-file .env.local down
```

To restart only a specific container, for example ``client``

```
1 docker compose -f compose.local.yml --env-file .env up -d --force-recreate client
```

Use

The application will be accessible at: <http://localhost> from web browser. Sign in using your <https://gitlab.com> account.

All the functionality of DTaaS should be available to you through the single page client now.

Limitations

The [library microservice](#) is not included in the localhost installation scenario.

References

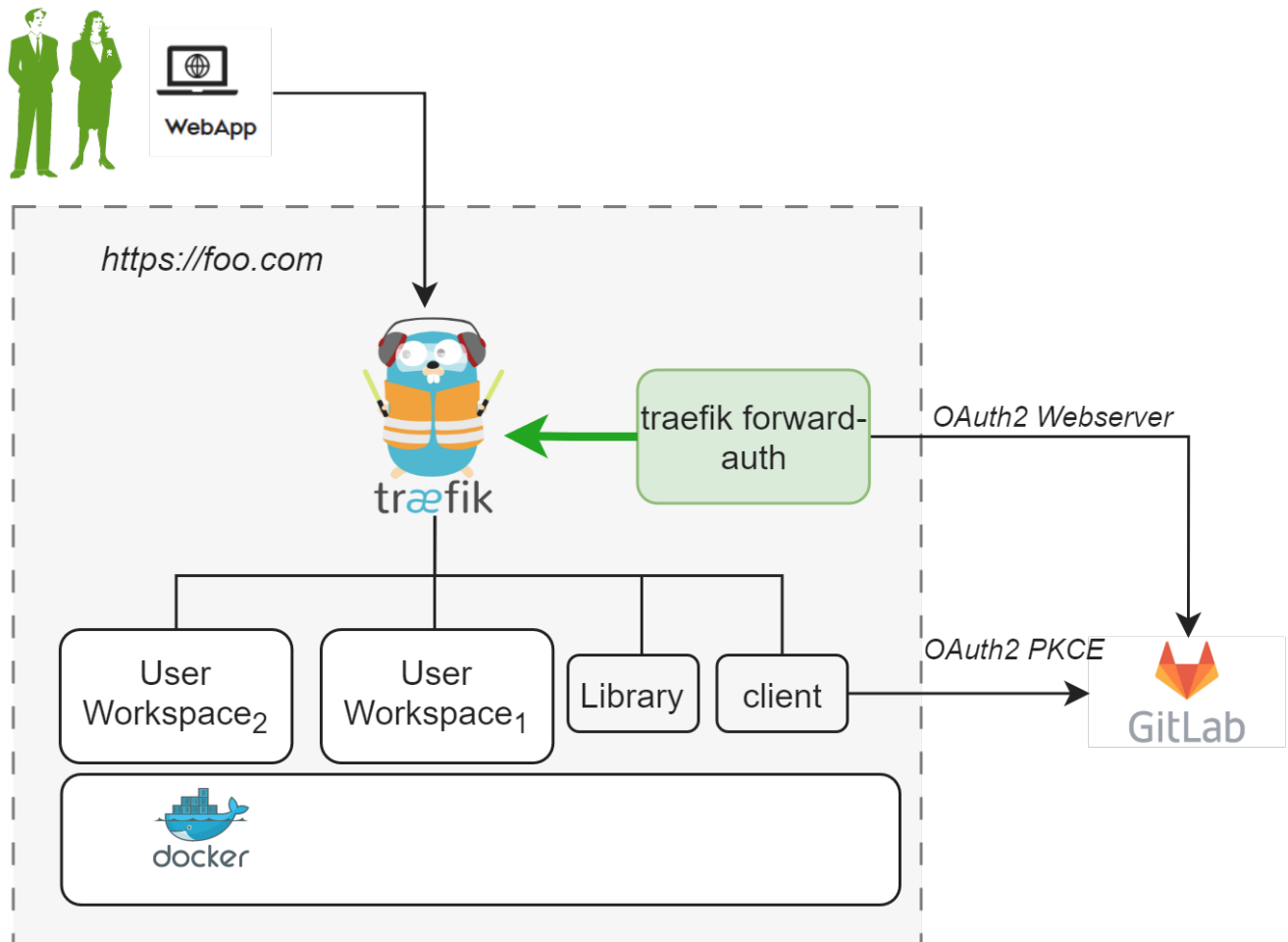
Image sources: [Traefik logo](#), [ml-workspace](#), [reactjs](#), [gitlab](#)

2.3.2 Install DTaaS on a Production Server

The installation instructions provided in this README are ideal for hosting the DTaaS as web application for multiple users.

Design

An illustration of the docker containers used and the authorization setup is shown here.



In the new application configuration, there are two OAuth2 applications.

Requirements

The installation requirements to run this docker version of the DTaaS are:

DOCKER WITH COMPOSE PLUGIN

It is mandatory to have [Docker](#) installed on your computer. We highly recommend using [Docker Desktop](#).

DOMAIN NAME

The DTaaS software is a web application and is preferably hosted on a server with a domain name like *foo.com*. It is also possible to use an IP address in place of domain name.

OAUTH PROVIDER

Gitlab Instance - The DTaaS uses Gitlab OAuth2.0 authorization for user authorization. You can either have an on-premise instance of gitlab, or use gitlab.com itself.

USER ACCOUNTS

Create user accounts in the linked gitlab instance for all the users.

OAUTH2 APPLICATION REGISTRATION

The multi-user installation setup requires dedicated authorization setup for both frontend website and backend services. Both these authorization requirements are satisfied using OAuth2 protocol.

- The frontend website is a React single page application (SPA).
- The details of OAuth2 app for the frontend website are in [client docs](#).
- The OAuth2 authorization for backend services is managed by [Traefik forward-auth](#). The details of this authorization setup are in [server docs](#).

Based on your selection of gitlab instance, it is necessary to register these two OAuth2 applications and link them to your intended DTaaS installation.

Please see [gitlab oauth provider](#) documentation for further help with creating these two OAuth applications.

Clone Codebase

```
1 git clone https://github.com/INTO-CPS-Association/DTaaS.git
2 cd DTaaS
```



Tip

1. The filepaths shown here follow Linux OS. The installation procedures also work with Windows OS.
2. The description below refers to filenames. All the file paths mentioned below are relatively to the top-level **DTaaS** directory.

Configuration

Three following configuration files need to be updated.

DOCKER COMPOSE

The docker compose configuration is in `deploy/docker/.env.server`. it is a sample file. It contains environment variables that are used by the docker compose files. It can be updated to suit your local installation scenario. It contains the following environment variables.

Edit all the fields according to your specific case.

URL Path	Example Value	Explanation
DTAAS_DIR	<code>'/Users/username/DTaaS'</code>	Full path to the DTaaS directory. This is an absolute path with no trailing slash.
SERVER_DNS	<code>foo.com</code>	The server DNS, if you are deploying with a dedicated server. Remember not use http(s) at the beginning of the DNS string
OAUTH_URL	<code>gitlab.foo.com</code>	The URL of your Gitlab instance. It can be <code>gitlab.com</code> if you are planning to use it for authorization.
CLIENT_ID	<code>'xx'</code>	The ID of your server OAuth application
CLIENT_SECRET	<code>'xx'</code>	The Secret of your server OAuth application
OAUTH_SECRET	<code>'random-secret-string'</code>	Any private random string. This is a password you choose for local installation.
username1	<code>'user1'</code>	The gitlab instance username of a user of DTaaS
username2	<code>'user2'</code>	The gitlab instance username of a user of DTaaS
CLIENT_CONFIG	<code>'/Users/username/DTaaS/ deploy/config/client/env.js'</code>	Full path to env.js file for client



Important points to note:

1. The path examples given here are for Linux OS. These paths can be Windows OS compatible paths as well.
2. The Server DNS can also be an IP address. However, for proper working it is necessary to use the same convention (IP/DNS) in the `CLIENT_CONFIG` file as well.

WEBSITE CLIENT

The frontend React website requires configuration which is specified via a filename provided in `CLIENT_CONFIG` variable of `deploy/docker/.env.server` file.

The `CLIENT_CONFIG` file is in relative directory of `deploy/config/client/env.js`.

Further explanation on the client configuration is available in [client config](#).



There is a default OAuth application registered on <https://gitlab.com> for client. The corresponding OAuth application details are:

```
1 REACT_APP_CLIENT_ID: '1be55736756190b3ace4c2c4fb19bde386d1dcc748d20b47ea8cfb5935b8446c',
2 REACT_APP_AUTH_AUTHORITY: 'https://gitlab.com/',
```

This can be used for test purposes. Please use your own OAuth application for secure production deployments.

CREATE USER WORKSPACE

The existing filesystem for installation is setup for `files/user1`. A new filesystem directory needs to be created for the selected user.

Please execute the following commands from the top-level directory of the DTaaS project.

```
1 cp -R files/user1 files/username
```

where *username* is one of the selected usernames. This command needs to be repeated for all the selected users.

CONFIGURE AUTHORIZATION RULES FOR BACKEND AUTHORIZATION

The Traefik forward-auth microservices requires configuration rules to manage authorization for different URL paths. The `deploy/docker/conf.server` file can be used to configure the authorization for user workspaces.

```
1 rule.onlyu1.action=auth
2 rule.onlyu1.rule=Path('/user1')
3 rule.onlyu1.whitelist = user1@localhost
4
5 rule.onlyu1.action=auth
6 rule.onlyu1.rule=Path('/user2')
7 rule.onlyu1.whitelist = user2@localhost
```

Please change the usernames and email addresses to the matching user accounts on the OAuth provider (either <https://gitlab.foo.com> or <https://gitlab.com>).

CAVEAT

The usernames in the `deploy/docker/.env.server` file need to match those in the `deploy/docker/conf.server` file.

Traefik routes are controlled by the `deploy/docker/.env.server` file. Authorization on these routes is controlled by the `deploy/docker/conf.server` file. If a route is not specified in `deploy/docker/conf.server` file but an authorisation is requested by traefik for this unknown route, the default behavior of traefik forward-auth kicks in. This default behavior is to enable endpoint being available to any signed in user.

If there are extra routes in `deploy/docker/conf.server` file but these are not in `deploy/docker/.env.server` file, such routes are not served by traefik; it will give **404 server response**.

Run

The commands to start and stop the application are:

```
1 docker compose -f compose.server.yml --env-file .env.server up -d
2 docker compose -f compose.server.yml --env-file .env.server down
```

To restart only a specific container, for example `client``

```
1 docker compose -f compose.server.yml --env-file .env.server up -d --force-recreate client
```

Use

The application will be accessible at: <http://foo.com> from web browser. Sign in using your account linked to either *gitlab.com* or your local gitlab instance.

All the functionality of DTaaS should be available to your users through the single page client now.

You may have to click Sign in to Gitlab on the Client page and authorize access to the shown application.

ADDING A NEW USER

Please see the [add new user](#) to add new users.

References

Image sources: [Traefik logo](#), [ml-workspace](#), [reactjs](#), [gitlab](#)

2.4 DTaaS Command Line Interface

This is a command line tool for the INTO-CPS-Association Digital Twins as a Service.

2.4.1 Prerequisite

The DTaaS application with base users and essential containers should be up and running before using the CLI.

2.4.2 Installation

Simply install using:

We recommend installing this in a virtual environment.

Steps to install:

- Change the working folder:

```
1 cd <DTaaS-directory>/cli
```

- We recommend installing this in a virtual environment. Create and activate a virtual environment.
- To install, simply:

```
1 pip install dtaas
```

2.4.3 Usage

Setup

The base DTaaS system should be up and running before adding/deleting users with the CLI.

Additionally, Setup the *dtaas.toml* file in the *cli* directory:

- Set *common.server-dns* to domain name of your server. If you want to bring up the server locally, please set this to "*localhost*".
- Set the *path* to the full system path of the DTaaS directory.

```
1 [common]
2 # absolute path to the DTaaS application directory
3 server-dns = "localhost"
4 path = "/home/Desktop/DTaaS"
```

Add users

To add new users using the CLI, fill in the *users.add* list in *dtaas.toml* with the Gitlab instance usernames of the users to be added

```
1 [users]
2 # matching user info must present in this config file
3 add = ["username1", "username2", "username3"]
```

Then simply:

```
1 dtaas admin user add
```

CAVEAT

This brings up the containers, without the AuthMS authentication.

- Currently the *email* fields for each user in *dtaas.toml* are not in use, and are not necessary to fill in. These emails must be configured manually for each user in the *deploy/docker/conf.server* files and the *traefik-forward-auth* container must be restarted. This is done as follows:
- Go to the *docker* directory

```
1 cd <DTaaS>/deploy/docker
```

- Add three lines to the *conf.server* file

```
1 rule.onlyu3.action=auth
2 rule.onlyu3.rule=PathPrefix(`/user3`)
3 rule.onlyu3.whitelist = user3@emailservice.com
```

Run the appropriate command for a server installation:

```
1 docker compose -f compose.server.yml --env-file .env up -d --force-recreate traefik-forward-auth
```

The new users are now added to the DTaaS instance, with authorization enabled.

Delete users

TO delete existing users, fill in the *users.delete* list in *dtaas.toml* with the Gitlab instance usernames of the users to be deleted.

Make sure you are in the *cli* directory.

Then simply:

```
1 dtaas admin user delete
```

Additional Points to Remember

- The *user add* CLI will add and start a container for a new user. It can also start a container for an existing user if that container was somehow stopped. It shows a *Running* status for existing user containers that are already up and running, it doesn't restart them.
- *user add* and *user delete* CLIs return an error if the *add* and *delete* lists in *dtaas.toml* are empty, respectively.

2.5 Vagrant

2.5.1 DTaaS Vagrant Box

This README provides instructions on creating a custom Operating System virtual disk for running the DTaaS software. The virtual disk is managed by **vagrant**. The purpose is two fold:

- Provide cross-platform installation of the DTaaS application. Any operating system supporting use of vagrant software utility can support installation of the DTaaS software.
- Create a ready to use development environment for code contributors.

There are two scripts in this directory:

Script name	Purpose	Default
user.sh	user installation	✓
developer.sh	developer installation	✗

If you are installing the DTaaS for developers, the default installation caters to your needs. You can skip the next step and continue with the creation of vagrant box.

If you are a developer and would like additional software installed, you need to modify `Vagrantfile`. The existing `Vagrantfile` has two lines:

```
1 config.vm.provision "shell", path: "user.sh"
2 #config.vm.provision "shell", path: "developer.sh"
```

Uncomment the second line to have more software components installed. If you are not a developer, no changes are required to the `Vagrantfile`.

This vagrant box installed for users will have the following items:

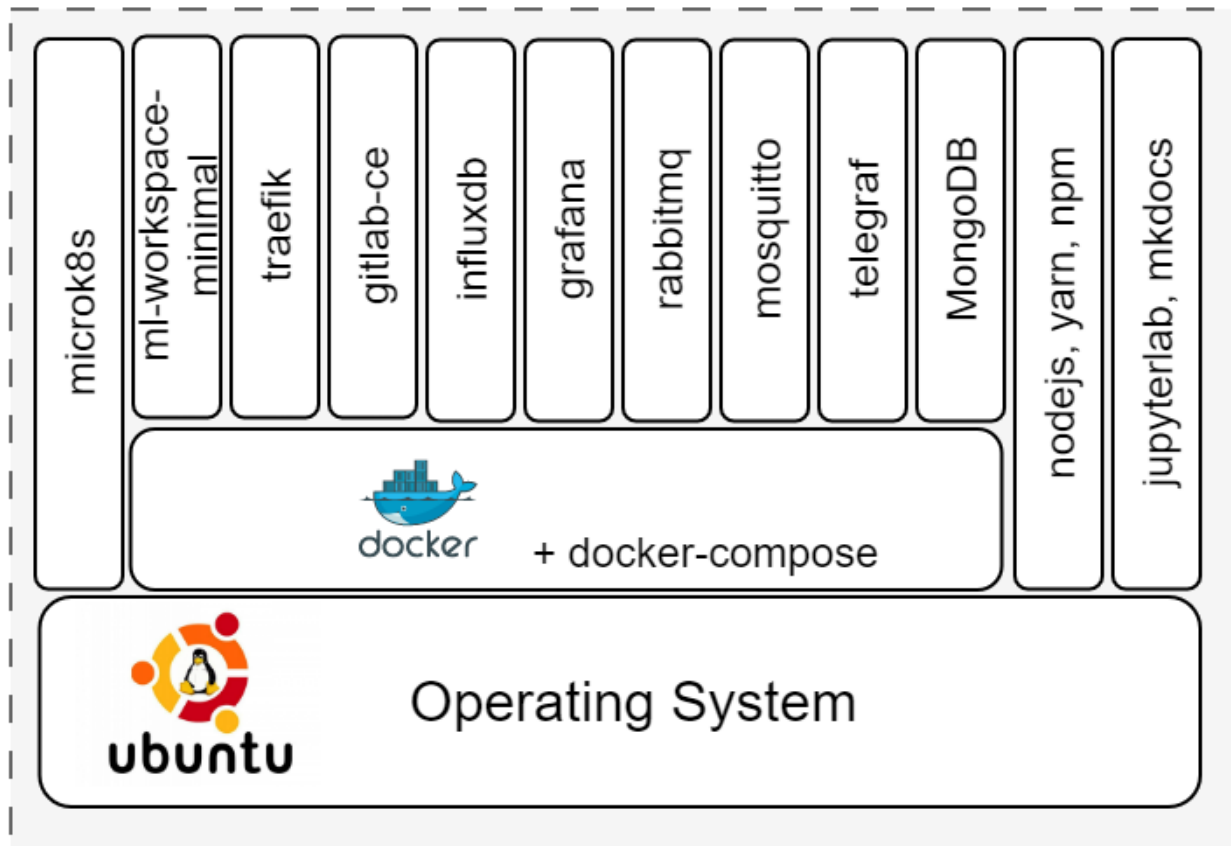
1. docker v24.0
2. nodejs v20.10
3. yarn v1.22
4. npm v10.2
5. containers - ml-workspace-minimal v0.13, traefik v2.10, gitlab-ce v16.4, influxdb v2.7, grafana v10.1, rabbitmq v3-management, eclipse-mosquitto (mqtt) v2, mongodb v7.0

This vagrant box installed for developers will have the following items additional items:

- docker-compose v2.20
- microk8s v1.27
- jupyterlab
- mkdocs
- container - telegraf v1.28

At the end of installation, the software stack created in vagrant box can be visualised as shown in the following figure.

vagrant box



The upcoming instructions will help with the creation of base vagrant box.

```

1  #create a key pair
2  ssh-keygen -b 4096 -t rsa -f vagrant -q -N ""
3
4  vagrant up
5
6  # let the provisioning be complete
7  # replace the vagrant ssh key-pair with personal one
8  vagrant ssh
9
10 # install the oh-my-zsh
11 sh -c "$(curl -fsSL https://raw.githubusercontent.com/ohmyzsh/ohmyzsh/master/tools/install.sh)"
12 # install plugins: history, autosuggestions,
13 git clone https://github.com/zsh-users/zsh-autosuggestions ${ZSH_CUSTOM:-~/.oh-my-zsh/custom}/plugins/zsh-autosuggestions
14
15 # inside ~/.zshrc, modify the following line
16 plugins=(git zsh-autosuggestions history cp tmux)
17
18 # to replace the default vagrant ssh key-pair with
19 # the generated private key into authorized keys
20 cp /vagrant/vagrant.pub /home/vagrant/.ssh/authorized_keys
21
22 # exit vagrant guest machine and then
23 # copy own private key to vagrant private key location
24 cp vagrant .vagrant/machines/default/virtualbox/private_key
25
26 # check
27 vagrant ssh #should work
28
29 # exit vagrant guest machine and then
30 vagrant halt
31
32 vagrant package --base dtaas \
33 --info "info.json" --output dtaas.vagrant
34
35 # Add box to the vagrant cache in ~/.vagrant.d/boxes directory
36 vagrant box add --name dtaas ./dtaas.vagrant
37
38 # You can use this box in other vagrant boxes using
39 #config.vm.box = "dtaas"

```

References

Image sources: [Ubuntu logo](#)

2.5.2 DTaaS on Single Vagrant Machine

These are installation instructions for running DTaaS software inside one vagrant Virtual Machine. The setup requires a machine which can spare 16GB RAM, 8 vCPUs and 50GB Hard Disk space to the vagrant box.

Create Base Vagrant Box

Create [dtaas Vagrant box](#). You would have created an SSH key pair - *vagrant* and *vagrant.pub*. The *vagrant* is the private SSH key and is needed for the next steps. Copy *vagrant* SSH private key into the current directory (`deploy/vagrant/single-machine`). This shall be useful for logging into the vagrant machines created for two-machine deployment.

Target Installation Setup

The goal is to use the [dtaas Vagrant box](#) to install the DTaaS software on one single vagrant machine. A graphical illustration of a successful installation can be seen [here](#).

