



EPICS IOC Development Guide

ALS-U CONTROLS TECHNICAL DOCUMENT

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1 Revision History

Rev.	CM number	Description of Change
A		Add the basic workflow

2 Abbreviations and Acronyms

ALS	Advanced Light Source
ALS-U	Advanced Light Source Upgrade
LBNL	Lawrence Berkeley National Laboratory
N/A	Non Applicable
EPICS	The Experimental Physics and Industrial Control System
IOC	Input-output controller

3 Introduction

3.1 Scope

- The purpose of this document is to describe the engineering procedure and troubleshooting about how the EPICS IOC should be developed and be maintained in cooperation with the ALS-U EPICS Environment.
- This document attempts to be a simple guideline, not to be a mandatory procedure.

3.2 Target Audience

This document is targeted to ALS/ALS-U Controls System engineers and technical stakeholders. It is assumed that the target audience has a technical background in the EPICS

development, a Unix/Linux environment, and a revision control system, specifically, `git`.

4 Build EPICS Application and an IOC

4.1 IOC Name Naming Convention

The first step is to define `IOCNAME`, its directory name, and repository name according to the IOC Name naming conventions [1]. The important name is Device Name, which can be used in multiple names, such as the repository name, and its EPICS application name. Each engineer has a different preference. Thus, please consult other engineers if one wants to follow a common standard name. Table 4.1 shows the IOC Name Naming example. Here we have two TC-32 devies in difference locations (B46 and B6).

Description	Name	EPICS Variable
Location	TEST, ALSU	
Device Name	TCTEMP	
Common IOC Stats Name	test-tctemp	\$IOCNAME
Full IOC Name (Dir Name)	ioctest-tctemp	\$IOC
Git Repository Name	tctemp	
Application Name	tctemp	

Table 1 TC-32 IOC Name Naming Example

4.2 Make Base Application : manual procedure

- One must check the `EPICS_BASE` variable and all other EPICS-related environment variables. For example,

```
export EPICS_BASE=/somewhere/epics_base
export EPICS_HOST_ARCH=darwin-aarch64
export PATH=${EPICS_BASE}/bin/${EPICS_HOST_ARCH}:${PATH}
export LD_LIBRARY_PATH=${EPICS_BASE}/lib/${EPICS_HOST_ARCH}:${LD_LIBRARY_PATH}
```

- Create a directory, e.g., `tctemp`, and change the current path to `tctemp`.
- Run `makeBaseApp.pl` to create the EPICS application.
- Run `makeBaseApp.pl` to add the IOC `test` into the created EPICS application.

```

$
$ echo ${EPICS_BASE}
/Users/JeongLee/epics/macOS/11.2.1/e881cb1/base

$ which makeBaseApp.pl
/Users/JeongLee/epics/macOS/11.2.1/e881cb1/base/bin/darwin-aarch64/makeBaseApp.pl

$ mkdir tctemp
$ cd tctemp

$ makeBaseApp.pl -t ioc tctemp
$ tree -L 1
.
+---[JeongLee 900] Makefile
+---[JeongLee 320] configure
+---[JeongLee 160] tctempApp

$ makeBaseApp.pl -i -t ioc -p tctemp test-tctemp
$ tree -L 2
.
+--- [JeongLee 900] Makefile
+--- [JeongLee 320] configure
|   +--- [JeongLee 838] CONFIG
|   +--- [JeongLee 1.6K] CONFIG_SITE
|   +--- [JeongLee 157] Makefile
|   +--- [JeongLee 1.6K] RELEASE
|   +--- [JeongLee 120] RULES
|   +--- [JeongLee 39] RULES.ioc
|   +--- [JeongLee 41] RULES_DIRS
|   +--- [JeongLee 40] RULES_TOP
+--- [JeongLee 128] iocBoot
|   +--- [JeongLee 121] Makefile
|   +--- [JeongLee 128] iocTest-tctemp
+--- [JeongLee 160] tctempApp
|   +--- [JeongLee 96] Db
|   +--- [JeongLee 304] Makefile
|   +--- [JeongLee 128] src

```

4.3 Make Base Applicatoin : Use a script

- Clone <https://git.als.lbl.gov/alsu/tools>
- Run `generate_ioc_structure.bash` outside the cloned tools folder.

```

$ git clone https://git.als.lbl.gov/alsu/tools.git
$ bash tools/generate_ioc_structure.bash -n tctemp -l test
Using target architecture darwin-aarch64 (only one available)
-----
Please create tctemp as Project Name in the ALS git server.
tctemp also is used for Project slug in the gitlab server.

After this, one may need to execute the following command:
git remote add origin ssh:...../tctemp.git
-----

```

```
$ tree --charset uft-8 -L 2 tctemp/
tctemp/
|-- [JeongLee 900] Makefile
|-- [JeongLee 30] README.md
|-- [JeongLee 320] configure
|   |-- [JeongLee 838] CONFIG
|   |-- [JeongLee 1.6K] CONFIG_SITE
|   |-- [JeongLee 157] Makefile
|   |-- [JeongLee 1.6K] RELEASE
|   |-- [JeongLee 120] RULES
|   |-- [JeongLee 39] RULES.ioc
|   |-- [JeongLee 41] RULES_DIRS
|   '-- [JeongLee 40] RULES_TOP
-- [JeongLee 128] iocBoot
|   |-- [JeongLee 121] Makefile
|   '-- [JeongLee 128] iocTest-tctemp
'-- [JeongLee 160] tctempApp
    |-- [JeongLee 96] Db
    |-- [JeongLee 304] Makefile
    '-- [JeongLee 128] src
$
```

4.4 Customization

- Edit `configure/CONFIG_SITE` if necessary
- Edit `configure/RELEASE` if necessary
- Add the proper database files into `xxxApp/Db`, and edit `Makefile` in `xxxApp/Db`
- Add the additional source files, sequencer files into `xxxApp/src` if necessary
- Edit `Makefile` into `xxxApp/src`

5 Add another IOC to the existing EPICS Application

There are two TC-32 units, one will be located in the B46, and the other will be located in the ALS SR ring for the radiation hardness test. Therefore, we need one more IOC startup script for an other EPICS IOC based on the same EPICS application, e.g., `tctemp`.

```
$ cd tctemp
$ $ makeBaseApp.pl -i -t ioc -p tctemp alsu-tctemp
Using target architecture darwin-aarch64 (only one available)
JeongLee@JeongLee-M70: tctemp$ tree --charset uft-8 -L 2 .
.
|-- [JeongLee 900] Makefile
|-- [JeongLee 30] README.md
|-- [JeongLee 320] configure
|   |-- [JeongLee 838] CONFIG
|   |-- [JeongLee 1.6K] CONFIG_SITE
```

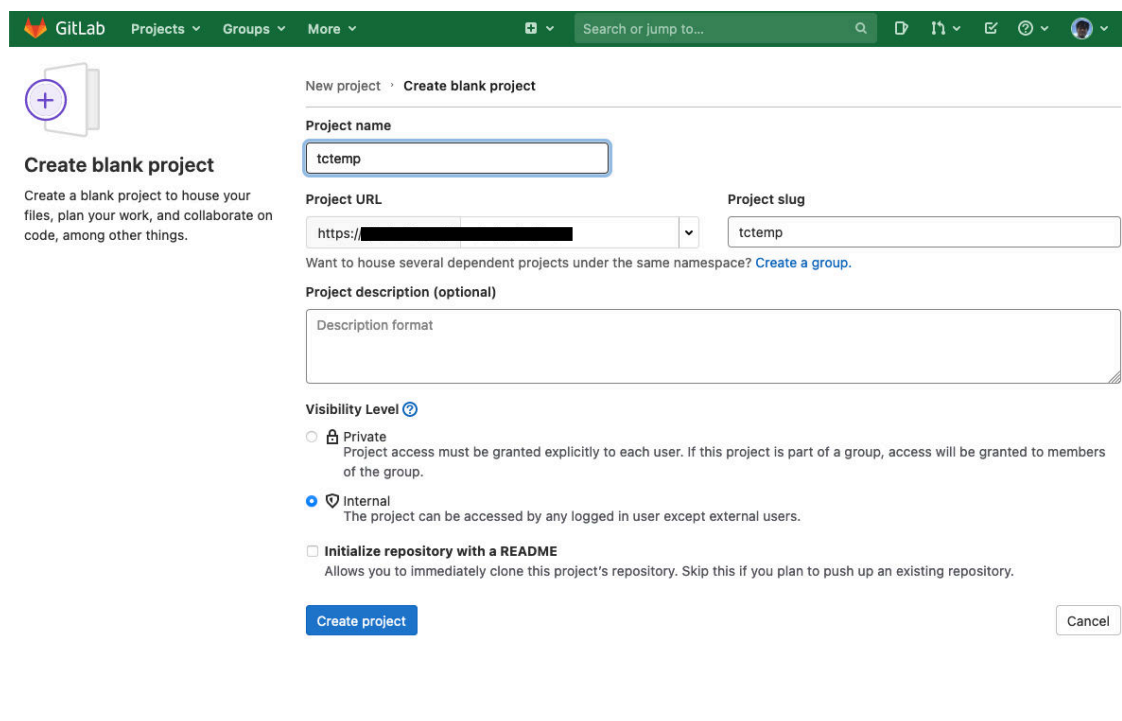
```
| |-- [JeongLee 157] Makefile
| |-- [JeongLee 1.6K] RELEASE
| |-- [JeongLee 120] RULES
| |-- [JeongLee 39] RULES.ioc
| |-- [JeongLee 41] RULES_DIRS
| '-- [JeongLee 40] RULES_TOP
|-- [JeongLee 160] iocBoot
| |-- [JeongLee 121] Makefile
| |-- [JeongLee 128] iocalsu-tctemp
| '-- [JeongLee 128] ioctest-tctemp
'-- [JeongLee 160] tctempApp
    |-- [JeongLee 96] Db
    |-- [JeongLee 304] Makefile
    '-- [JeongLee 128] src
```

6 To a remote repository

There are many ways in which we can create a repository, but here we limit our scenario to create a repository through the web interface.

- Login the gitlab server
- Move the proper IOCs directory
- Create blank project
- Initialize the git repository according to its configuration

6.1 Create a remote repository



The screenshot shows the GitLab web interface for creating a new project. The top navigation bar is green with the GitLab logo and links to Projects, Groups, and More. A search bar is also present. On the left, there's a sidebar with a '+ Create blank project' button and a description: 'Create a blank project to house your files, plan your work, and collaborate on code, among other things.' The main form area is titled 'New project > Create blank project'. It contains several fields: 'Project name' with the value 'tctemp', 'Project URL' with a dropdown menu, and 'Project slug' with the value 'tctemp'. Below these is a 'Project description (optional)' text area. The 'Visibility Level' section has two radio buttons: 'Private' (selected) and 'Internal'. The 'Initialize repository with a README' checkbox is also present. At the bottom, there are 'Create project' and 'Cancel' buttons.

GitLab Projects Groups More Search or jump to...

Create blank project
Create a blank project to house your files, plan your work, and collaborate on code, among other things.

New project > Create blank project

Project name
tctemp

Project URL
https://

Project slug
tctemp

Want to house several dependent projects under the same namespace? [Create a group.](#)

Project description (optional)
Description format

Visibility Level ?

☐ Private
Project access must be granted explicitly to each user. If this project is part of a group, access will be granted to members of the group.

☒ Internal
The project can be accessed by any logged in user except external users.

☐ Initialize repository with a README
Allows you to immediately clone this project's repository. Skip this if you plan to push up an existing repository.

Create project Cancel

Figure 1 Create a Project which is the remote repository.

GitLab Projects Groups More Search or jump to...

Project overview Details Activity Issues 0 Jira Merge requests 0 CI/CD Security & Compliance Operations Packages & Registries Analytics Wiki Snippets Members Settings

ALS-U Controls > ... > IOCs > tctemp

Project 'tctemp' was successfully created.

tctemp Project ID: 325

The repository for this project is empty

You can get started by cloning the repository or start adding files to it with one of the following options.

Clone New file Add README Add LICENSE Add CHANGELOG Add CONTRIBUTING

Command line instructions

You can also upload existing files from your computer using the instructions below.

Git global setup

```
git config --global user.name "Jeong Han Lee"
git config --global user.email "[email protected]"
```

Create a new repository

```
git clone ssh://[email protected]:[redacted]/tctemp.git
cd tctemp
touch README.md
git add README.md
git commit -m "add README"
git push -u origin master
```

Push an existing folder

```
cd existing_folder
git init
git remote add origin ssh://[email protected]:[redacted]/tctemp.git
git add .
git commit -m "Initial commit"
git push -u origin master
```

Push an existing Git repository

```
cd existing_repo
git remote rename origin old-origin
git remote add origin ssh://[email protected]:[redacted]/tctemp.git
git push -u origin --all
git push -u origin --tags
```

Figure 2 Project git configuration.

6.2 Push local source files to the remote repository

```
$ cd tctemp
$ git init
Initialized empty Git repository in /Users/JJeongLee/gitsrc/tctemp/.git/
$ git add .
$ git status
On branch master
No commits yet
```

```
Changes to be committed:
  (use "git rm --cached <file>..." to unstage)
    new file:   Makefile
    new file:   README.md
    new file:   configure/CONFIG
    new file:   configure/CONFIG_SITE
    new file:   configure/Makefile
    new file:   configure/RELEASE
    new file:   configure/RULES
    new file:   configure/RULES.ioc
    new file:   configure/RULES_DIRS
    new file:   configure/RULES_TOP
    new file:   iocBoot/Makefile
    new file:   iocBoot/iocalsu-tctemp/Makefile
    new file:   iocBoot/iocalsu-tctemp/st.cmd
    new file:   iocBoot/iocTest-tctemp/Makefile
    new file:   iocBoot/iocTest-tctemp/st.cmd
    new file:   tctempApp/Db/Makefile
    new file:   tctempApp/Makefile
    new file:   tctempApp/src/Makefile
    new file:   tctempApp/src/tctempMain.cpp
$ git remote add origin ssh://git@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx/tctemp.git
$ git commit -m "Initial Commit"
$ git push --set-upstream origin master
```

Bibliography

- [1] Jeong Han Lee and Tyna Ford. *AL-1451-7452 : IOC Name Naming Convention at ALS*, June, 2021. [ALS-U Document AL-1451-7452](#).