CA Gen Integration

Building CA Gen code through Jenkins

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Revision History

Revision	Date	Change Description
v1.0	2019/09/30	Initial version
v1.1	2019/10/15	Minor corrections (copyright notices)
V2.0	2020/08/10	Extension to remote & Linux/Unix builds

References

WilliamBoyd, Linux Academy – Adding a Jenkins Agent Node
https://linuxacademy.com/blog/linux-academy/adding-a-jenkins-agent-node/

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Introduction

Jenkins is a widely used Continuous Integration platform, many organizations rely on to integrate their developments with.

By lack of in-depth knowledge of CA Gen, however, many customers haven't tried to push the use of Jenkins in CA Gen territory. This results in a loss of major opportunities:

- ***Communication***: Although CA Gen is very different from other development environments, from a CI perspective, the difference stops when CA Gen toolset or encyclopedia has generated the source files corresponding to the code (C, Cobol, …). This helps communication between DevOps teams, reducing the barrier generally separating CA Gen from other development teams
- ***Integration***: Once created, a CA Gen build / split / transfer step can easily be integrated into a Jenkins pipeline, to achieve more complex integration processes and DevOps workflows
- ***Workload reduction***: Using only one tool, DevOps teams only need to check at one place, to identify any issue occurring in the integration process
- ***Configuration management***: Jenkins can easily ensure the presence of the right / latest versions of software (like EAB libraries, bitmaps, …) the CA Gen application requires, increasing the quality of the CA Gen builds
- ***3rd-party products usage***: with the easiness with which Jenkins can work across environments, CA Gen build steps can be concentrated on a single computer only, significantly reducing the required licenses of 3rd-party products. Also, concentration on one environment makes 3rd-party products upgrades much easier and safer
- ***Security***: Jenkins provides much more flexibility in terms of communication across machines than what the CA Gen Build tool does. Also, it does not require any user account on target machines.

Whatever the target environment, such integration can easily be achieved with CA Gen.

Note that, using the new CA Gen Generator API, it's now possible to chain code generation and build, either using some custom code generator and Jenkins CLI to build, or creating a Jenkins pipeline, where the first steps generate the code and the next build it.

In this document, we will see:

1. How to create a Jenkins job to process CA Gen code and what CA Gen-specific features can be processed with Jenkins
2. What main possibilities are available to submit Jenkins jobs for build of CA Gen applications using Jenkins
3. Some possibilities to discover RMT files that need to be built.

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The Jenkins job

There are normally 3 possible actions (not necessarily exclusive) the Jenkins job can perform:

1. ***Transfer***: if a build on another machine is needed, the RMT file need to be transferred to its target destination. Multiple options are available. To name the most common: (S)FTP or Jenkins agent for distributed, CA Brightside / Zowe[1] for mainframe targets. Depending on organizational / technical constraints or easiness, flexibility and knowledge will dictate some choice, or at least provide some guidance.
   The next step will then consist in the split
2. ***Split***: A RMT file is easy to split into its individual components. 2 options are possible:
   a. Use custom tools to split the RMT file. This option can be preferred if CA Gen Build Tool is not used to process the file
   b. Use the Build Tool to split the RMT file. This is safer, as the build tool will also check the integrity of the files that get extracted. When this option is selected, split and build processing are normally done together
3. ***Build***: Here again, 2 options are possible:
   a. Build the load module / RI Trigger library using the CA Gen Build Tool
   b. Build the load module / RI Trigger library using a custom build procedure (make, ant, Endevor, …).

As this document relies on real-world implementation, not all steps or options will be detailed in the current version. Based on feedback / experience, future versions will incorporate documentation of more options.

Doing it all in one step

In this approach, Jenkins communicates with one if its agents to process a given RMT file on the machine the agent runs on.
(The setup of the infrastructure is described in Appendix A).
The Jenkins project is associated with a specific agent, running on a machine where the CA Gen build tool has been installed.

Build Step - Linux

It receives 3 parameters:

- A ***file*** parameter, which will be used to upload the RMT file to the agent
- A ***Target*** string parameter, specifying where the RMT file will be moved and what name it will get (as the first parameter gives a default name)
- A ***BuildProfile*** drop-down list, providing a choice among existing profiles on the server.

The Jenkins project execution then does the following:

[1] Although transfer of individual files making up the RMT could be considered, it's strongly advised (because much easier) to transfer the RMT as a whole and split it in the target location

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1. Upload the RMT file in the machine running the agent,
2. Execute a step consisting of:
    a. Move the file to the specified target location
    b. Build the file, using the command-line built tool and the specified build profile
    c. Add the CA Gen build output to the Jenkins job output
    d. Returns success / failure status, depending on the result of the CA Gen build.

Hereunder an example of such logic:

```
#!/bin/bash
mv gen.rmt $Target
# Split target into folder and file
IFS='/'
read -ra ARRAY <<< "$Target"
folder=""
len=${#ARRAY[@]}
for ((i = 0; i < $len - 1; i++)) do
    folder="$folder${ARRAY[i]}/"
done
rmtFile="${ARRAY[$len-1]}"
IFS=' ' # reset to default value after usage
echo Folder: $folder
echo RmtFile: $rmtFile
# Process remote file
$IEFH/bt/bldtool -c COMMAND -a BUILD -l $folder -n $rmtFile -f
$BuildProfile
# Split file into file name and extension
IFS='.'
read -ra ARRAY <<< "$rmtFile"
fileName=${ARRAY[0]}
#fileExtension=${ARRAY[1]}
IFS=' ' # reset to default value after usage
# Prints build output
cat $folder$fileName.out
grep --silent IEFSIGNAL:OK $folder$fileName.out
```

(See Appendix B for the full definition of this sample Jenkins build).

Splitting RMT files

CA Gen-based Jenkins split job

Using CA Gen Build tool to split a RMT file on a local file system is very easy.

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Parameters

I suggest having 2 parameters:

1. **LoadModule**: load module name (or name of RMT file without extension)
2. **RMTFolder**: folder containing remote files generated by CA Gen[2]

Build Step - Windows

This step will consist in a Windows batch command (or similar for another OS). The build step can call the ***bldtool.bat*** file (located in the Gen folder of Developer workstations), or, more generically and with less overhead, call the ***bt.ui.jar*** file (Gen\bt folder of Developer workstations).
With the second solution, a typical build step to split a RMT file would be:

```
cd /D "%RMTFolder%"
call java -jar "C:\Program Files (x86)\CA\Gen86\Gen\bt\bt.ui.jar"
-c command -a SPLIT -l . -n %LoadModule%.rmt
if "%errorlevel%" == "1" type %LoadModule%.out & exit
```

Building CA Gen executable artifacts

CA Gen-based Jenkins project

Parameters

Same parameters can be used for Build as for Split step, with a few additions:

1. **LoadModule**: load module name (or name of RMT/ICM file without extension)
2. **SourceFolder**: folder containing source files generated by CA Gen[3]
3. **BuildProfile**: optionally, if you need specific build profile to build your load modules, you can add a BuildProfile string parameter, with an adequate default value, or a drop-down list with available profiles
4. **ProfilesFolder**: location of the build profiles definitions (with default, for easy use / change), if multiple folders are available

[2] We will here consider that the folder is not where the RMT file was generated, because it would then contain all the necessary files, so a split would not be needed
[3] If directly generated from the CSE, it consists of the *Source Code* / *Installation Control* / *Remote Installation* path, specified in the CSE configuration, followed by *Operating System* and *language*, as always added by the CA Gen Construction server. If you want to build it directly from the RMT, no need for a distinct split step, everything can be done at once, selecting a SourceFolder equal to the RMTFolder of the previous (Split) step.

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Build Step – Windows

This step will consist in a Windows batch command (or similar for another OS). The build step can call the ***bldtool.bat*** file (located in the Gen folder of Developer workstations), or, more generically and with less overhead, call the ***bt.ui.jar*** file (Gen\bt folder of Developer workstations).
With the second solution, a typical build step for an ICM file would be:

```
cd /D "%SourceFolder%"
call java -Duser.home="%ProfilesFolder%" -jar "C:\Program Files
(x86)\CA\Gen86\Gen\bt\bt.ui.jar" -c command -a BUILD -l . -n
%LoadModule%.icm -f %BuildProfile% >%loadModule%.java.out
type %loadModule%.java.out
for /F "tokens=1-9" %%f in (%LoadModule%.java.out) do call
:process %%f %%g %%h %%i %%j %%k %%l %%m %%n
if "%errorlevel%" == "1" type %LoadModule%.out & exit
%errorlevel%
goto :EOF
:process
if "%1" == "Build-FAILED" set errorlevel=1& goto :EOF
shift /1
if not "%1" == "" goto :process
goto :EOF
```

(Note the special logic to detect a build failure and report it to Jenkins).
To process RMT files, simply replace %LoadModule%.icm with %LoadModule%.rmt[4]

External tool-based build job

As previously mentioned, build is not a specific CA Gen activity: it only uses the Build Tool scripts to drive execution of the relevant 3rd-party products on the source files mentioned in the ICM.
Based on the environment and the generated pieces of code, this can however be more or less complicated.

Java Proxy build with Ant

Building a generated Java Proxy with Anit is very simple.

Parameters

Again, you need the similar 2 parameters:

1. **Proxy**: name of the proxy (or name of RMT/ICM file without extension)

[4] Or add an icm/rmt parameter to the job

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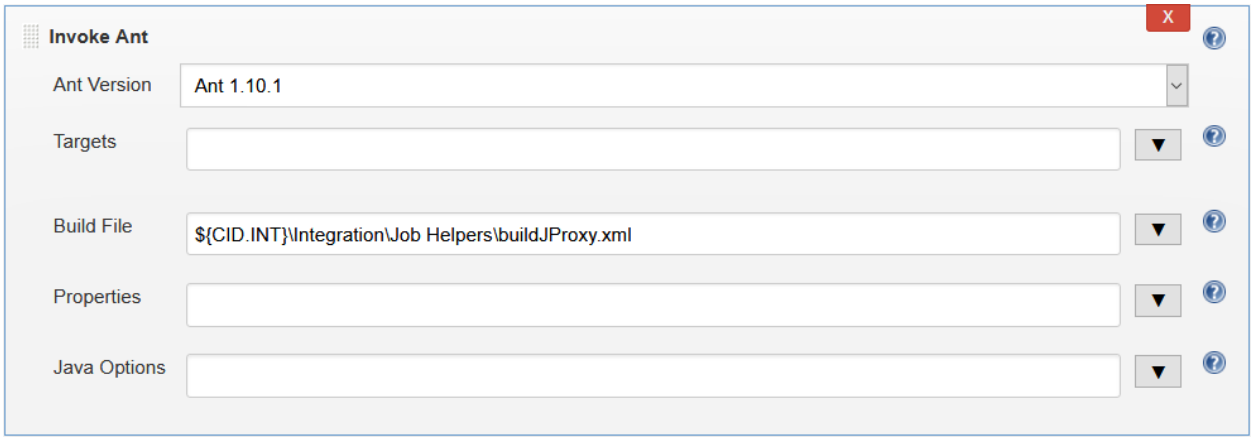
2. **SourceFolder**: folder containing source files generated for the proxy by CA Gen[5]

Build Step

This time, the build step is an Ant step. There, you need to specify a version of Apache Ant installed in Jenkins, together with a pointer to the build script that will be executed, as shown below (in this specific case, using parameters)



The ant script would then look like:

```
<project name='JProxy' default='all'>
  <property environment="env"/>
  <path id='classpath.base'>
    <pathelement location='C:\Program Files
(x86)\CA\Gen86\Gen\classes\Gen86.jar'/>
  </path>
  <target name='all' depends='compile,jar'/>
  <target name='compile'>
    <property environment="env"/>
    <echo message='... Compiling Java code'/>
    <mkdir dir='${env.SourceFolder}/classes/${env.Proxy}'/>
    <javac fork="yes" executable="${env.JAVA_HOME}/bin/javac.exe"
srcdir='${env.SourceFolder}/src/${env.Proxy}'
destdir='${env.SourceFolder}/classes/${env.Proxy}'
         includes='com/**'
         debug='on' target='1.6' source='1.6'
classpathref='classpath.base'/>
  </target>
```

[5] If directly generated from the CSE, it consists of the *Source Code* / *Installation Control* / *Remote Installation* path, specified in the CSE configuration, followed by */proxy/java*, as always added by the CA Gen Construction server. If you want to build it directly from the RMT, no need for a distinct split step, everything can be done at once, selecting a SourceFolder equal to the RMTFolder of the previous (Split) step.

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```
  <target name='jar'>
    <echo message='... Building JAR file'/>
    <mkdir dir='${env.SourceFolder}/deploy'/>
    <jar destfile='${env.SourceFolder}/deploy/${env.Proxy}.jar'
basedir='${env.SourceFolder}/classes/${Proxy}' update='false'
includes='**'/>
  </target>
</project>
```

Submitting Jenkins jobs

Submitting Jenkins jobs for CA Gen code is fairly easy.
For the CSE, as there is currently no API available, chaining code generation with Jenkins projects is not possible. On Developer workstations, however, the new Generator API makes such chain possible.

The 3 easiest possibilities are:

- Build submission using Jenkins console
- Use of a build pipeline
- Execution of individual jobs, based upon some form of RMT discovery

The first approach is trivial, for Jenkins users, and won't be detailed here.

Use of a Build Pipeline

Static Jenkins Pipeline

Use of a static Build Pipeline is certainly the most powerful approach, as you specify:

- Initialization step
- Termination step
- All intermediary build steps, with relevant parameters for each.

Jenkins pipelines are very powerful, and support many requirements. The disadvantage is that you need to manually keep it in sync with your application architecture. Whenever it changes (like addition of a load module), you need to update it (or you need to create a repetitive build step, with loss of modularity and flexibility).

Dynamic Jenkins Pipeline

A dynamic Jenkins pipeline can also be created. Based upon some form of RMT discovery, a Jenkins Pipeline is created to trigger build of all [new] remote files
This approach is fine if you build all your RMT files with the same settings (like build profile), but becomes much more complex if some flexibility is needed.

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Also, a Dynamic Pipeline requires usage of a Source Control System. Such dynamic pipeline could be created from a Jenkins job, or externally, then committed to the selected Source Control System.

Build triggering

Whatever the solution, the job can run periodically (including discovery for the second possibility), or upon demand, by use of the Jenkins console, CLI, or any external trigger.

Individual Build jobs

Rather than using Build Pipelines, individual build jobs can be triggered, separately or based upon a discovery mechanism, be it from Jenkins itself or from an external utility.
Of course, such a solution is not suitable / advisable for workflows, but can be used as a point solution.

Submission of Jenkins build jobs

Depending on the type of submission desired, different approaches need to be taken for the submission of Jenkins build jobs for CA Gen:

- For ***static pipelines***, the best approach is scheduling. If not feasible or suitable, on-demand submission is the alternative
- For ***dynamic pipelines***, it is recommended to chain the discovery step with the execution of the pipeline in Jenkins. Once again, scheduling or on-demand triggering are possible. The first step would then:
    - Specify the dynamic pipeline using the selected RMT discovery mechanism
    - Commit the pipeline to the Source Control System
    - Chain to the execution of the pipeline
- For ***individual jobs***, as they are point solutions:
    - If there are very few jobs to submit, the Jenkins console is the right tool
    - Otherwise, best is to couple the discovery activity with a utility that posts build requests to Jenkins, through its REST interface.

RMT discovery

2 approaches are easy to implement, for discovery of remote files:

- Scanning of CSE log files
- Directory scanning

Scanning of CSE log files - Windows

The ***iefmd<nnn>.log*** file contains information issued by the Construction Server, in the form of lines like:

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```
Command Line:  "C:\Program Files (x86)\CA\Gen86\CSE\bin\rfg.exe"
"HLL" "WINDOWS" "C:\temp\gentest\ENCYADMN\remote.ctl"
"C:\temp\gentest\ENCYADMN\rfg.txt" "NODELETE" "*" "Y"
Packaging of C:\temp\gentest\mvs\cobol\P900.icm is complete
[...]
1684 UTLGENCD End Time: 2019-09-30 10:34:23
```

From there, it should be possible to determine the RMT files that need to be processed and build them.

Scanning of folders - Windows

Another possibility consists in scanning folders to discover the files that need to be built.
As an example, here is some windows command code for unconditional discovery of remote files. (This could be enhanced with conditional discovery, based, for instance, on remote file creation date).

```
@echo off
for /R %%f in (*.rmt) do call :process "%%f"
goto :EOF

:process
set rmt=%1
set rmt=%rmt:"=%
echo Submitting build job for %rmt%
for /F "delims=\ tokens=1-7" %%f in ("%rmt%") do call :submit
"%%f//%%g//%%h//%%i//%%j//%%k" %%l
goto :EOF

:submit
set path=%1
set path=%path:"=%
for /F "delims=. tokens=1" %%f in ("%2") do call SubmitJenkins -p
"BaseFolder=%path%" -p LoadModule=%%f
```

In this example, the command file automatically pushes build requests through Jenkins' REST interface. Although, in this specific case, the SubmitJenkins code is in Java, many ways are available to achieve the same result. Basically, the call is a HTTP POST to an URL like:

```
http://<jenkinsHost>:<jenkinsPort>/job/<jobName>/build
```

or

```
http://<jenkinsHost>:<jenkinsPort>/job/<jobName>/buildWithParamet
ers?parm1=val1&parm2=val2
```

and basic authorization.

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If successful, the reply will contain a ***location*** header field, with value similar to:

`http://<jenkinsHost>:<jenkinsPort>/queue/item/1/`

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Appendix A. Jenkins Master – Agent configuration using SSH

(This appendix is **not** meant to provide a reference implementation, but simply exposes an example of such configuration)

Configuration

Agent machine setup – Linux

First step is to prepare the agent machine to act as a Jenkins agent, connected to the master through SSH. It consists in (see *Adding a Jenkins Agent Node* for details):

- Installing the necessary packages (java 8)
- Creating a user to run the Jenkins agent and its jobs
- Generating an **ssh key** for remote access to that user and adding the public key to the ***authorized_keys*** file of the user
- Creating a folder to act as a repository for Jenkins work (including the ***workspace*** folder) (e.g., */var/jenkins*)
- Adding the necessary CA Gen accesses in the ***.bashrc*** file of the Jenkins user

```
# User specific aliases and functions
export IEFH=/opt/CA/CAGen/runtime
export IEFPLATFORM=IEF_LINUX
export IEFJRE=/etc/alternatives/jre_1.8.0_openjdk/
export AEPATH=$IEFH:$HOME/sample
PATH=$PATH:$IEFH/bin
export PATH
# Oracle Settings
export TMP=/tmp
export TMPDIR=\$TMP

export ORACLE_HOSTNAME=oel82g86o18
export ORACLE_UNQNAME=orcl
export ORACLE_BASE=/opt/oracle
export ORACLE_HOME=$ORACLE_BASE/product/18.0.0/db_home
export ORA_INVENTORY=/opt/oracle/oraInventory
export ORACLE_SID=orcl
export DATA_DIR=/opt/oradata

export PATH=/usr/sbin:/usr/local/bin:$PATH
export PATH=$ORACLE_HOME/bin:$PATH

export LD_LIBRARY_PATH=$ORACLE_HOME/lib:/lib:/usr/lib:$IEFH/lib
```

Jenkins Master setup – Windows

Pre-requisites

- **SSH Build Agent Plugin**: To (easily) connect to the Agent, it is recommended to install the **SSH Build Agents Plugin** (https://github.com/jenkinsci/ssh-slaves-plugin)
- **OpenSSH**: Windows 2010 and Server 2019 natively provide an optional Powershell implementation of OpenSSH (see OpenSSH in Windows). For these operating systems, best is to install it.

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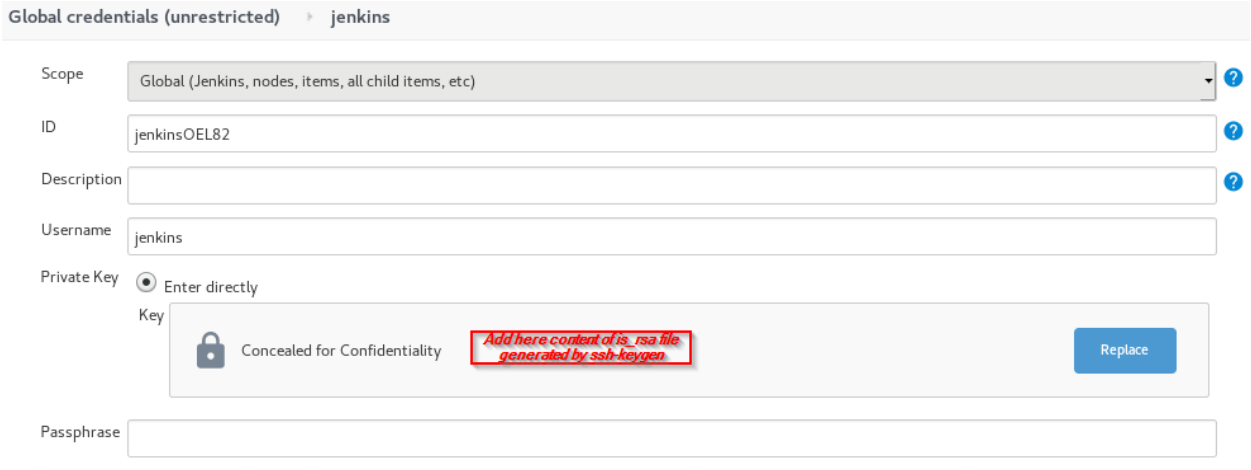
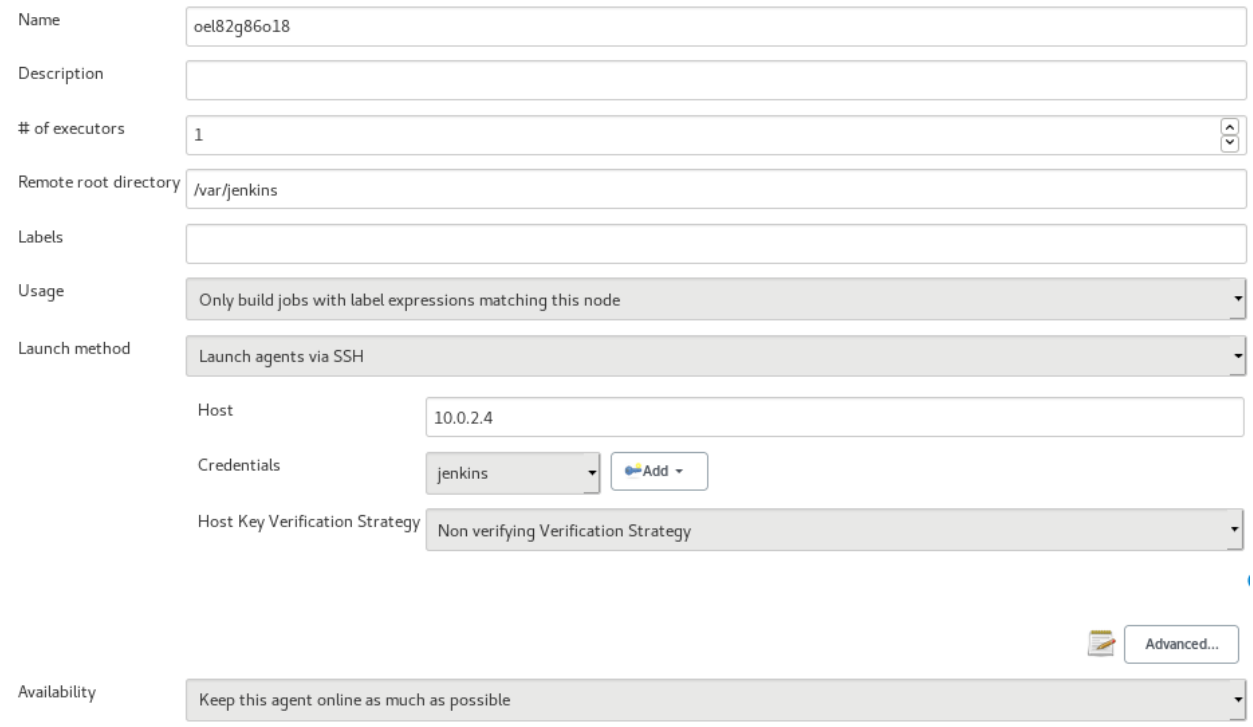
Credentials definition



Node setup



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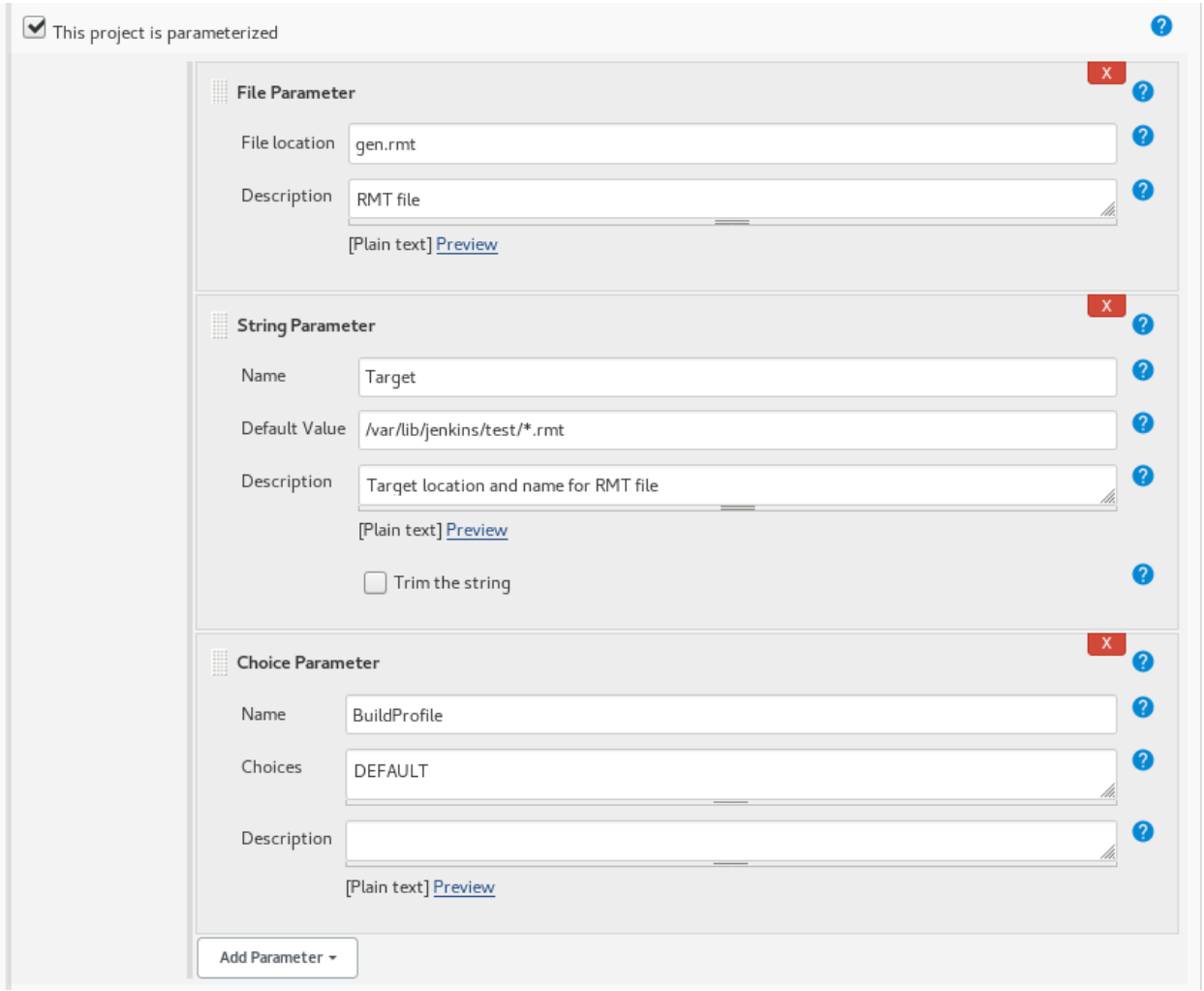
Appendix B. Jenkins Project for CA Gen remote build

Project Parameters



Project association with Agent

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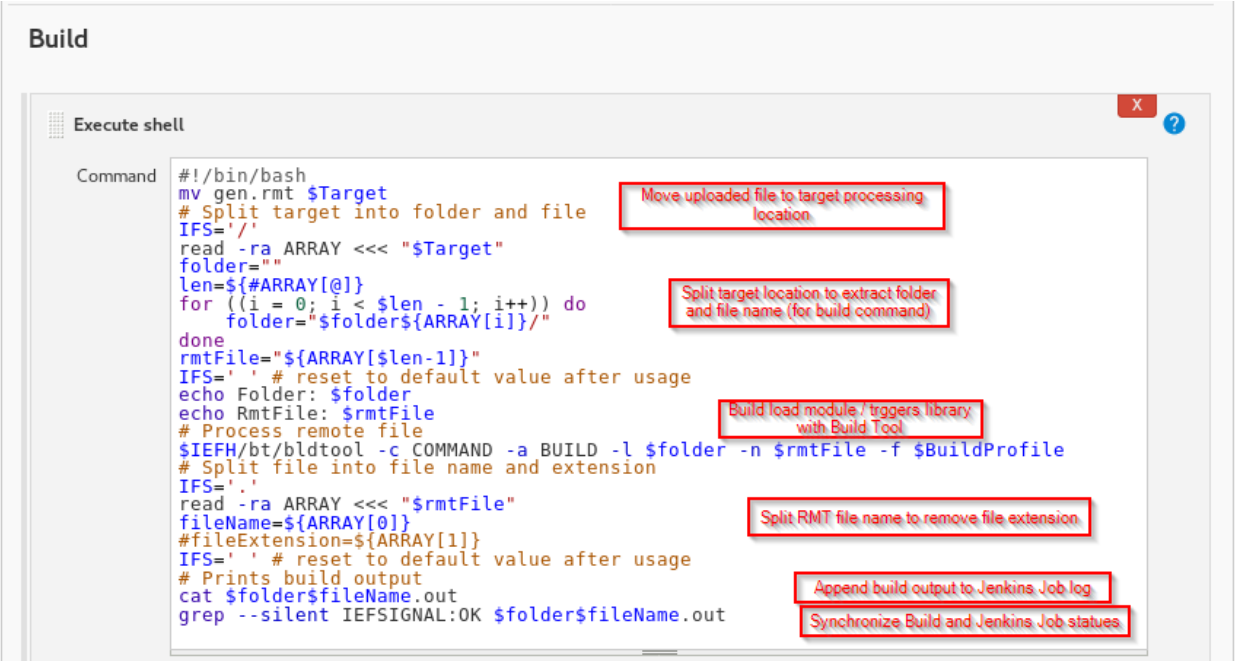
Build Shell Definition



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