

CICD - Working Title

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Abstract

To be written. to see latest revision, please see:

<https://github.com/adedomin/cicd-in-dist-env.git>

1. Introduction

Content goes here. Example use of cite-proc [1]

2. Background

CICD is the process of accelerating the building, testing and installation of applications to end servers. In a world where web technology moves fast and new features are ideal, it's critical to go to market fast. To do this there are two major architectures that are used.

CI, continuous integration is concerned with the development process. In the realm of continuous integration there is usually a source code repository. The source code repository is usually technologies like git, svn, cvs or other version and source controlling software. The idea of the source code repository is to allow for efficient ways to handle code changes and to manage multiple developers working on the same code.

Lastly, there is a server, running software similar to Jenkins CI or Travis CI which can potentially handle many tasks. At a high level, it is usually used to run a build or test step in, say, a build.gradle, project.json, Makefile or various other build tools. To enhance tools like Jenkins, there are binary and other code quality scans like SonarQube and others which attempt to find issues outside of the space of unit and mock tests. Other such triggers, like diff checking, can be used to trigger code reviews for massive revisions of source code.

Generally, the final stage of Continuous Integration is to notify the developers, or other interested parties, the results of these various tests and builds. In a full CICD build pipeline, generally there is the process of uploading

so called artifacts to a artifact or binary repository. These binary repositories are more in the realm of continuous delivery.

Continuous delivery also has it's share of tools and structure. One of the first requirements of continuous delivery is having some form of binary repository. For java based projects, there are things like nexus. Other languages, like python, have their own packaging sites; python for instance has PyPI.

In order to deploy these binaries, many tools make use of remote shell protocols. Remote shell protocols give tools access to execute the needed steps to get software deployed. Generally these tools run through scripts which make the machine require the needed binaries and create the needed configurations. The remote shells are no different than conventional user-controlled shells.

There are various tools and servers that do this; a few examples are Ansible, uDeploy and Puppet. Ansible uses remote shell protocols, such as secure shell (ssh), to execute a set of instructions written in yaml, generally with the intent of installing some type of software. uDeploy is similar in how it causes change on target machines, using secure shell; however uDeploy generally requires the target machines to be running some kind of daemon.

Many POSIX-like systems make use of package management to deliver software. Packages, like .deb's and .rpm's, are a collection of installation shell scripts, including pre-installation and post-installation, and a binary or source code. Package managers, as their name implies, also manages these installed binaries, scripts and configurations. Part of their management requires tracking file locations. This allows for rolling back, upgrading or removal of installed files.

Deployment strategy can be different depending on the available infrastructure. In an environment with fixed inventory, it might not be ideal to do things like 'make install' which are hard to reverse. However in an environment where machines can be spun up at whim, or even automatically, it wouldn't matter as much; in such cases one would simply destroy and create a new machine for every deployment. In a fixed architecture, it

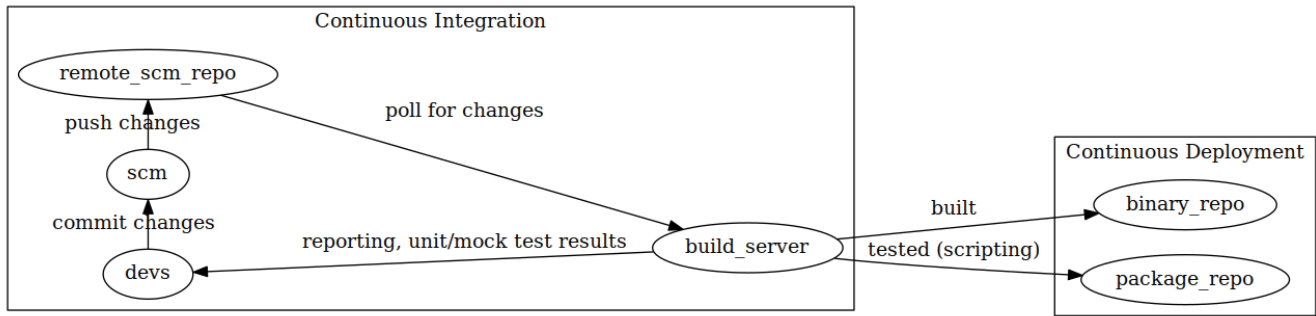


Figure 1: An example Continuous Integration Workflow

might be ideal to stick to package management solutions for delivering binaries. It might not matter if it is dynamic as the cleanliness of the system.

3. Ansible and other Domain Specific Languages

Ansible is one of the newer configuration management tools. One of its advantages over its predecessors is that it is agent-less; agent-less as in, it creates self-contained python payloads that is executes on the remote machine. This means less setup as other tools require a running service to manage and trigger jobs. However, the one thing that makes them the same is how they all kind of work.

Ansible, like many of its competitors: puppet, chef, uDeploy, etc; consume domain specific languages. The domain specific language is then parsed and compiled (or interpreted) into some actionable set of instructions. To make them more extensible, many of these tools allow for creating what are called modules; These modules are written in a much more general programming language and are thus, more expressive, but theoretically harder to write for non-programmers.

Domain specific languages differentiate themselves from general purpose languages in the sense that their scope is significantly limited to a very specific problem. The goal of this is to make it simpler to solve problems in a particular domain by doing less. Generally, domain specific languages make use of simple grammars, like yaml, json, etc; to write in. These languages have mature parsers in most general purpose languages like python, ruby and perl. Thus, instead of writing a whole new language, generally one can fallback on these

¹more akin to a uDeploy setup, a master server orchestrates actions to be take against numerous machines; generally the machines fetch the binaries they need to install from an artifact repository. Master can be triggered to action by the CI system as well.

simpler languages and then generate the code using the structured output of the parsers.

Ansible for instance uses yaml syntax to describe “playbooks;” basically a set of instructions to execute on machines. The yaml is parsed into a simple object that is a collection of key value pairs, where the values can be numbers, strings, boolean, objects or lastly, arrays of all of the other types. From there, the ansible tool creates a python script by using the data contained in the parsed result. Calls to modules and other such things in the parsed structure are replaced with literal python source. Effectively, it’s just a translation to library calls.

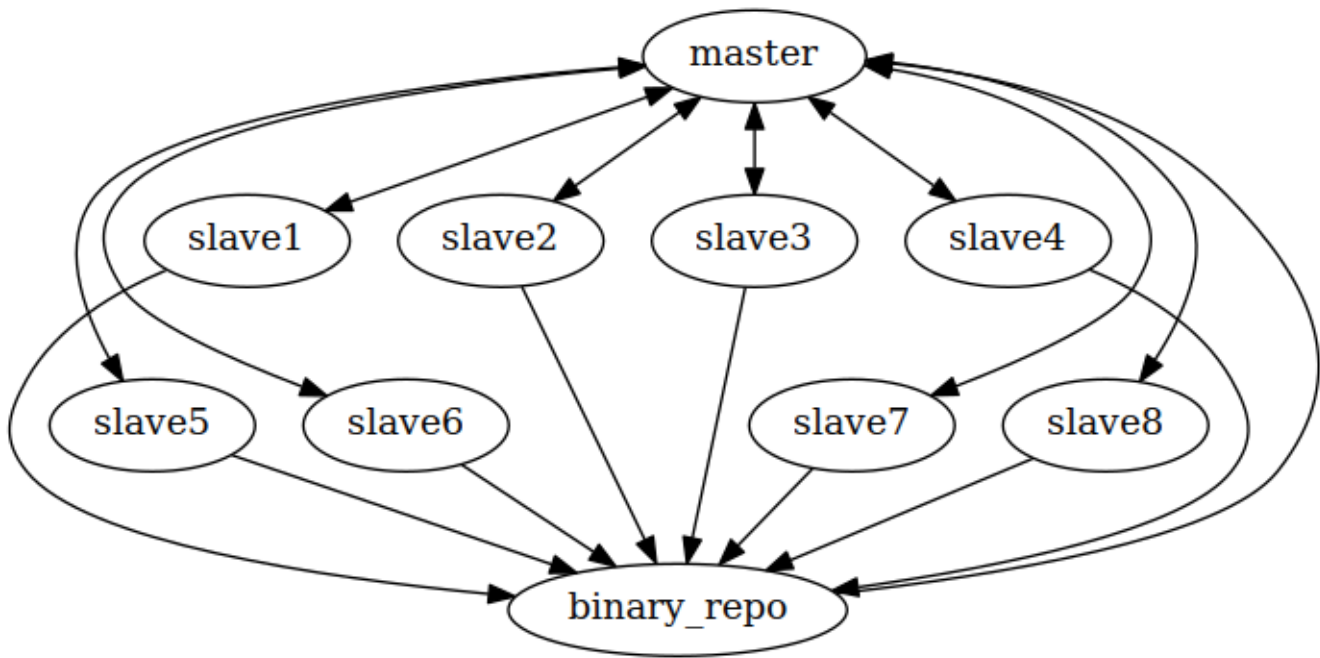
In CI

Travis CI makes use of a domain specific language to configure* one time build and testing environments for programs. Using a yaml source file, the developer can specify the needed build, and environment settings to define tests to be executed and ran. This file is then translated using ruby’s extensive metaprogramming facilities into actionable code on Travis-CI’s systems to build virtual machines to carry out the instructions laid out.

Jenkins has its own descriptive language which allows it to do something similar to travis-ci. However many claim the richness of the language, especially when working with plugins in Jenkins, can make it unwieldy and challenging to use. It ultimately shows that a domain specific language should be very straightforward for it to be useful.

4. Downsides to Ansible, et al.

One of the biggest issues with these deployment tools, like ansible, is their irreversibility. Changes made to remote machines are not easily tracked and are thus harder to undo.

Figure 2: Example Continuous Deployment setup¹

Another downside to domain specific languages as a whole is balancing the right amount of features.

5. Domain Specific Language for Integration testing, Packaging and Deployment

Below will be the explanation of a new DSL that I will develop that will attempt to solve shortfalls in other tools. Ideally, to also merge them into a universal testing, packaging and deployment framework. The goal of the language is to solve the following.

- Irreversibility of many configuration management tools.
 - Many of the tools in use make untracked, and ultimately, difficult to revert, changes to the filesystem.
 - Tools should track needed changes to the filesystem so that they can be removed and cleaned up or possibly updated later.
 - Many devops manuals expect you to do A-B deployments to prevent this issue.
 - A and B as in, when a new deployment needs to occur, build a new machine to deploy to and if it breaks, bring back the old machine.
 - Some systems take it to the extreme by having the OS be an immutable source tree which is entirely redeployed or reverted on changes.
- Resolving build tool, and other environment specific dependencies
 - There are various tools for languages like java: gradle, maven, ant, etc.
 - These tools may not be installed on the CI server.
 - To work around this, gradle and maven offer "wrapper" scripts.
 - This requires your project to ship with a gradle or maven java binary.
 - In C/C++, people could be using GNU Autoconf, CMake or even Microsoft Visual Studio
- Lack of pull and push centric deployment architectures.
 - Tools depend on shell-like protocols to deploy binaries which can be resource intensive and slow for massive deployments.
 - Pull architectures allow for servers to fetch their own binaries.
- Clean artifacting of configurations out of binaries/scripts
 - uDeploy offers the concept of artifacts, which allows for composing deployments by combining versioned artifacts.
 - other tools do not.
- Confusing structure and execution flow of deployments
 - Tools like Ansible and Puppet may not execute a set of tasks or roles in the order they are written, it's generally recommended one uses listeners and/or handlers and signal

them to prevent race conditions.

DSL should feature:

- Multi-paradigm for describing deployments
 - graphs (Metamodeling - or Model driven)
 - Ideally with a drawing tool
 - Alternatively, users could make graphs using the DOT language, or another simpler graph language
 - sequential steps (yaml | toml | json | etc)
 - similar to ansible, puppet and many others.
- Dependency management for playbooks & components
 - think npm, pip, etc.
 - requires playbooks and components have a package file that describes what they provide.
- Integration of all the key steps in a integration and deployment pipeline
 - Integration (testing)
 - Packaging (artifactory)
 - Deployment
 - Configuration Management
- “Agentless” service
 - Utilize builtins only
 - Scripting languages

resolving dependencies for services, like databases; and build tools like gradle.

6.2. Configuration Management Domain

The final domain of the CICD process is configuration and maintenance. This portion is more of a optional “agent-less” manager. In this domain, the key problem is generating configuration files, and at a later time, able to regenerate them using newer information. Currently to solve this problem, configuration management tools (and by extension, continuous deployment tools) offer the ability to take a structured document and apply the values therein to a general template.

Citations

[1] M. Fenner, “One-click science marketing,” *Nature Materials*, vol. 11, no. 4, pp. 261–263, 2012.

6. Domain Specific Languages (DSL)

- DSL
 - Limited scope, easy to solve singular task
 - Composed into general languages
 - Obfuscated library calls
 - Similar to PHP’s origin
- Challenges
 - scope creep
 - defining a encompassing scope for the problem domain
 - Adding logic to DSL

6.1. Continuous Integration Domain

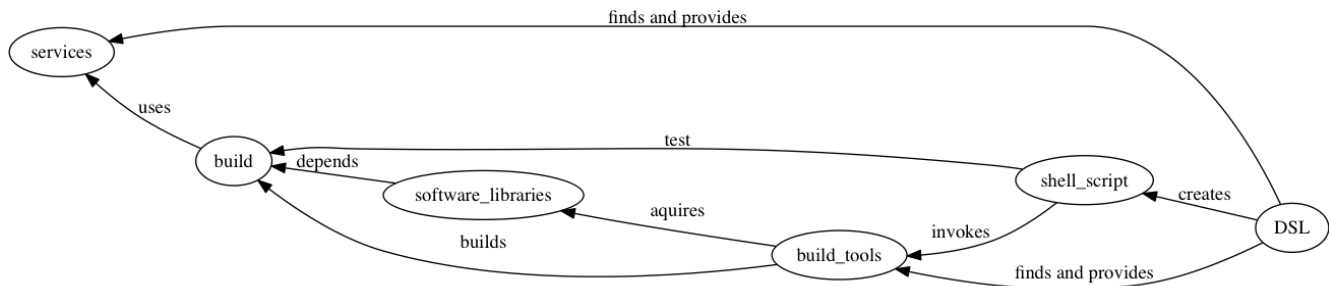
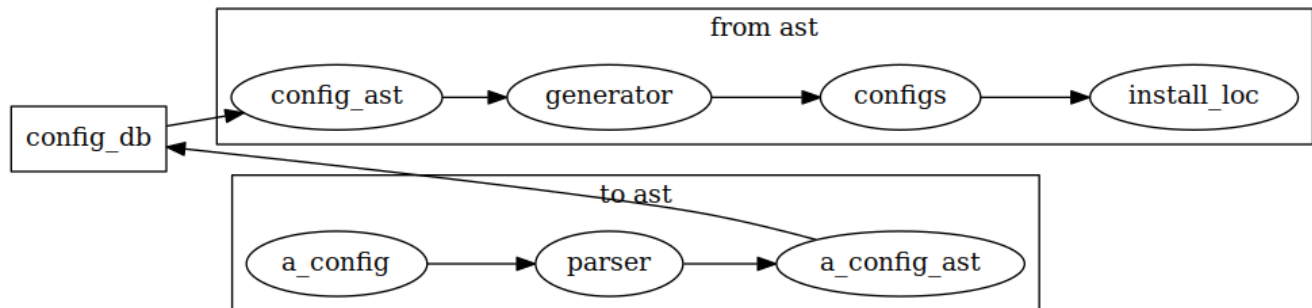
Key domain concepts

- shell driven interactions
- fork() and exec() of build tools.
- managing environment variables
- provisioning services, such as databases for testing purposes

Most of the problems in this domain boil down to shell script execution and interactions. Secondary problem is

²graph that shows what the Domain Specific language must solve in CI space.

³The idea behind this, is instead of pushing plaintext configurations and basic templating, users can develop parsers for various software configs or derive them from the community. The parsers would allow for dynamic configuration to occur in a clean way. It would also allow for more advanced querying.

Figure 3: CI language domain²Figure 4: Example Workflow Proposal³