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DevNet Zone



The bridge to possible

Using CI/CD pipelines for network automation

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DEVNET-3069



DevNet Zone

#CiscoLiveAPJC

Cisco Webex App

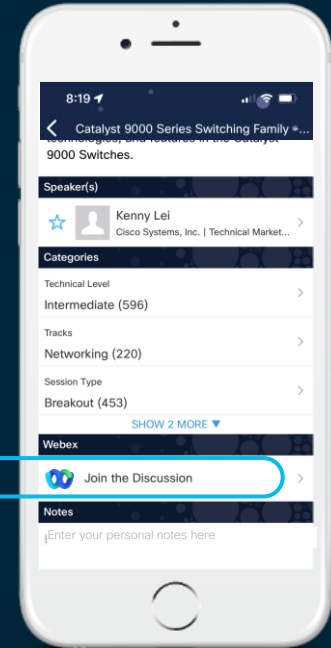
Questions?

Use Cisco Webex App to chat with the speaker after the session

How

- 1 Find this session in the Cisco Live Mobile App
- 2 Click “Join the Discussion”
- 3 Install the Webex App or go directly to the Webex space
- 4 Enter messages/questions in the Webex space

Webex spaces will be moderated by the speaker until Thursday 22 December, 2022.





Agenda

- CI/CD overview
- GitLab
- Example of a CI/CD pipeline workflow
- Demo
- Resources

CI/CD overview



CI/CD Pipelines

Continuous Integration - Software

- Practice of integrating **code** that developers are producing
- Code is developed in separate **branches**
 - Multiple developers
 - Multiple features
- When code is **merged** into a branch
 - Testing validates changes
 - Flush out potential bugs
 - Ensure quality and no **integration** issues

CI/CD Pipelines

Continuous Delivery - Software

- Releases can be created and delivered at any time
- Changes have met integration requirements?
 - Push to a “stage” environment
 - Run additional tests and checks
- All tasks are automated

CI/CD Pipelines

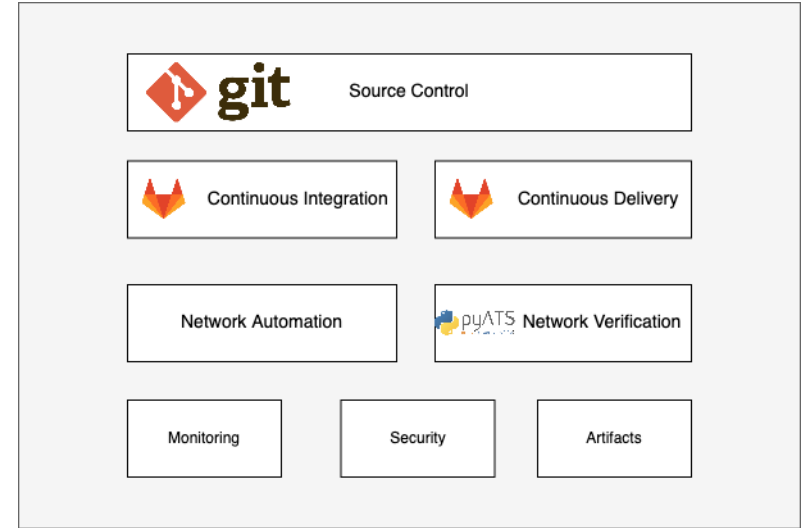
Continuous Deployment - Software

- Takes delivery a step further
- Deploys changes to a production environment
 - Many different deployment strategies available
 - Blue/Green, Canary, Rolling

CI/CD Pipelines

Infrastructure Automation

- Network as Code and Configuration Management strategies
- Continuous Delivery approach to network changes
- Continuous health and improvement approach to monitoring



CI/CD Pipelines

Infrastructure Automation

- Configuration changes are done through automation
- Historical insight into changes made to the network
- Validate changes prior to configuring the network
- If an issue is introduced into the network, those changes can be rolled back to a known good state
- Integration with change and ticketing systems for true Continuous Deployment

GitLab

GitLab

Overview

- Complete DevOps platform
- Project Management
- Hosted Git repositories
- Built-in CI/CD

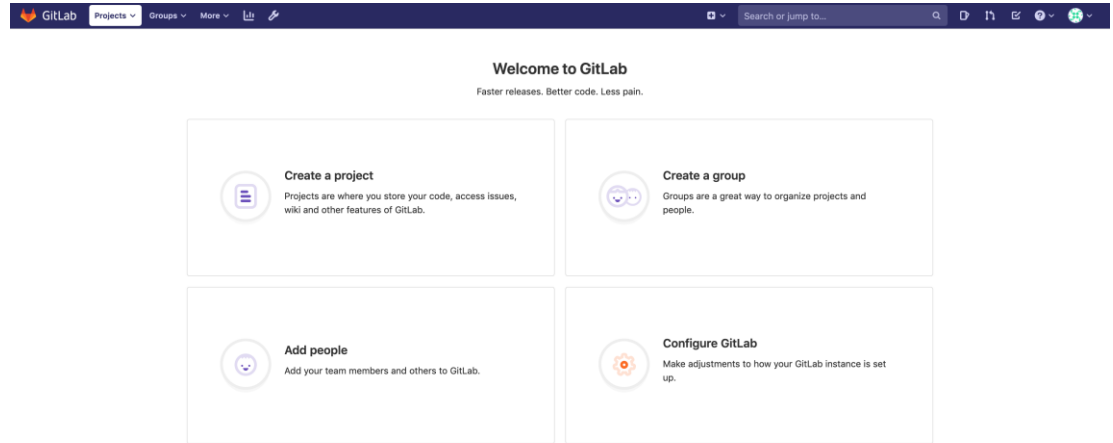
Stages of the DevOps lifecycle

Manage Plan Create Verify Package Secure Release Configure Monitor Defend

GitLab

Projects

- Code, issues, wikis, etc. are organized into projects



GitLab

Projects

- Create new projects from scratch, use a template, or import an existing project
- Configurable visibility levels: private, internal, public

The screenshot shows the 'New project' page in the GitLab web interface. The page has a dark blue header with the GitLab logo and navigation links. The main content area is divided into three tabs: 'Blank project' (selected), 'Create from template', and 'Import project'. The 'Blank project' tab contains a form with the following fields and options:

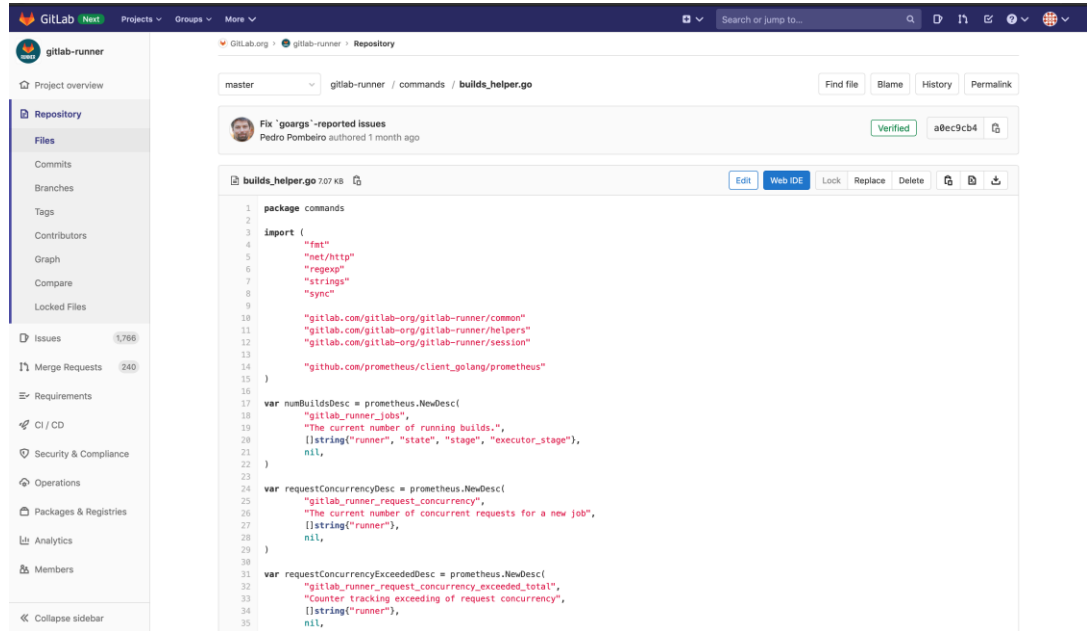
- Project name:** A text input field containing 'my-first-git-project'.
- Project URL:** A text input field containing 'http://10.194.104.70:8080/devcx/'.
- Project slug:** A text input field containing 'my-first-git-project'.
- Project description (optional):** A large text area with a placeholder 'Description format'.
- Visibility Level:** A section with three radio button options:
 - ☒ **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.
 - ☐ **Public**: The project can be accessed without any authentication.
- ☐ **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.

At the bottom of the form are two buttons: a green 'Create project' button and a grey 'Cancel' button.

GitLab

Files

- View, edit, create files under or in your project (repository)



GitLab

Commits

- View and manage commits within your project

The screenshot shows the GitLab web interface for the 'gitlab-runner' project. The left sidebar contains navigation links: Project overview, Repository (with sub-links for Files, Commits, Branches, Tags, Contributors, Graph, Compare, and Locked Files), Issues (1,766), Merge Requests (240), Requirements, CI / CD, Security & Compliance, Operations, Packages & Registries, Analytics, and Members. The main content area is titled 'Commits' and shows a list of commits for the 'master' branch. The commits are grouped by date: 06 Aug, 2020 (5 commits) and 04 Aug, 2020 (7 commits). Each commit entry includes a merge request icon, a description, the author's name and profile picture, the time since the commit, a status icon (warning or verified), the commit hash, and icons for file diff and download.

Date	Commit Description	Author	Time	Status	Hash	File Diff	Download
06 Aug, 2020	Merge branch 'docs/add-security-process' into 'master'	Suzanne Selhorn	4 hours ago	Warning	cbb7a8c0	Yes	Yes
	Document security release process	Steve Azzopardi	4 hours ago		68a83e1b	Yes	Yes
	Merge branch 'docs-selhorn-tokenupdate' into 'master'	Steve Azzopardi	9 hours ago	Warning	93e797b1	Yes	Yes
	Docs: Added specific token steps	Suzanne Selhorn	9 hours ago		f8819110	Yes	Yes
	Merge remote-tracking branch 'security/master' into master	Steve Azzopardi	15 hours ago	Verified	f6865779	Yes	Yes
04 Aug, 2020	Merge branch 'ak/upgrade-git' into 'master'	Tomasz Maczugin	2 days ago	Warning	523854c8	Yes	Yes
	Merge branch '3440-move-runner-pkg-binary' into 'master'	Steve Azzopardi	2 days ago	Warning	26b5a61e	Yes	Yes
	Merge branch '26536-log-job-attachment-to-runner-vm' into 'master'	Steve Azzopardi	2 days ago	Warning	9035831c	Yes	Yes
	Merge branch 'ajwalker/docker-health-check-use-container-id' into 'master'	Steve Azzopardi	2 days ago	Warning	f7b701868	Yes	Yes
	Log additional docker-machine prep/cleanup info	Arran Walker	4 weeks ago		fb4df5ad	Yes	Yes
	Added Docker healthcheck integration check	Arran Walker	2 months ago		d24ca2c0	Yes	Yes
	Merge branch 'msj-fix-external-links-0803-gr' into 'master'	Evan Read	2 days ago	Warning	a68cec87	Yes	Yes

GitLab

Branches

- A version of a project's working tree
- Create merge requests
- Perform inline code review

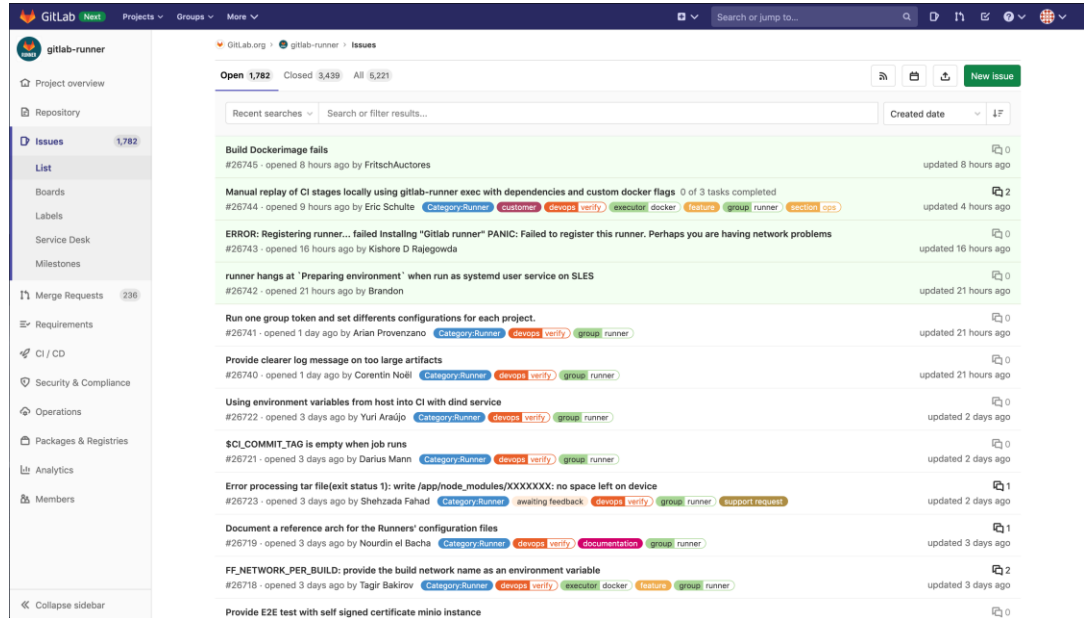
The screenshot displays the GitLab web interface for the 'gitlab-runner' repository. The left sidebar contains navigation links for Project overview, Repository (Files, Commits, Branches, Tags, Contributors, Graph, Compare, Locked Files), Issues (1,766), Merge Requests (240), Requirements, CI / CD, Security & Compliance, Operations, Packages & Registries, Analytics, and Members. The main content area shows the 'Branches' page, which is divided into 'Active branches' and 'Stale branches'. Each branch entry includes a commit hash, a description of the change, a progress bar, and buttons for 'Compare' and 'Download'.

Branch Name	Commit Hash	Description	Progress	Buttons
docs-register-runner-dotcom	2bce7332	Update Registering Runners page · 31 minutes ago	7 / 1	Compare, Download
25358-enable-coverage	8364e22e	fixup! tmp: Change tested code to visualize coverage · 1 hour ago	0 / 4	Compare, Download
prauemann-master-patch-77834	83823c47	Apply 1 suggestion(s) to 1 file(s) · 2 hours ago	81 / 15	Compare, Download
helper-image-custom-ca	ac5cc517	Address MR review comments · 4 hours ago	2 / 3	Compare, Download
master	cb07a8c8	Merge branch 'docs/add-security-process' into 'master' · 5 hours ago		Compare, Download
upgrade-mockery	94b44640	Upgrade mockery to v1.0.0 · 3 months ago	576 / 1	Compare, Download
collect-suricata	8a5a8d1f	fixed module errors · 3 months ago	587 / 6	Compare, Download
test-docker-buildx	2cc84204	Run 'docker buildx inspect --bootstrap' · 3 months ago	580 / 2	Compare, Download
eliot-webhook-test	b27a0a01	garbage, this is a test. · 3 months ago	585 / 1	Compare, Download
mr-origin-168	542cc97c	Code review · 3 months ago	594 / 2	Compare, Download

GitLab

Issues

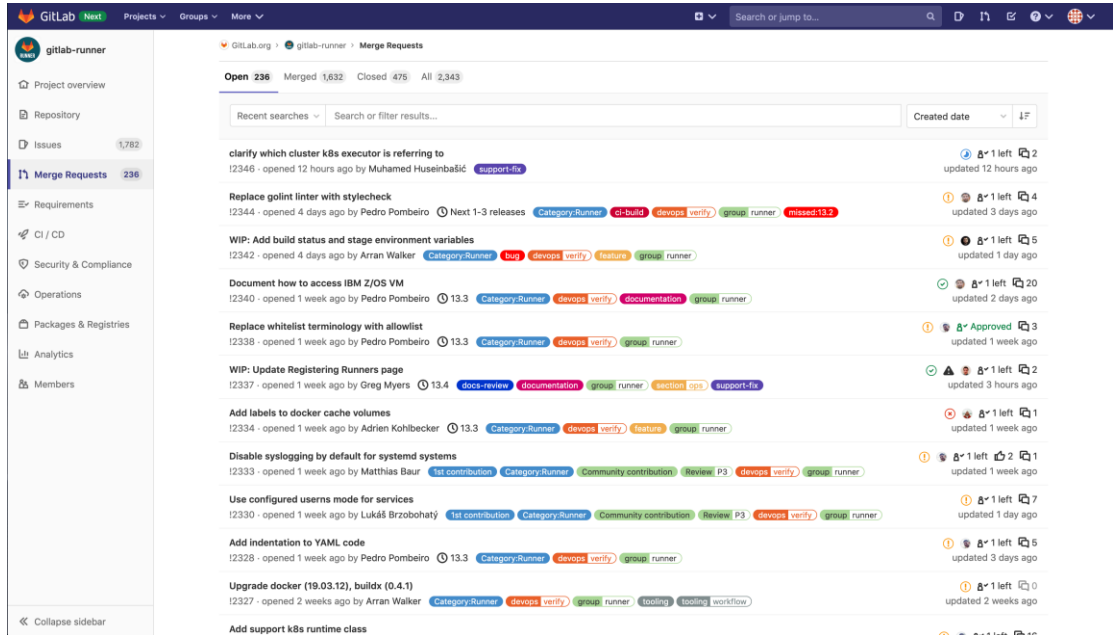
- Used for collaborating on ideas and planning work
- Enable sharing and discussion of ideas/proposals
- Track status of work and tasks



GitLab

Merge Requests

- Request to merge one branch into another



The screenshot shows the GitLab Merge Requests interface for the `gitlab-runner` repository. The left sidebar contains navigation links: Project overview, Repository, Issues (1,782), Merge Requests (236), Requirements, CI / CD, Security & Compliance, Operations, Packages & Registries, Analytics, and Members. The main content area displays a list of merge requests with the following details:

- Open: 236**, **Merged: 1,632**, **Closed: 476**, **All: 2,343**
- Search bar: "Search or filter results..."
- Sort by: "Created date" (1F)
- Recent searches: (empty)
- Table of merge requests with columns for title, author, date, status, and actions.

Title	Author	Date	Status	Actions
clarify which cluster k8s executor is referring to	Muhammed Husseinbašić	opened 12 hours ago	Open	1 left, 2 updated 12 hours ago
Replace golint linter with stylecheck	Pedro Pombeiro	opened 4 days ago	Open	1 left, 4 updated 3 days ago
WIP: Add build status and stage environment variables	Arran Walker	opened 4 days ago	Open	1 left, 5 updated 1 day ago
Document how to access IBM Z/OS VM	Pedro Pombeiro	opened 1 week ago	Open	1 left, 20 updated 2 days ago
Replace whitelist terminology with allowlist	Pedro Pombeiro	opened 1 week ago	Open	Approved, 3 updated 1 week ago
WIP: Update Registering Runners page	Greg Myers	opened 1 week ago	Open	1 left, 2 updated 3 hours ago
Add labels to docker cache volumes	Adrien Kohlbecker	opened 1 week ago	Open	1 left, 1 updated 1 week ago
Disable syslogging by default for systemd systems	Matthias Baur	opened 1 week ago	Open	1 left, 2 updated 1 week ago
Use configured users mode for services	Lukáš Brzobohatý	opened 1 week ago	Open	1 left, 7 updated 1 day ago
Add indentation to YAML code	Pedro Pombeiro	opened 1 week ago	Open	1 left, 5 updated 3 days ago
Upgrade docker (19.03.12), buildx (0.4.1)	Arran Walker	opened 2 weeks ago	Open	1 left, 0 updated 2 weeks ago
Add support k8s runtime class			Open	1 left, 1 updated 1 week ago

GitLab

Pipelines

- Fundamental building blocks for CI/CD

The screenshot displays the GitLab interface for the 'gitlab-runner' project. The left sidebar contains navigation links: Project overview, Repository, Issues (1,782), Merge Requests (236), Requirements, CI / CD (selected), Pipelines, Jobs, Schedules, Security & Compliance, Operations, Packages & Registries, Analytics, and Members. The main content area shows the 'Pipelines' page with a search bar and a table of pipeline runs.

Status	Pipeline	Triggerer	Commit	Stages	Actions
running	#177869707	[Avatar]	!2346 -> 8effc580 Merge branch 'k8sexectorclust...	[Icons]	[Download]
running	#177869404	[Avatar]	!2346 -> d3b5331f Merge branch 'k8sexectorclust...	[Icons]	[Download]
running	#177606098	[Avatar]	!2325 -> cfa77e77 Merge branch 'patch-4' into 'm...	[Icons]	[Download]
running	#177604493	[Avatar]	!2325 -> 3b94d486 Updated Windows steps	[Icons]	[Download]
canceled	#177590399	[Avatar]	!2325 -> 2846f438 Merge branch 'patch-4' into 'm...	[Icons]	[Download]
canceled	#177535883	[Avatar]	!2325 -> 2846f438 Merge branch 'patch-4' into 'm...	[Icons]	[Download]
passed	#177412421	[Avatar]	!26632-gitlab -> 9a6585be Add helper binary	[Icons]	[Download]
passed	#177408271	[Avatar]	!26632-gitlab -> 825f9495 Add helper binary	[Icons]	[Download]

GitLab

Pipelines

- Composed of:
 - Jobs – What to do
 - Stages – When to run jobs
- A typical pipeline would contain four stages
 - Build (compile)
 - Test (unit-tests)
 - Staging (deploy-to-stage, integration-tests)
 - Production (deploy-to-prod)

GitLab

Runners

- Used to run the jobs and send results back to GitLab
- When a pipeline is triggered, a Runner will `git clone` the repo and then execute the instructions inside of `.gitlab-ci.yml`
- Implements a variety of executors
 - Jobs can run in different scenarios
 - SSH, Shell, Parallels, VirtualBox, Docker, Kubernetes, Custom

GitLab

.gitlab-ci.yml

```
1 stages:
2   - build
3   - test
4   - deploy
5
6 image: alpine
7
8 compile_a:
9   stage: build
10  script:
11    - echo "This job builds something."
12
13 compile_b:
14   stage: build
15   script:
16     - echo "This job builds something else."
17
18 unit_test_a:
19   stage: test
20   script:
21     - echo "This job tests something. It will only run when all jobs in the"
22     - echo "build stage are complete."
23
24 unit_test_b:
25   stage: test
26   script:
27     - echo "This job tests something else. It will only run when all jobs in the"
28     - echo "build stage are complete too. It will start at about the same time as test_a."
29
30 deploy_a:
31   stage: deploy
32   script:
33     - echo "This job deploys something. It will only run when all jobs in the"
34     - echo "test stage complete."
35
36 deploy_b:
37   stage: deploy
38   script:
39     - echo "This job deploys something else. It will only run when all jobs in the"
40     - echo "test stage complete. It will start at about the same time as deploy_a."
```

GitLab

Schedules

- Pipelines normally run when conditions are met
 - When a branch is pushed to a repository
- Schedules enable pipeline runs at specific intervals
 - Once every day
 - Every Friday
 - Any schedule as needed

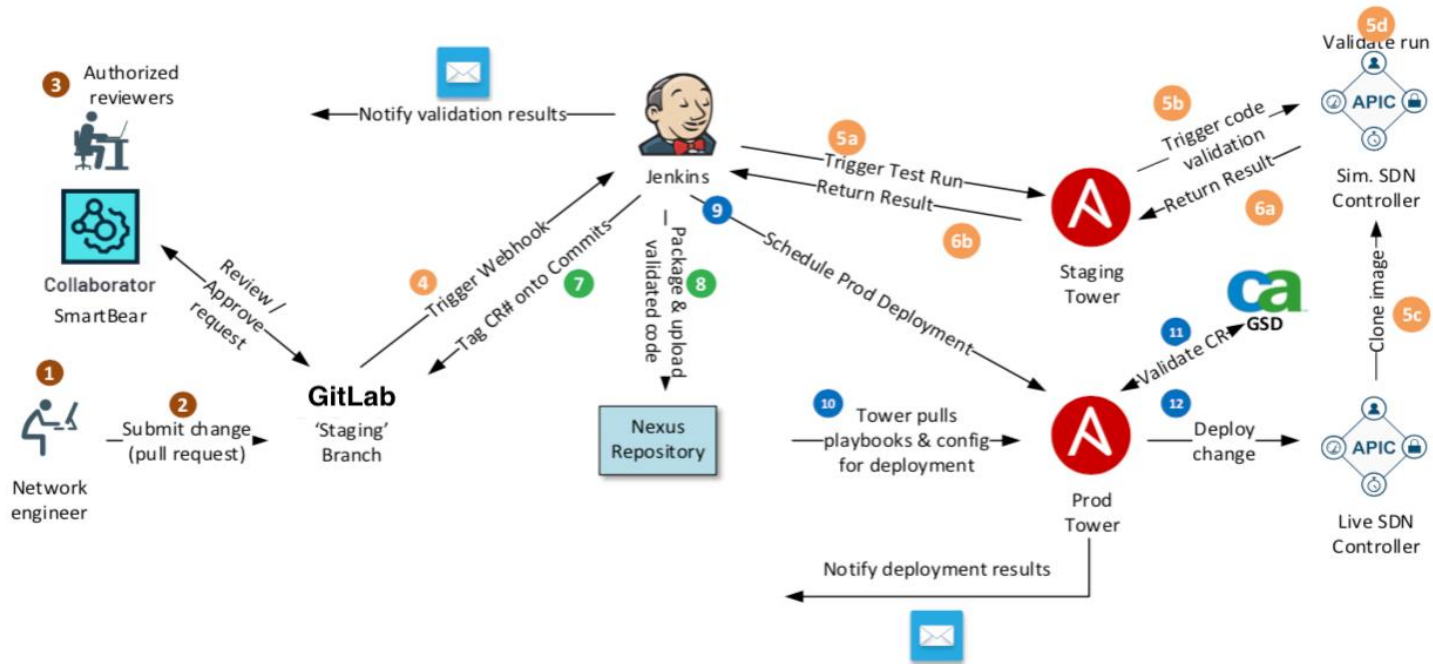
GitLab

Environment Variables

- Useful for customizing your jobs

```
export CI_JOB_ID="50"  
export CI_COMMIT_SHA="1ecfd275763eff1d6b484ea3168962458c9f27a"  
export CI_COMMIT_SHORT_SHA="1ecfd275"  
export CI_COMMIT_REF_NAME="master"  
export CI_REPOSITORY_URL="https://gitlab-ci-token:abcde-1234ABCD5678ef@example.com/gitlab-org/gitlab-foss.git"  
export CI_COMMIT_TAG="1.0.0"  
export CI_JOB_NAME="spec:other"  
export CI_JOB_STAGE="test"  
export CI_JOB_MANUAL="true"  
export CI_JOB_TRIGGERED="true"  
export CI_JOB_TOKEN="abcde-1234ABCD5678ef"  
export CI_PIPELINE_ID="1000"  
export CI_PIPELINE_IID="10"  
export CI_PAGES_DOMAIN="gitlab.io"  
export CI_PAGES_URL="https://gitlab-org.gitlab.io/gitlab-foss"  
export CI_PROJECT_ID="34"  
export CI_PROJECT_DIR="/builds/gitlab-org/gitlab-foss"  
export CI_PROJECT_NAME="gitlab-foss"  
export CI_PROJECT_TITLE="GitLab FOSS"  
export CI_PROJECT_NAMESPACE="gitlab-org"  
export CI_PROJECT_ROOT_NAMESPACE="gitlab-org"  
export CI_PROJECT_PATH="gitlab-org/gitlab-foss"  
export CI_PROJECT_URL="https://example.com/gitlab-org/gitlab-foss"  
export CI_REGISTRY="registry.example.com"  
export CI_REGISTRY_IMAGE="registry.example.com/gitlab-org/gitlab-foss"  
export CI_REGISTRY_USER="gitlab-ci-token"  
export CI_REGISTRY_PASSWORD="longalphanumericstring"  
export CI_RUNNER_ID="10"  
export CI_RUNNER_DESCRIPTION="my runner"  
export CI_RUNNER_TAGS="docker, linux"  
export CI_SERVER="yes"  
export CI_SERVER_URL="https://example.com"  
export CI_SERVER_HOST="example.com"  
export CI_SERVER_PORT="443"  
export CI_SERVER_PROTOCOL="https"  
export CI_SERVER_NAME="GitLab"  
export CI_SERVER_REVISION="70606bf"  
export CI_SERVER_VERSION="8.9.0"  
export CI_SERVER_VERSION_MAJOR="8"  
export CI_SERVER_VERSION_MINOR="9"  
export CI_SERVER_VERSION_PATCH="0"  
export GITLAB_USER_EMAIL="user@example.com"  
export GITLAB_USER_ID="42"
```

Example of a CI/CD Pipeline Workflow



Demo

Test environment

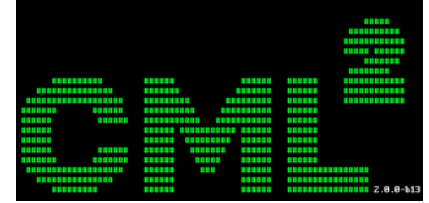


**Dev
Workstation**



CentOS

**Hosting
Server**



**Network
Simulation**



**Infrastructure
as Code**



GitLab

**Source
Control**



**Testing
Framework**

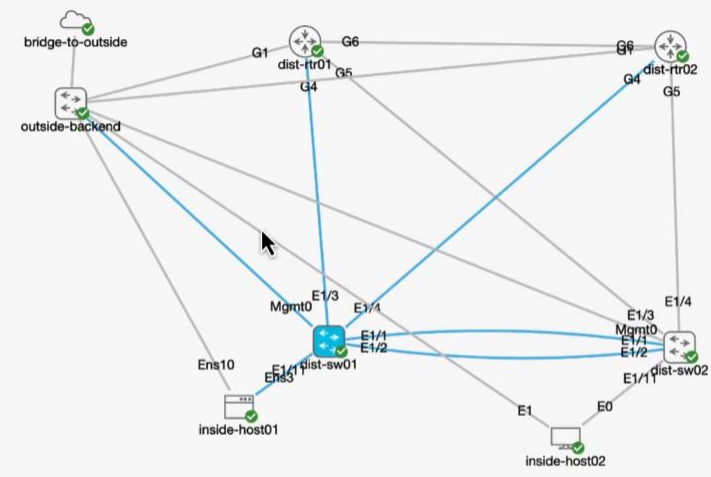
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NODE INFO SIMULATE CONNECTIVITY CONSOLE VNC EDIT CONFIG INTERFACES

CLONE NODE DELETE NODE

NX-OS 9000
Node Name:
dist-sw01

CPU 28.56% MEMORY 18.82% DISK 8.38% Notifications 6 Status OK



Resources



- <https://blogs.cisco.com/author/adrianiliesiu>
- <https://github.com/CiscoDevNet>

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Cisco Modeling Labs

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Cisco Learning Network

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Authorized training partners supporting Cisco technology and career certifications

Cisco Instructor-led and Virtual Instructor-led training

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Cisco Guided Study Groups

180-day certification prep program with learning and support

Cisco Continuing Education Program

Recertification training options for Cisco certified individuals





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