

Kubernetes-from-Scratch on LXD

Reference Guide — Ubuntu 26.04 · LXD 5.21 LTS · Kubernetes 1.33.x

This guide accompanies the `lxd-preseed.yaml` and automation scripts for building a two-node Kubernetes lab (k8master + k8worker1) inside LXD system containers on a single Ubuntu 26.04 host, matching a VirtualBox NAT → LXD bridge (k8sbr0) topology.

1. Architecture Recap

Layer	Value
Host OS	Ubuntu 26.04 LTS
Container manager	LXD 5.21 LTS (snap channel 5.21/stable)
Storage pool	default (ZFS, loop-backed 30GiB)
Bridge	k8sbr0 — 192.168.100.1/24, NAT + DHCP (.100-.199)
Profile	k8s-base — privileged, nested, kernel modules for kube-proxy/CNI
Control plane	k8master — 192.168.100.10 (static)
Worker	k8worker1 — 192.168.100.11 (static)
Kubernetes	1.33.x via kubeadm, containerd runtime, Flannel CNI

2. Build Order

- 1 `lxd init --preseed < lxd-preseed.yaml` — storage pool, k8sbr0, default + k8s-base profiles
- 2 Launch k8master / k8worker1 on the k8s-base profile; pin static IPs via device override
- 3 Install containerd + kubeadm/kubelet/kubectcl 1.33.x on both nodes
- 4 `kubeadm init` on k8master, install Flannel CNI
- 5 `kubeadm join` on k8worker1 using the token from step 4
- 6 Validate with `kubectcl get nodes` / `kubectcl get pods -A`
- 7 Snapshot at each milestone (base-provisioned, packages-installed, control-plane-ready, cluster-joined)

3. GitHub Repositories

[corneliusweig/kubernetes-lxd](https://github.com/corneliusweig/kubernetes-lxd)

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Minimal step-by-step guide to run kubeadm inside a single LXC container; good for understanding the raw prerequisites (kernel modules, capabilities) before automating.

[cr1st1p/k8s-on-lxd](https://github.com/cr1st1p/k8s-on-lxd)

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Bash-script toolkit for multi-node, multi-cluster Kubernetes on LXD system containers; handles image pre-baking and node add/remove.

lxc/cluster-api-provider-incus

<https://github.com/lxc/cluster-api-provider-incus>

Production-grade Cluster API provider for Incus/LXD/MicroCloud; useful once you outgrow hand-rolled kubeadm scripts and want declarative cluster lifecycle.

kogeler/k8s-lab

<https://github.com/kogeler/k8s-lab>

Ansible + Terraform + Helm building blocks for a single-host Kubernetes lab on LXC nodes, driven by Cluster API; a reference for 'growing up' this lab.

inercia/terraform-provider-kubeadm

<https://github.com/inercia/terraform-provider-kubeadm/blob/master/docs/examples/lxd>

Terraform provider example showing kubeadm cluster declarations against an LXD provider — useful pattern for IaC-driven rebuilds.

4. Video Walkthroughs

Kubernetes Cluster in LXC Containers (scripts updated to v1.29)

<https://www.youtube.com/watch?v=fmSW494-3tQ>

Walkthrough of fixing/updating LXD provisioning scripts to deploy a Kubernetes cluster in LXC containers.

[Kube 30] Deploying Kubernetes Cluster using LXC Containers

<https://www.youtube.com/watch?v=XQvQUE7tAsk>

Deploys a multi-node Kubernetes cluster using LXC containers as a lightweight VM alternative.

Automation of LXD Container Creation for Kubernetes

https://m.youtube.com/watch?v=3tMT9_NMHtY

Short demo focused on automating LXD container creation as prep for a Kubernetes deployment.

5. Official Documentation

- **LXD documentation (Canonical)** — <https://documentation.ubuntu.com/lxd/en/latest/>
- **LXD preseed / lxd init reference** — <https://documentation.ubuntu.com/lxd/en/latest/howto/initialize/>
- **Kubernetes kubeadm reference** — <https://kubernetes.io/docs/reference/setup-tools/kubeadm/>
- **kubeadm: Creating a cluster** — <https://kubernetes.io/docs/setup/production-environment/tools/kubeadm/create-cluster-kubeadm/>
- **containerd systemd cgroup driver guide** — <https://kubernetes.io/docs/setup/production-environment/container-runtimes/>
- **Flannel CNI** — <https://github.com/flannel-io/flannel>
- **Running Kubernetes inside LXD (Ubuntu blog)** — <https://ubuntu.com/blog/running-kubernetes-inside-lxd>

6. Known Pitfalls (from community reports)

- kubeadm preflight error 'unable to load kernel module configs' — a known LXD/kubeadm gap tracked in [kubernetes/kubernetes#96081](#); workaround is documented in [corneliusweig/kubernetes-lxd](#).
- btrfs/ZFS as the container's own storage driver can break the Docker/containerd graph driver inside the guest — prefer ext4-backed instances for the node's root filesystem story even if the LXD pool itself is ZFS.
- CNI plugins expecting real kernel network namespaces can behave oddly with nested/unprivileged containers — this is exactly why the k8s-base profile forces `security.privileged + security.nesting + raw.lxc AppArmor unconfined`.

Companion files: `lxd-preseed.yaml`, `scripts/00-init-lxd.sh` through `04-join-worker.sh`, `rebuild.sh`, `validate.sh`, `uninstall.sh`, `README.md`.