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Building Network Digital Twins

With Containerlab and Gitlab CI/CD

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What is Network Digital Twin

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- Virtual Replica: Exact copy of your production network topology and configurations.
- Safe Testing: Test changes, new features and upgrades.
- Fast Deployment: Create complete network environment quickly.

Technology Stack

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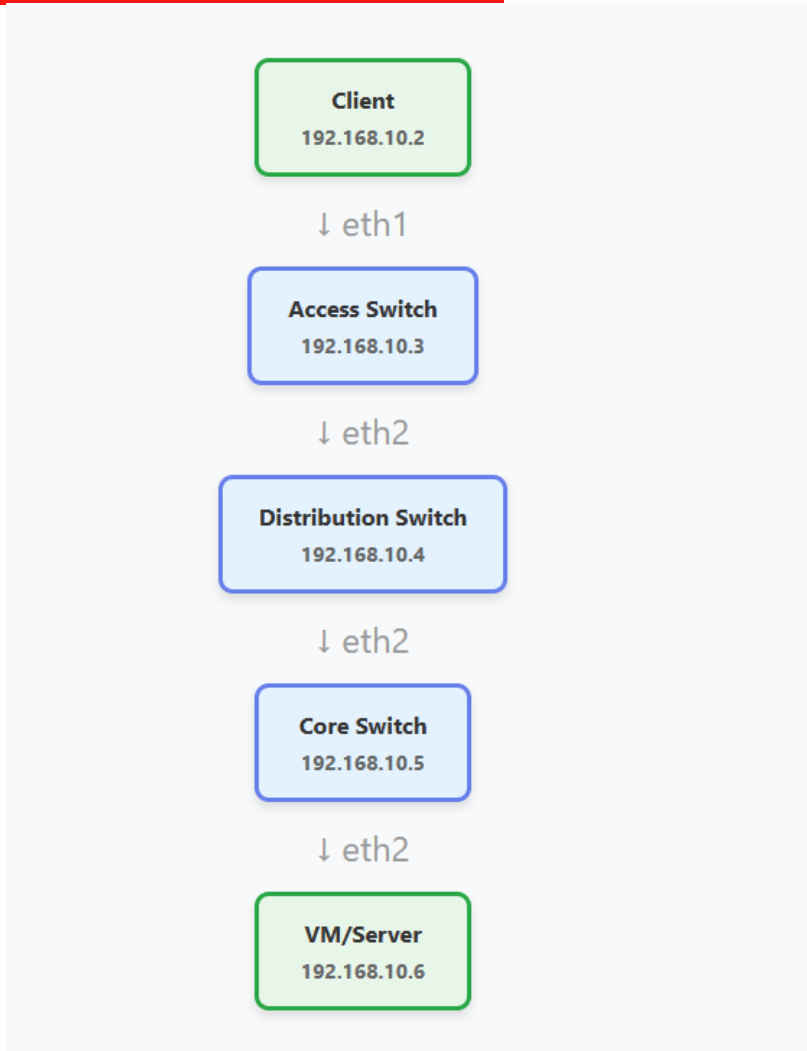
Component	Technology	Purpose
Containerlab	Network Emulation	Creates virtual network topology
Arista cEOS	Virtual Switches	Production-grade switch OS
Alpine Linux	End Devices	Lightweight client/server nodes
GitLab CI/CD	Automation	Automated deployment pipeline
Docker	Containerization	Runs all network nodes

Our Digital Twin Topology



Automated Deployment flow

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Automated Deployment Flow

Key Features:

- ✓ Automated configuration deployment from Git repository
- ✓ Pre-configured OSPF routing between all switches
- ✓ Static IP addressing for management access
- ✓ Automated connectivity testing (ping client → vm)

Key Benefits

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- **Cost Savings:** No physical hardware
- **Risk Reduction:** Test safely before production
- **Collaboration:** Team members can work on same environment configurations
- **Scalability:** Scale from small to larger topologies as per need

Real-World Use Cases

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- **Pre-Change Validation:** Test configuration changes before applying to production
- **Feature Testing:** Evaluate new network features in isolated environment
- **Training & Learning:** Hands-on practice without production risk
- **Troubleshooting:** Reproduce production issues in safe environment
- **Disaster Recovery:** Test recovery procedures and validate backups

Repository Structure (in GitLab):

```
/
├──── .gitlab-ci.yml
├──── topology.clab.yml
├──── configs
        access.cfg
        distribution.cfg
        core.cfg
└──── deploy.sh
└──── scripts/
    └──── deploy.sh
```

```
/home/saeed/containerlab/
├──── topology.clab.yml      ← Copied by GitLab CI
└──── deploy.sh              ← Copied by GitLab CI
```

Gitlab Variables

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Variables to Create

Key	Value	Type
SSH_USER		Variable
SSH_HOST		Variable
SUDO_PASSWORD		Variable

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Live Demo

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Questions and Answers

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Thank you for your attention