muBench Benchmarking Experiment Architecture

Color Coding:

Host Machine | Remote Server | Both Machines

HOST MACHINE (Local)

Experiment Runner (Python)
Executes on Host

• Orchestrates 180 runs (6 topologies × 3 sizes × 10 reps)
• Manages deployment, measurement, cleanup
• Aggregates results into run_table.csv

Controls
Starts/Stops

Locust Load Generator
Executes on Host

• 100 concurrent users
• 10-minute test duration
• Sends requests via SSH tunnel (localhost:9090)
• Metrics: throughput, latency, failures

Uses
HTTP requests

SSH Tunnels
Established from Host

• Gateway: localhost:9090 → gl3:9090
• Prometheus: localhost:30000 → gl3:30000

SSH Connection
(via glgate jump host)
SSH commands, data transfer

REMOTE SERVER

Kubernetes Cluster — Runs on Remote Server

muBench Application (per run)
Namespace: mubench-{topology}-{size}-{replicate}

Service s0
(Gateway)
→ Service calls →
Service s1
→ Service calls →
Service sN

NGINX Gateway (gw-nginx)
Port-forward: 9090:80

Prometheus (monitoring namespace)
• Collects metrics from all pods
• Port-forward: 30000:9090
• Metrics: CPU, memory, network

EnergiBridge (Server Process)
Executes on Remote Server

• Runs on server (not in container)
• CPU Package Energy (RAPL)
• DRAM Energy
• CPU Usage, Frequency, Memory
• Outputs: energibridge.csv

EXPERIMENT WORKFLOW (Color indicates execution location)

Setup Phase

BEFORE_RUN
Host Machine

• Select config
• Create directory

START_RUN
Both Machines

Host: Deploy commands
Server: Deploy mBench
Host: Start gateway port-fwd
Host: Verify readiness

Measurement and data processing Phase

START_MEASURE
Both Machines

Host: Start Locust (10 min)
Server: Start EnergiBridge

STOP_MEASURE
Both Machines

Host: Stop EnergiBridge
Host: Retrieve CSV
Host: Query Prometheus

Parse & Aggregate

POPULATE_DATA
Host Machine

• Parse Locust CSV
• Parse EnergiBridge CSV
• Parse Prometheus data
• Aggregate into run_table.csv

Cleanup Phase

STOP_RUN
Both Machines

Host: Delete namespace
Server: Cleanup K8s

COOLDOWN
Host Machine

• Wait 1 minute

NEXT RUN
Host Machine

Loop to next run

METRICS COLLECTED (by tool and location)

Performance (Locust)
Collected on Host

• Throughput (req/s)
• Avg Latency (ms)
• P95 Latency (ms)
• Failure Rate (%)
• Request Count

Energy (EnergiBridge)
Collected on Server

• Package Energy (J)
• DRAM Energy (J)
• CPU Usage (%)
• CPU Frequency (MHz)
• Memory Used (Bytes)
• Memory Total (Bytes)

System (Prometheus)
Collected on Server
Queried from Host

• CPU Usage Rate
• Memory Working Set (Bytes)

Experiment Configuration

• Topologies: 6
• System Sizes: 3 (5, 10, 20 services)
• Repetitions: 10 per configuration
• Total Runs: 180 (6 × 3 × 10)
• Load: 100 users, 10-minute duration
• Cooldown: 1 minute between runs