覆盖导向的分布式系统故障注入测试工具

FaultFuzz: A Coverage Guided Fault Injection Tool for Distributed Systems

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Systematic Recovery Testing for Distributed Systems is Challenging

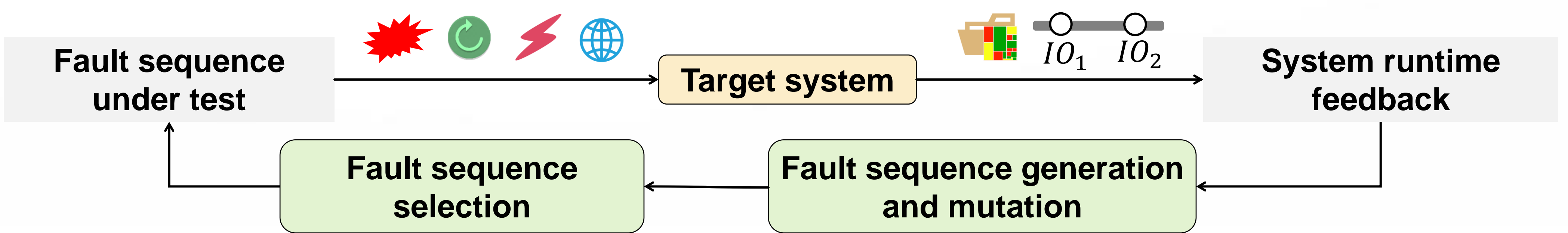☐ Distributed systems have become the backbone of Internet applications.

☐ Distributed systems face numerous fault scenarios

Where to inject faults?
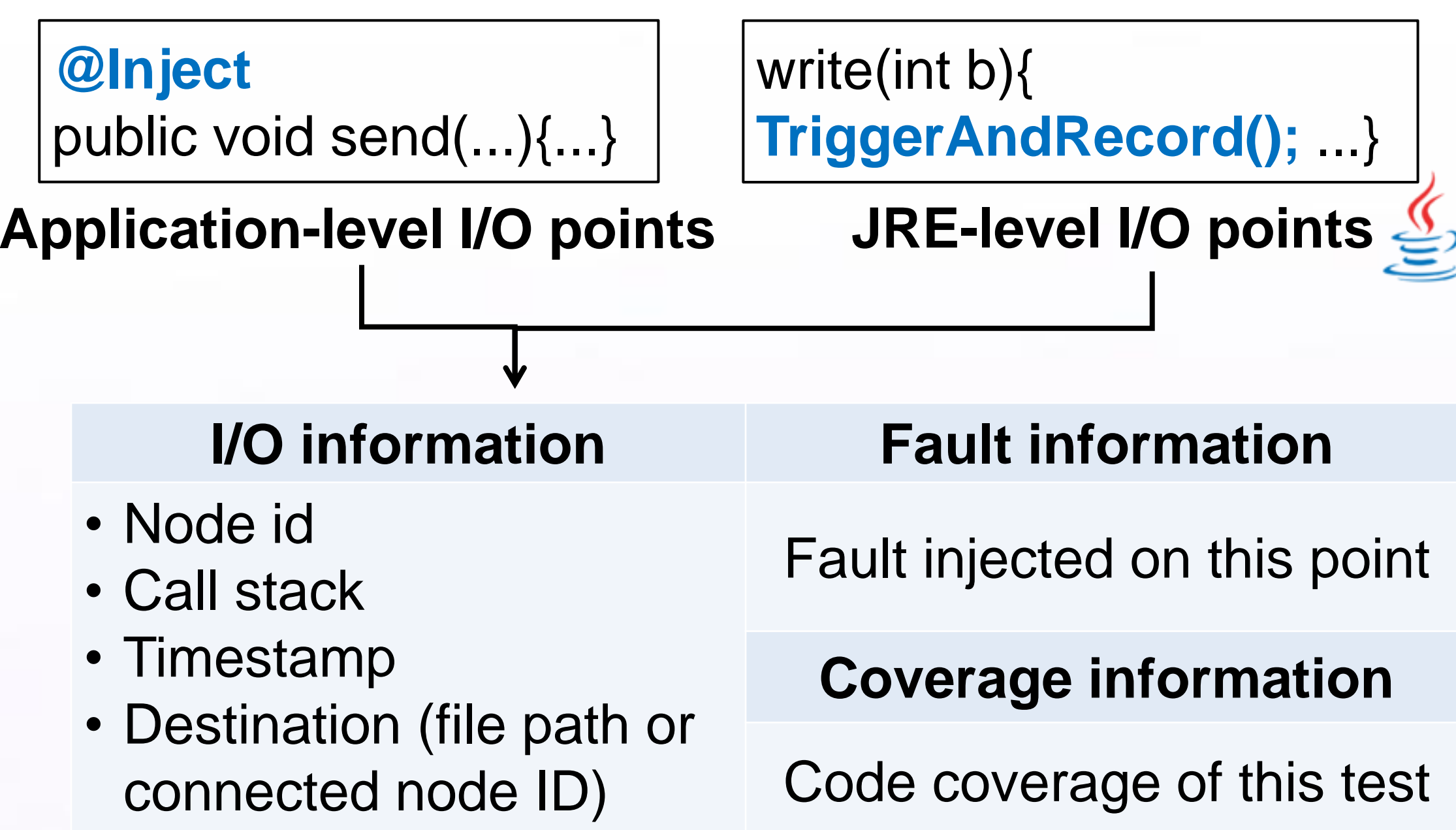**When** to inject faults?
What faults to inject?
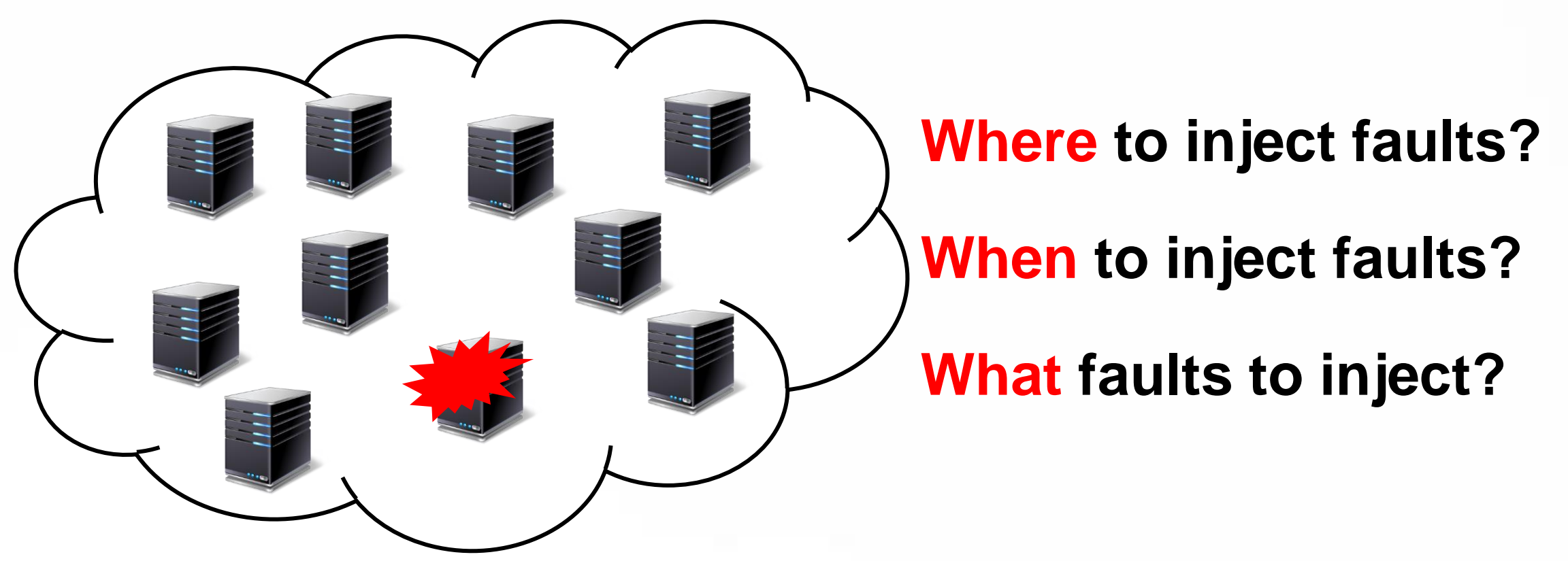
Overview

☐ FaultFuzz: a coverage-guided fault injection tool to test distributed systems
- Fault injection point: I/O point
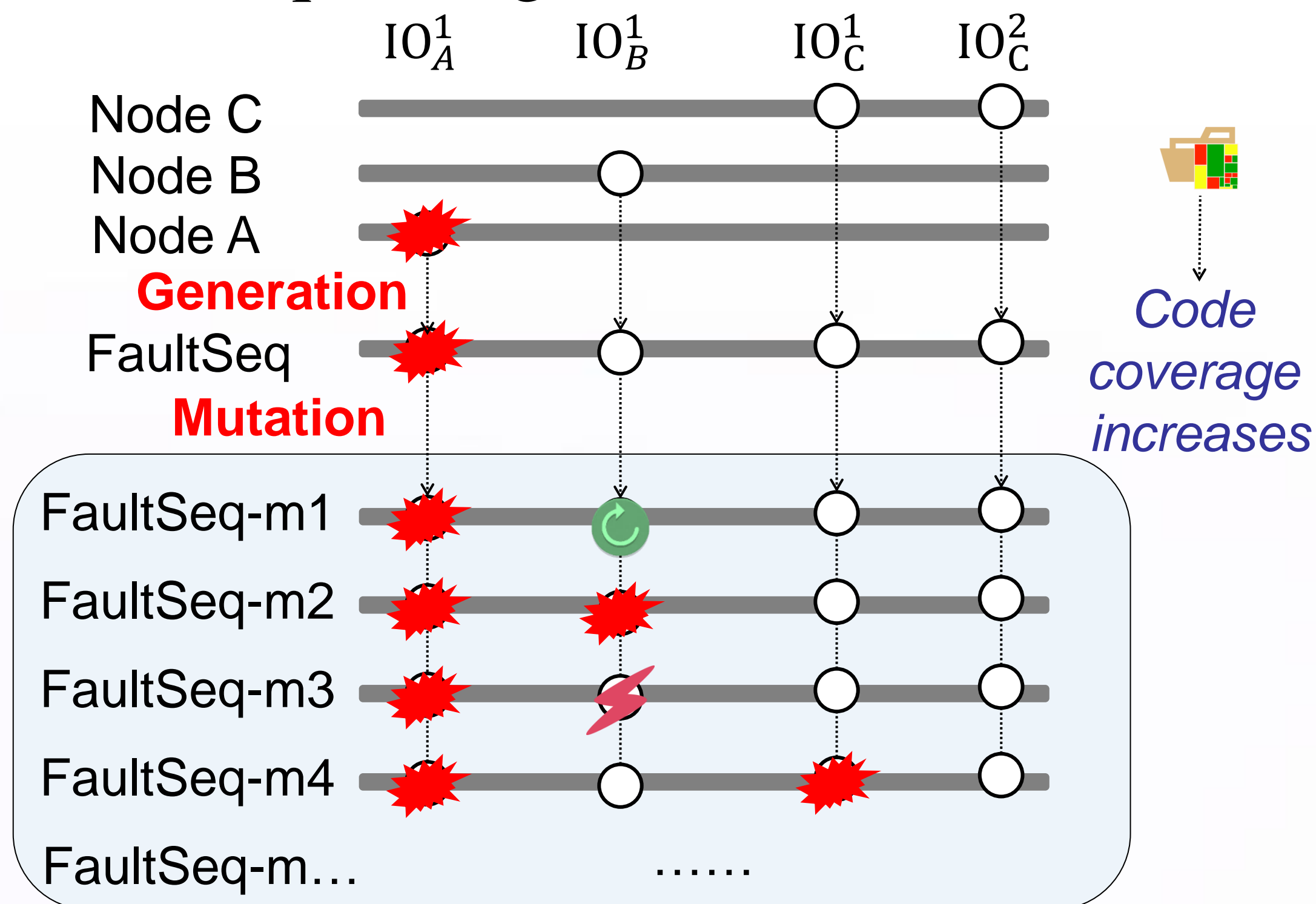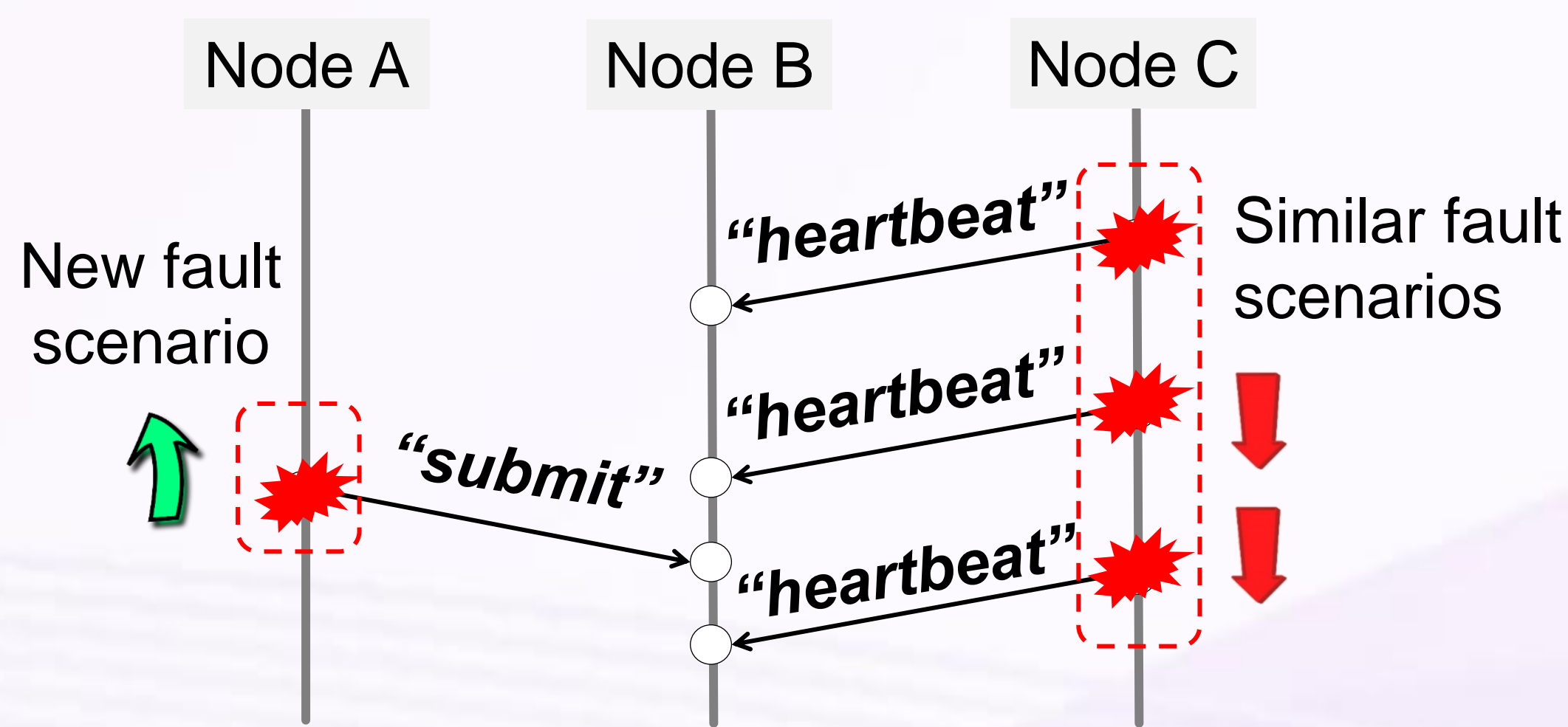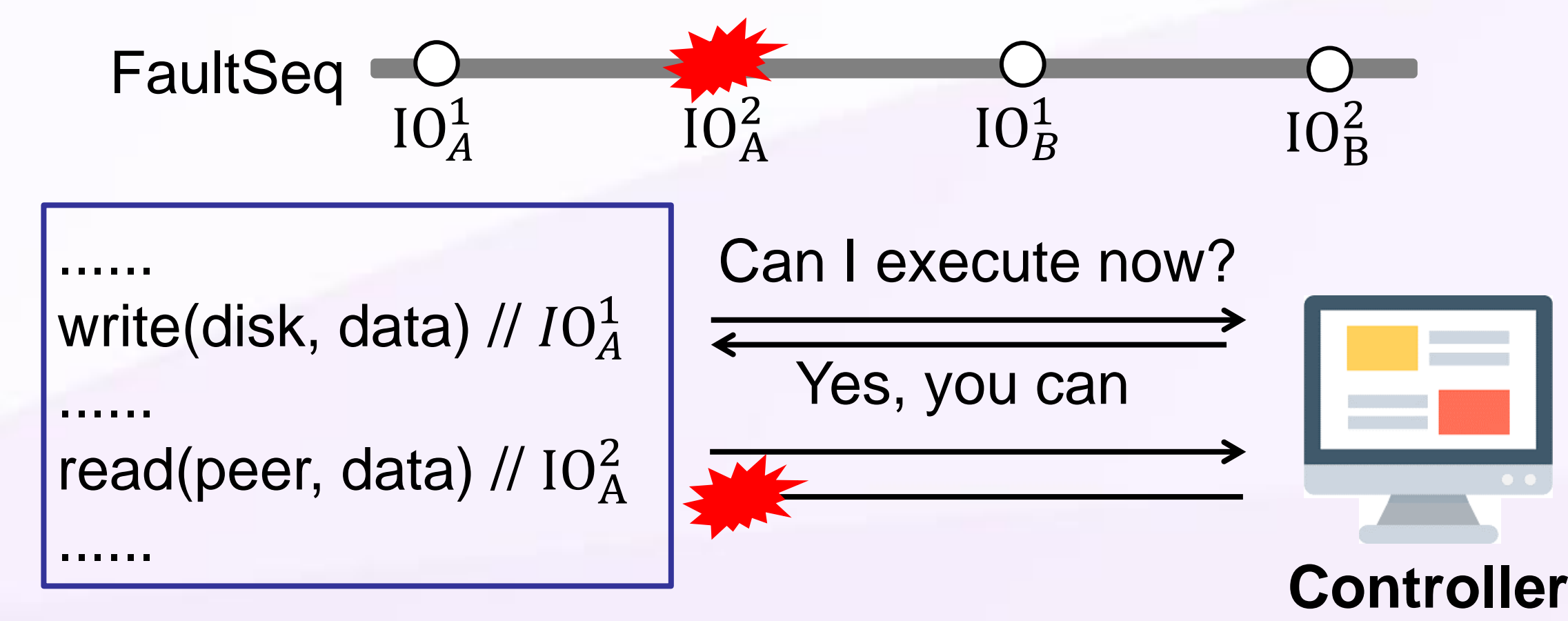- Fault types: crash, reboot, network disconnection, network reconnection

Fault sequence under test → Target system → IO_1 IO_2 → System runtime feedback → Fault sequence generation and mutation → Fault sequence selection → Fault sequence under test

Approach

☐ Information collection

```
@Inject
public void send(...){...}
```
Application-level I/O points

```
write(int b){
TriggerAndRecord(); ...}
```
JRE-level I/O points

I/O information	Fault information
• Node id • Call stack • Timestamp • Destination (file path or connected node ID)	Fault injected on this point
	Coverage information
	Code coverage of this test

☐ Fault sequence generation/mutation

IO_A^1 IO_B^1 IO_C^1 IO_C^2

Node C
Node B
Node A
Generation
FaultSeq
Mutation

FaultSeq-m1
FaultSeq-m2
FaultSeq-m3
FaultSeq-m4
FaultSeq-m... ......

Code coverage increases

☐ Fault sequence selection

Node A   Node B   Node C

New fault scenario
"heartbeat"   Similar fault scenarios
"submit"
"heartbeat"
"heartbeat"

☐ Fault injection testing

FaultSeq IO_A^1 IO_A^2 IO_B^1 IO_B^2

```
......
write(disk, data) // IO_A^1
read(peer, data) // IO_A^2
......
```
Can I execute now?
Yes, you can
Controller

Implementation

☐ FaultFuzz architecture

Frontend
UI with Appsmith
Configuration | Auto testing | Runtime statistics
workloads / configuration ↓ ↑ results
SpringBoot Web Server

Backend
Test controller
Fault sequence pool → Fault sequence selection
Fault sequence generation and mutation ← Fault injection testing

SUT
Observer | Observer | Observer
coverage and I/O info

☐ Screenshot

Specify testing configurations

Start testing

Real-time testing results

Replay a fault sequence