Scenario-based Resilience Evaluation and Improvement of Microservice Architectures: A Case Study

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Motivation

How can we evaluate resilience requirements to suggest architecture improvements?
Goal

Explore the application and adoption of the ATAM for resilience requirements elicitation and resilience testing by using chaos experimentation for architecture assessment and improvement.

Research Question:

How to leverage ATAM to elicit resilience requirements to quantitatively evaluate resilience through resilience experiments and suggest architectural improvements?
ATAM-based Workshop

Setup Experiment Environment

Execution and Analysis

Architecture Improvement
ATAM-based Workshop

Session 1: Architecture
Component & Use Case Diagrams

Session 2: Hazard Analysis
Fault Tree

Session 3: Scenarios
Post-It Notes

2x Architects
1x Quality Assurance
1x Product Owner

12 Resilience Scenarios

Scenario-based Resilience Evaluation and Improvement of Microservice Architectures: A Case Study | Lion W., Dominik K.
Software Scenarios — Example

Scenario

- Source: Wage Clerks

Stimulus

- Trigger a lot of Calculations

Artifact

- Microservices A-D

Response

1. Handle the calculations correct and in time
2. Autoscale if necessary

Response Measure

- Response-Time <= 1s for 99% of Requests

Environment

- Regular Service Hours
Software Scenarios — Example

Scenario

Source
Wage Clerks

Stimulus
Trigger a lot of Calculations

Artifact
Microservices A-D

Response
1. Handle the calculations correct and in time
2. Autoscale if necessary

Response Measure
Response-Time ≤ 1s for 99% of Requests

Environment
Regular Service Hours

Experiment

Target:
Calculation Request Endpoint

Method:
Normal workload that increases linear over a short time period

Hypothesis

Load Profile
Steady-State
Experiment Results

- Application is able to recover from injected failures
- Improved Success Rate for the cost of slightly worse performance (higher mean of response times)
- Higher response times still satisfy scenario requirements
Selection of Resilience Patterns

Load-Balancers
Resilience Libraries
Service Discovery Tools

Settled on Resilience4J Retry
+ Supports natural System Behavior
+ Great Spring Integration

Feedback and Discussions
Resilience scenarios can successfully be transposed to chaos experiments.

Eliciting resilience requirements increases hazard analysis.

ATAM workshop requires considerable refinement that can be done offline.

Chaos Experiments can be further automated.