COMPUTER SCIENCE AND DATA ANALYTICS

Course: **Guided Research**

Project Title: **Evaluating Performance Scalability of Microservice-Based Application**

Student: **Tural Mehtiyev**

Instructors & Supervisors: **Dr. Stephen Kaisler, Dr. Jamal Hasanov**

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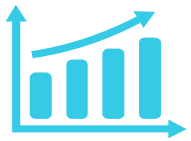
Why this topic?/ Why now?

Problem: "Scalability issues causing performance issues and as a result substantial financial losses highlight the critical need for **rigorous performance testing** in today's software applications"

Performance Impact

Software performance and scalability issues lead to poor user experiences and customer loss.



A survey by ITIC found that **86% of companies** a single hour of downtime would cause a significant reputational impact.

An IDC study suggests that scalability issues cost businesses an average of **$10,000 - $100,000 per hour**

Profitability Impact

As per a report by the Information Systems Audit and Control Association (ISACA), poor performance directly impacts operational efficiency, customer satisfaction, and ultimately profitability

A study by Gartner estimates Average cost of downtime **$5,600 per minute**

Amazon found that **100ms** increase in page load time led to a **1% decrease** in sales

User Expectations

A Microsoft study found that 33% of users would abandon a website that's prone to crashing or slow speeds, highlighting the importance of stability and performance for retaining users.

According to a study by Akamai **40%** of consumers abandon a website that takes more than **3 seconds** to load.

Server Downtime

Amazon's website went down for just **40 minutes** in 2018, and the estimated cost to the company was approximately **$4.6 million** in lost sales.

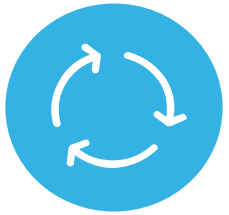
High Traffic Events

In 2015, Target's website crashed on Cyber Monday, a critical online shopping day, causing a significant loss of potential revenue and customer trust.

Project Objective

"The primary objective of this project was to gain **fundamental insights into software scalability challenges**, laying a groundwork for further exploration and potential solutions in handling modern application performance issues in my master thesis and later doctoral studies."

- System Design & Architecture
- Microservice Implementation
- Functionality Testing
- Software Application Deployment
- Developing Expertise in tech stacks
- Documentation Methodologies



- Data Cleaning and Pre-processing Techniques
- Data Visualizations
- Statistical Applications
- Interpretations & Insight Driving

Topic Investigation

- Study of Performance Scalability Issues
- Understanding Microservice Architecture
- Factors Impacting Scalability
- Current Challenges

Application Development

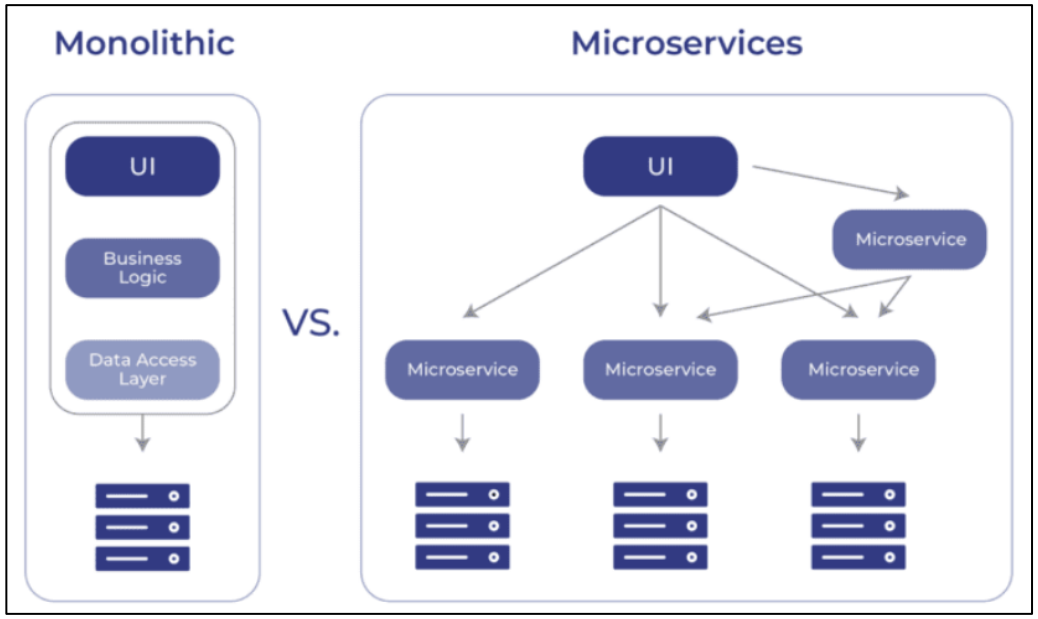
Performance Testing

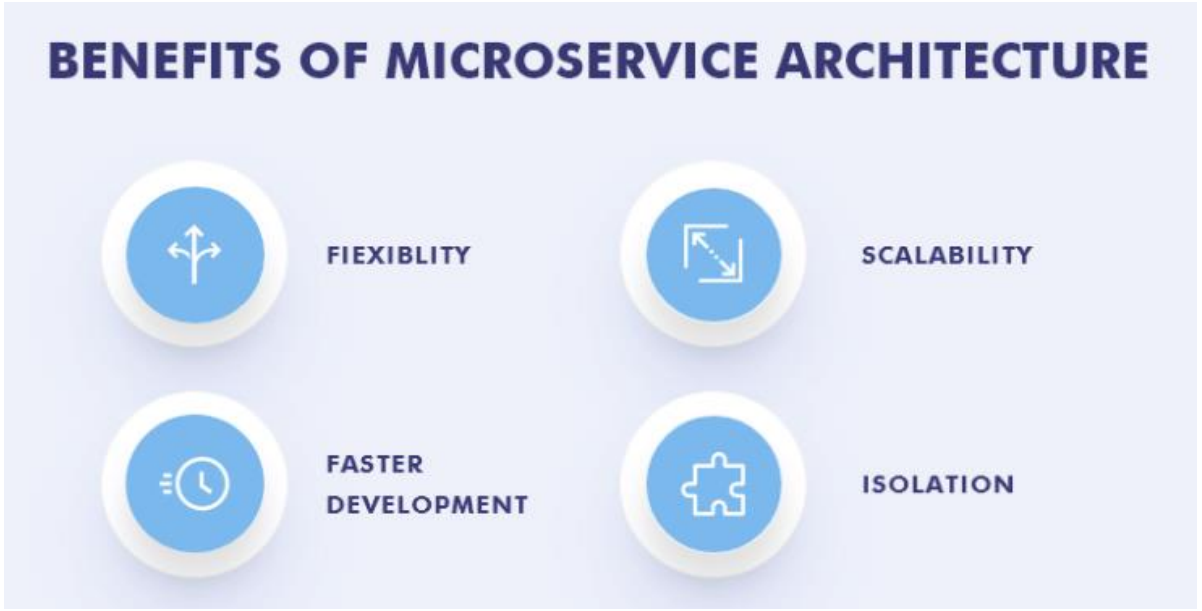
- Key Metrics Comprehension
- Tool Mastery (Apache JMeter)
- Test Scenario Design and User Behavior Simulation
- Experimental Data Gathering
- Grasping the fundamental load testing Limitations

Analysis Methodology

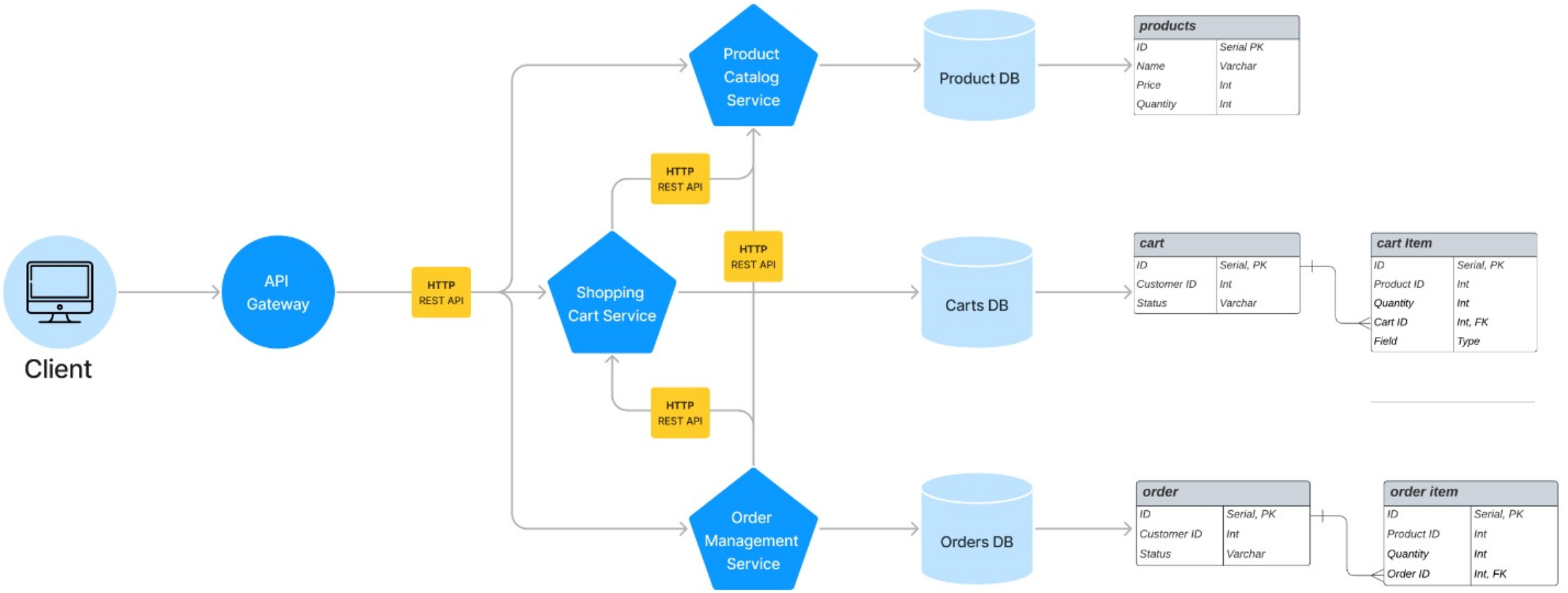
How Is It Done Today

Today's monolithic architectures are **limited in scalability** due to their **tightly integrated components**, whereas microservices address this challenge by enabling **granular and independent scaling of discrete services**.

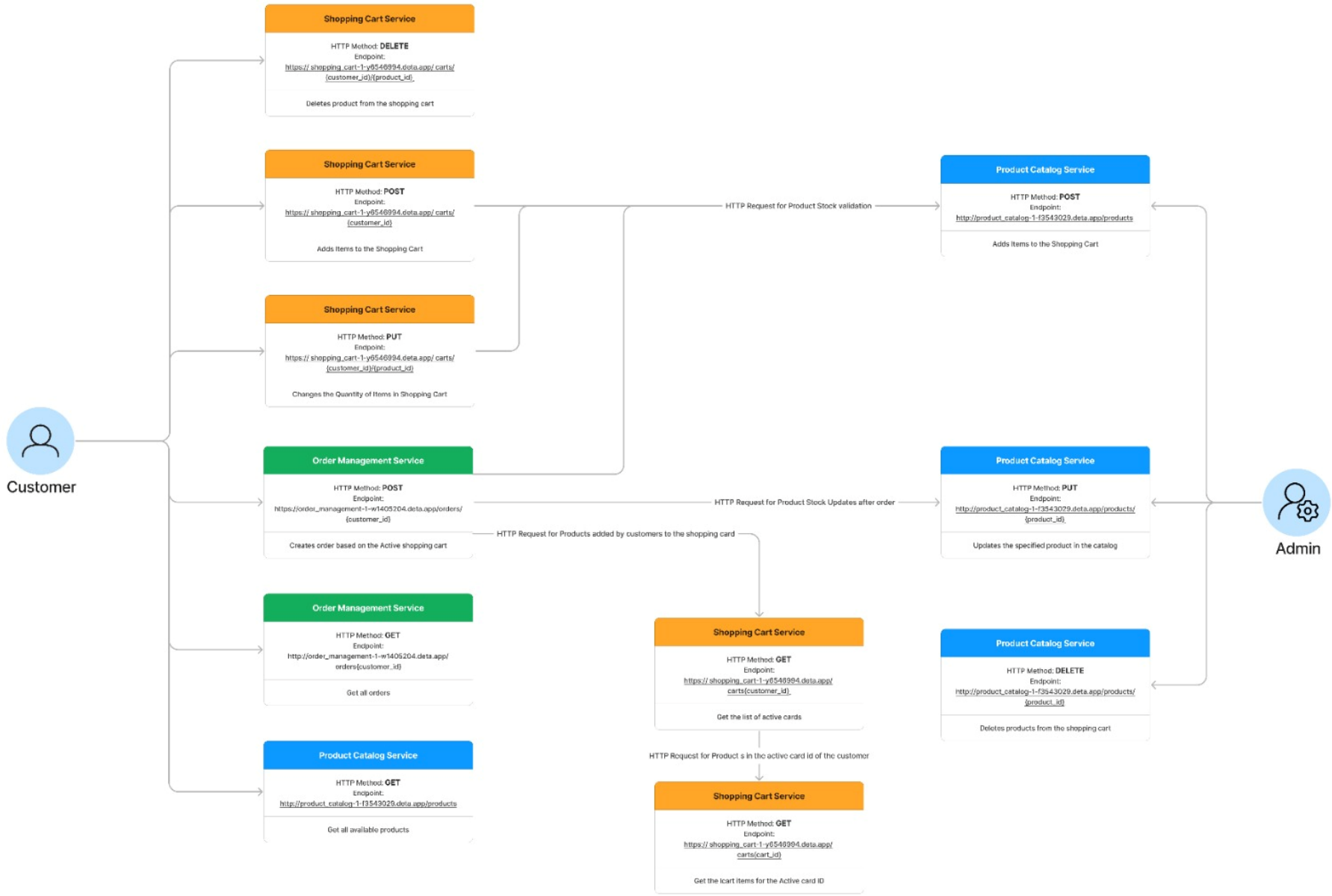




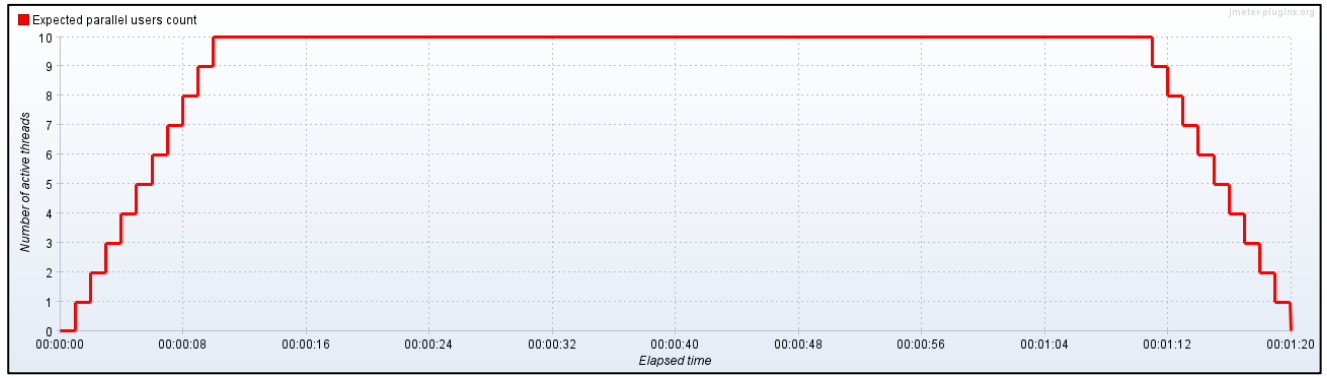
Technical Approach: Architecture Diagram



Technical Approach: Use Case Diagram

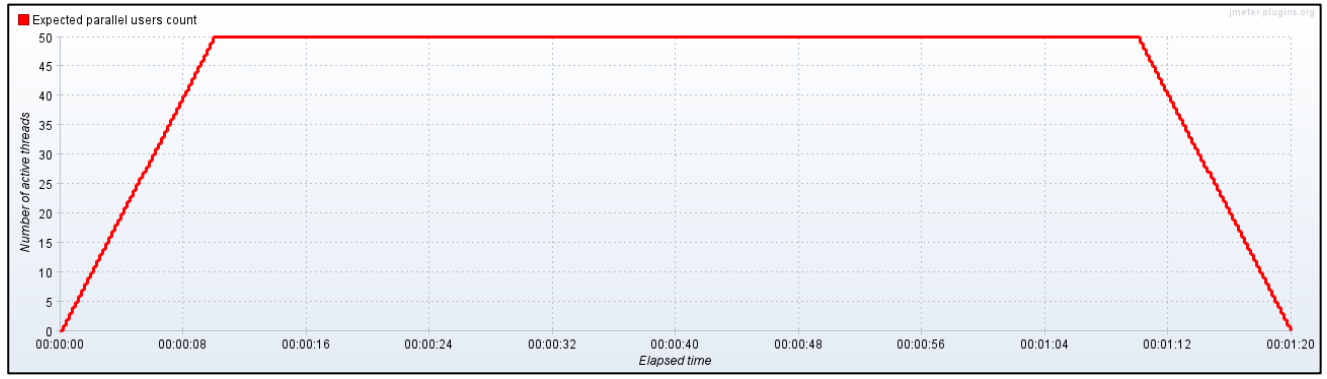


Technical Approach: Load Test Scenarios



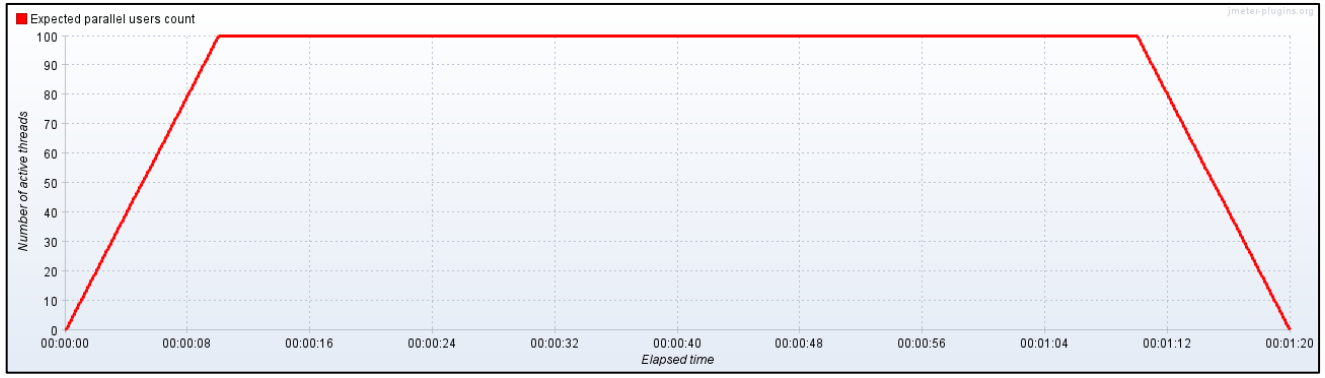
Load Test Scenario 1

Metrics	Value
Start Threads Count	10
Initial Delay, sec	0
Startup Time, sec	10
Hold Load For, sec	60
Shutdown Time, sec	10



Load Test Scenario 2

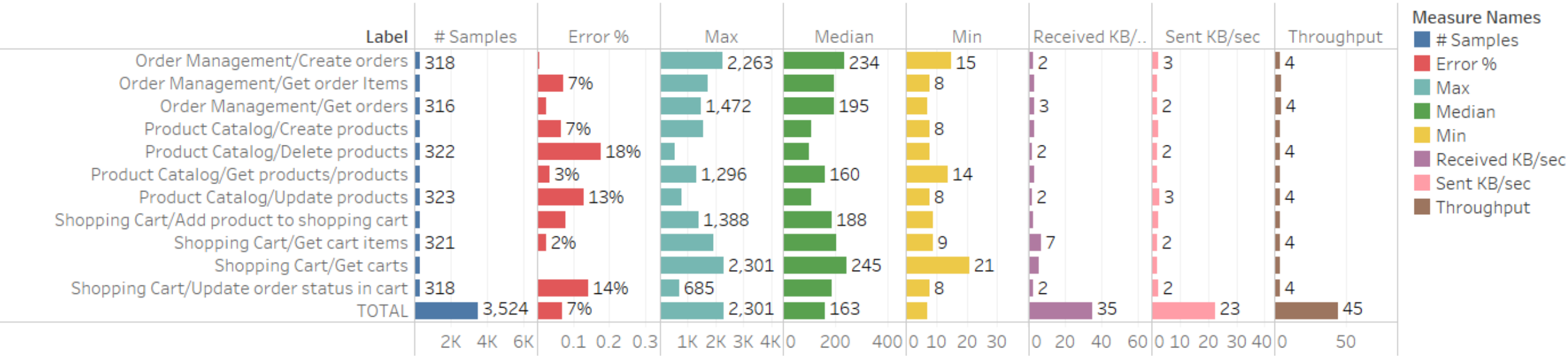
Metrics	Value
Start Threads Count	50
Initial Delay, sec	0
Startup Time, sec	10
Hold Load For, sec	60
Shutdown Time, sec	10



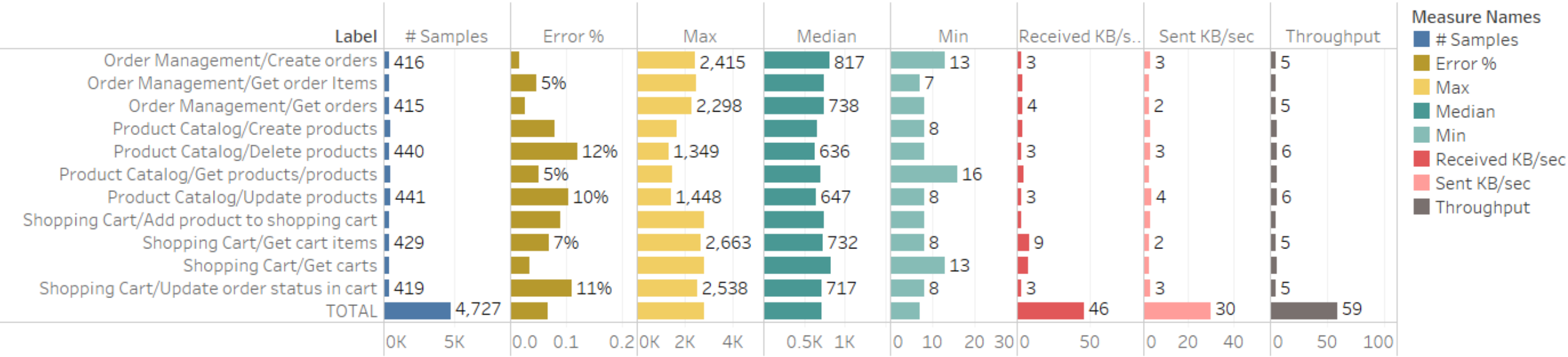
Load Test Scenario 3

Metrics	Value
Start Threads Count	100
Initial Delay, sec	0
Startup Time, sec	10
Hold Load For, sec	60
Shutdown Time, sec	10

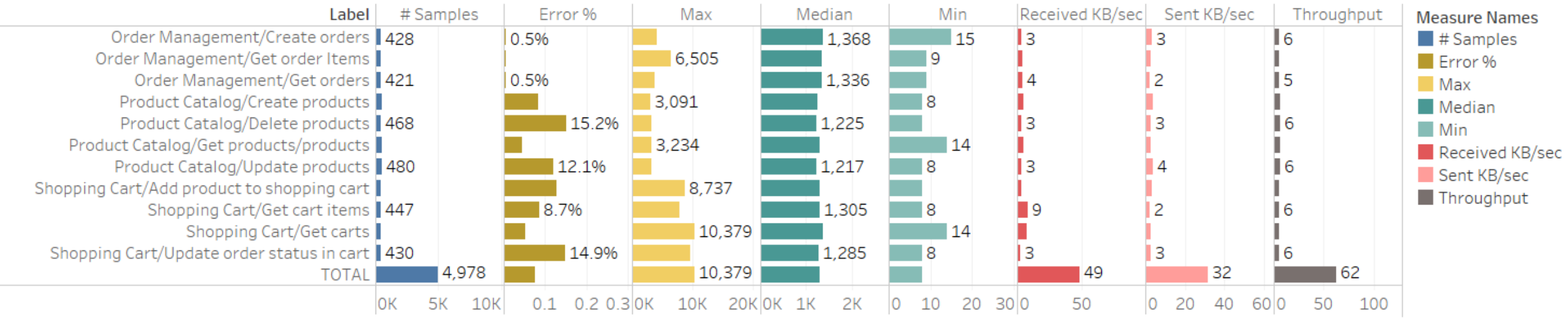
Results: Scenario 1



Results: Scenario 2



Results: Scenario 3



Conclusion

- In Progress

Future Work

- In Progress