

TP3: Software Logging and Observability

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1 Introduction

This report documents the implementation of a software system designed to explore Structured Logging and Distributed Observability. The project evolves from a monolithic logging strategy (Exercise 1) to a full distributed tracing architecture (Exercise 2).

2 System Architecture & Design

2.1 UML Class Diagram

The application follows a standard Controller-Service-Repository pattern. The **StoreService** is the central point for business logic and logging instrumentation.

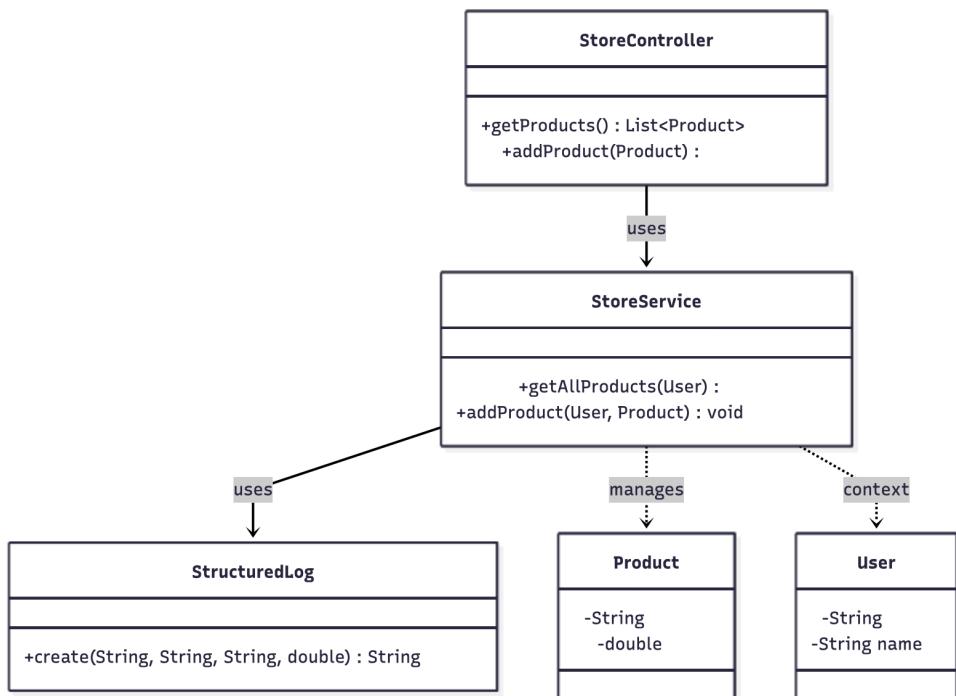


Figure 1: UML Class Diagram showing the dependency between Controller, Service, and the Logging Utility.

2.2 Profiling Workflow (Exercise 1)

User profiles are constructed via a post-execution analysis pipeline. Logs are generated in JSON format during runtime and parsed offline to categorize user behavior.

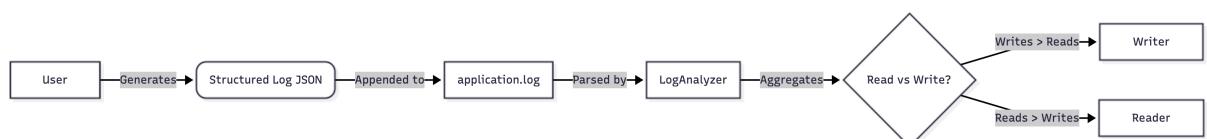


Figure 2: Workflow for generating User Profiles from Structured Logs.

3 Exercise 1: Implementation Details

3.1 Structured Logging

We utilized **SLF4J/Logback** to generate JSON logs.

```
1 public static String create(String userId, String op, String ctx, double
2   metric) {
3   Map<String, Object> log = new HashMap<>();
4   log.put("who", userId);
5   log.put("what", op); // READ or WRITE
6   return mapper.writeValueAsString(log);
}
```

Listing 1: StructuredLog.java Helper

3.2 Profiling Results

The LogAnalyzer successfully processed the logs.

```
1 User U1: [READER PROFILE] (Reads: 5, Writes: 0)
2 User U2: [WRITER PROFILE] (Reads: 0, Writes: 3)
```

Listing 2: Console Output: Constructed Artifacts

4 Exercise 2: Distributed Tracing Implementation

4.1 Sequence Diagram: Context Propagation

The core challenge was propagating the W3C Trace Context from the React Frontend to the Spring Boot Backend.

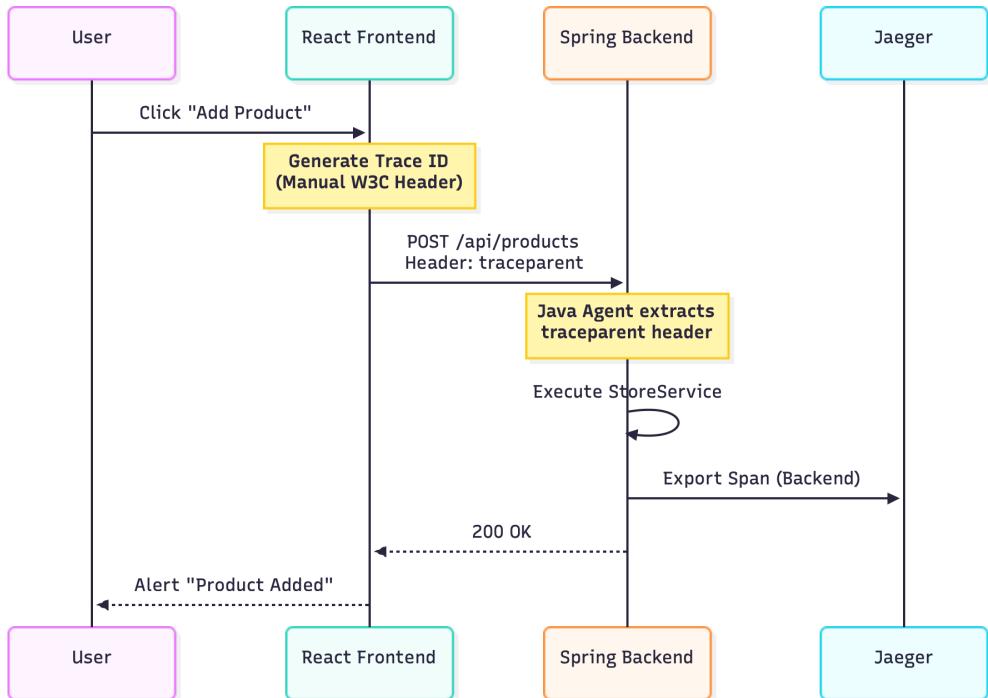


Figure 3: Sequence Diagram illustrating Manual Header Injection and Agent Extraction.

4.2 Frontend Implementation

We implemented manual header injection in React to bypass library version conflicts.

```

1 const generateTraceHeader = () => {
2     // Generates 00-{traceId}-{spanId}-01
3     return `00-${randomHex(32)}-${randomHex(16)}-01`;
4 };
5 // Used in fetch headers: 'traceparent': generateTraceHeader()

```

Listing 3: App.js: Manual Injection

5 Results and Screenshots

5.1 Application Interface

The React frontend allows simulating "Read" and "Write" scenarios.

Store Frontend (Simulation Mode)

Load Products Add Product

Figure 4: Frontend UI (React) running on localhost:3000.

5.2 Observability Results (Jaeger)

After executing the scenarios, traces were captured in Jaeger.

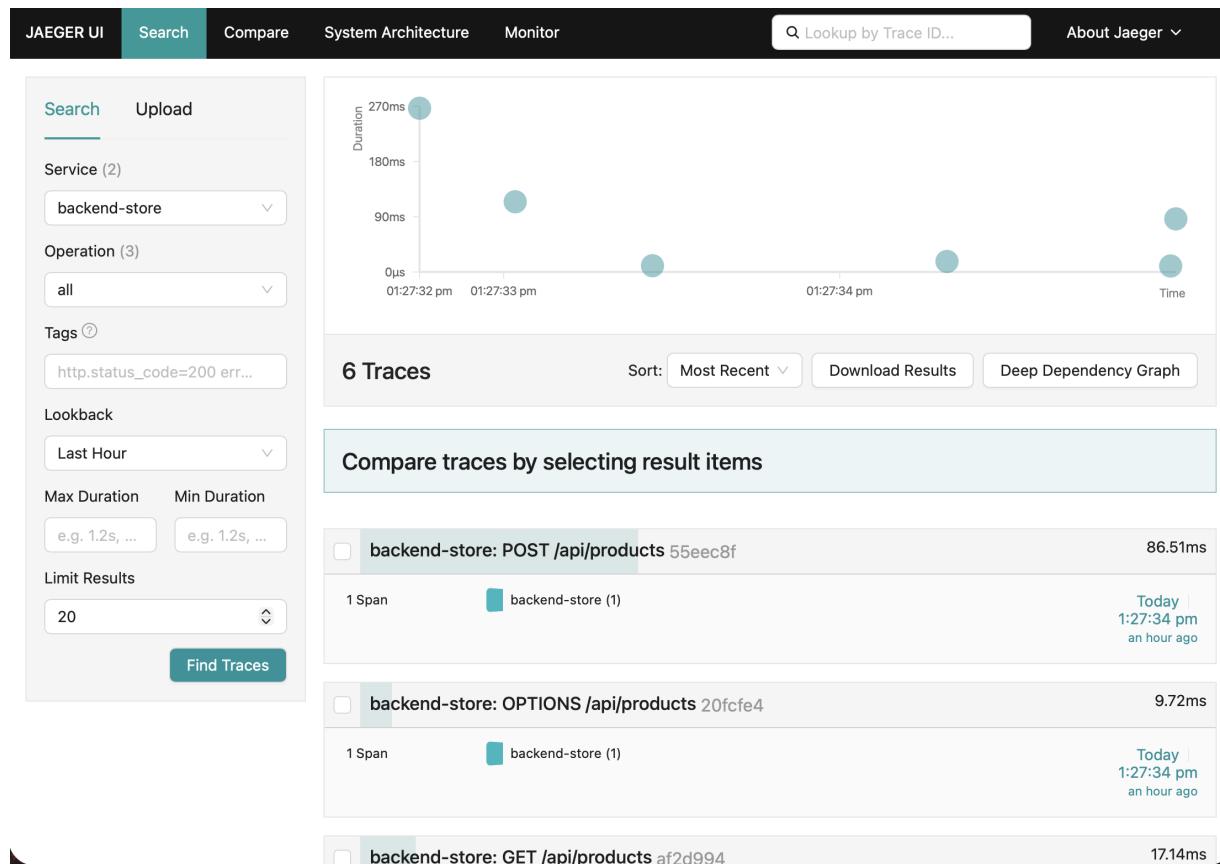


Figure 5: Jaeger UI showing traces captured for the 'backend-store' service.

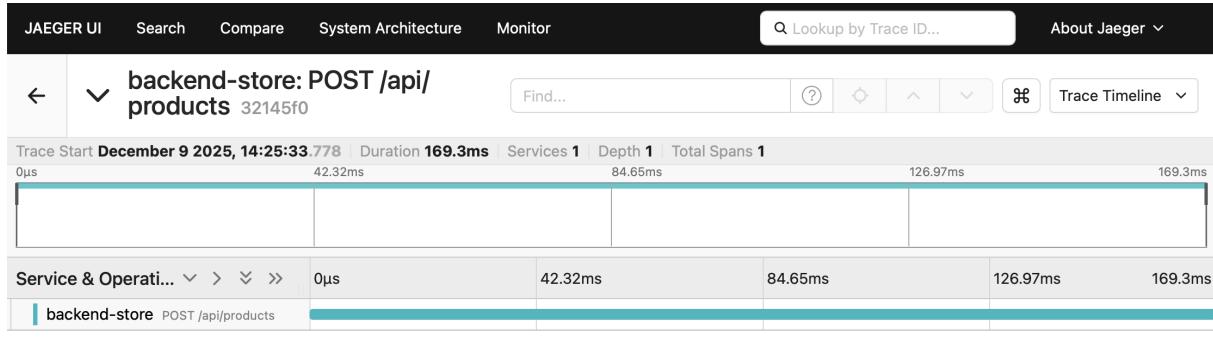


Figure 6: Detailed Trace View. The blue bar represents the Backend processing the request initiated by the Frontend.

6 Conclusion

The project successfully demonstrated that manual context propagation (Frontend) combined with auto-instrumentation (Backend) allows for complete visibility into distributed transactions, fulfilling the requirements of Exercise 2.

A Log Artifacts

```

1 {"timestamp": "2025-12-09...", "who": "U1", "what": "READ", "where": "getProduct", "metric": 1500.0}
2 {"timestamp": "2025-12-09...", "who": "U2", "what": "WRITE", "where": "addProduct", "metric": 20.0}

```

Listing 4: Snippet of generated application.log