Securaa Custom Utils – High Level Design

Document Information

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Executive Summary

The Securaa Custom Utils Service is a microservice designed to enable users to create, manage, and execute custom utility functions in a secure, multi-tenant environment. The service supports Python-based transformers and scripts, providing isolated execution environments through containerization while maintaining comprehensive audit trails and performance optimization.

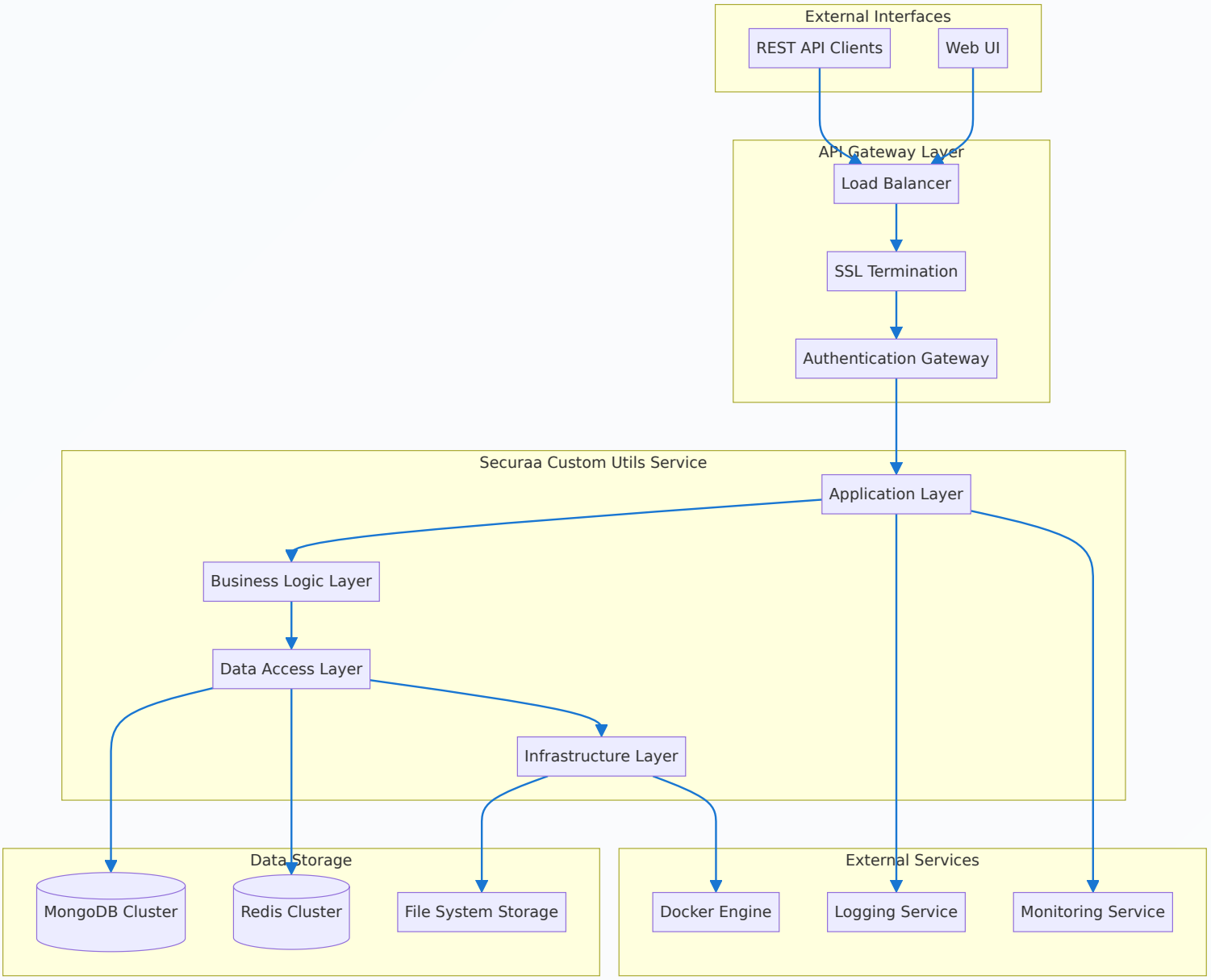
Key Business Value

- **Extensibility**: Allows users to create custom data processing utilities
- **Security**: Provides secure code validation and isolated execution
- **Multi-tenancy**: Supports multiple tenants with data isolation
- **Scalability**: Designed for high-volume, concurrent operations
- **Compliance**: Comprehensive audit logging for regulatory requirements

Solution Approach

- **Microservice Architecture**: Self-contained service with clear boundaries
- **Container-based Execution**: Docker containers for secure Python code execution
- **Multi-tier Caching**: Redis and in-memory caching for performance
- **Multi-tenant Data Model**: Isolated data storage per tenant
- **Event-driven Processing**: Asynchronous operations for non-critical tasks

System Overview



System Context

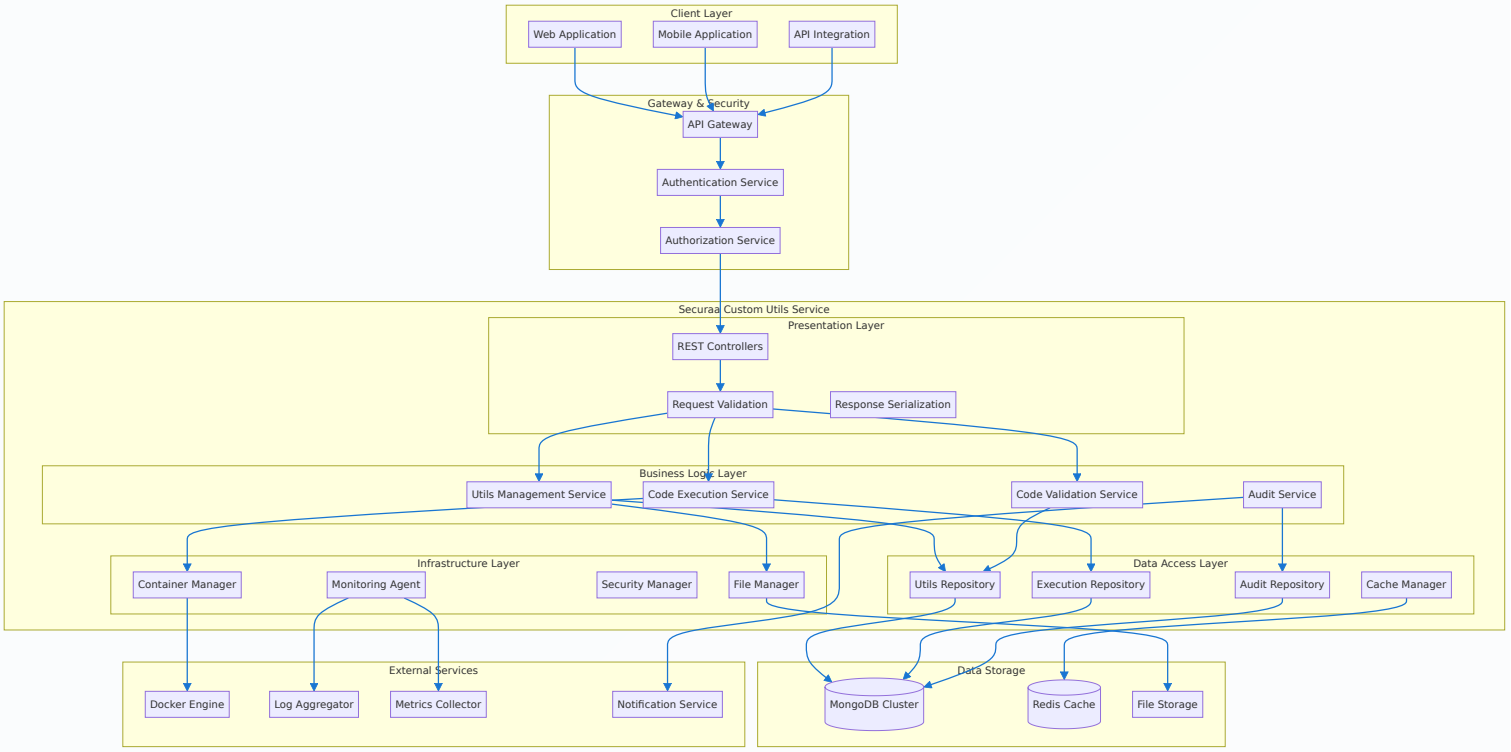
The Securaa Custom Utils Service operates within a larger ecosystem of microservices, providing custom utility management capabilities. It integrates with:

- **Authentication Services**: For user authentication and authorization
- **Tenant Management**: For multi-tenant configuration and isolation
- **Container Orchestration**: For isolated execution environments
- **Monitoring Infrastructure**: For observability and alerting
- **Storage Services**: For persistent data and file management

Solution Architecture

Architectural Principles

- **Microservice Architecture**: Independent, deployable, and scalable service
- **Domain-Driven Design**: Clear domain boundaries and responsibility
- **Event-Driven Architecture**: Asynchronous processing for better performance
- **Container-First Design**: Isolated execution environments
- **Multi-Tenant by Design**: Built-in tenant isolation and data security
- **API-First Approach**: RESTful APIs for all interactions



Component Architecture

Core Components

Utils Management Service

- **Purpose**: Manages custom utility lifecycle (CRUD operations)
- **Responsibilities**:
  - Create, read, update, delete utility definitions
  - Validate utility code and metadata
  - Manage utility versioning
  - Handle utility sharing and permissions
- **Key Features**:
  - Multi-tenant utility isolation

- Version control and rollback capabilities
- Code validation and syntax checking
- Dependency management

Code Execution Service

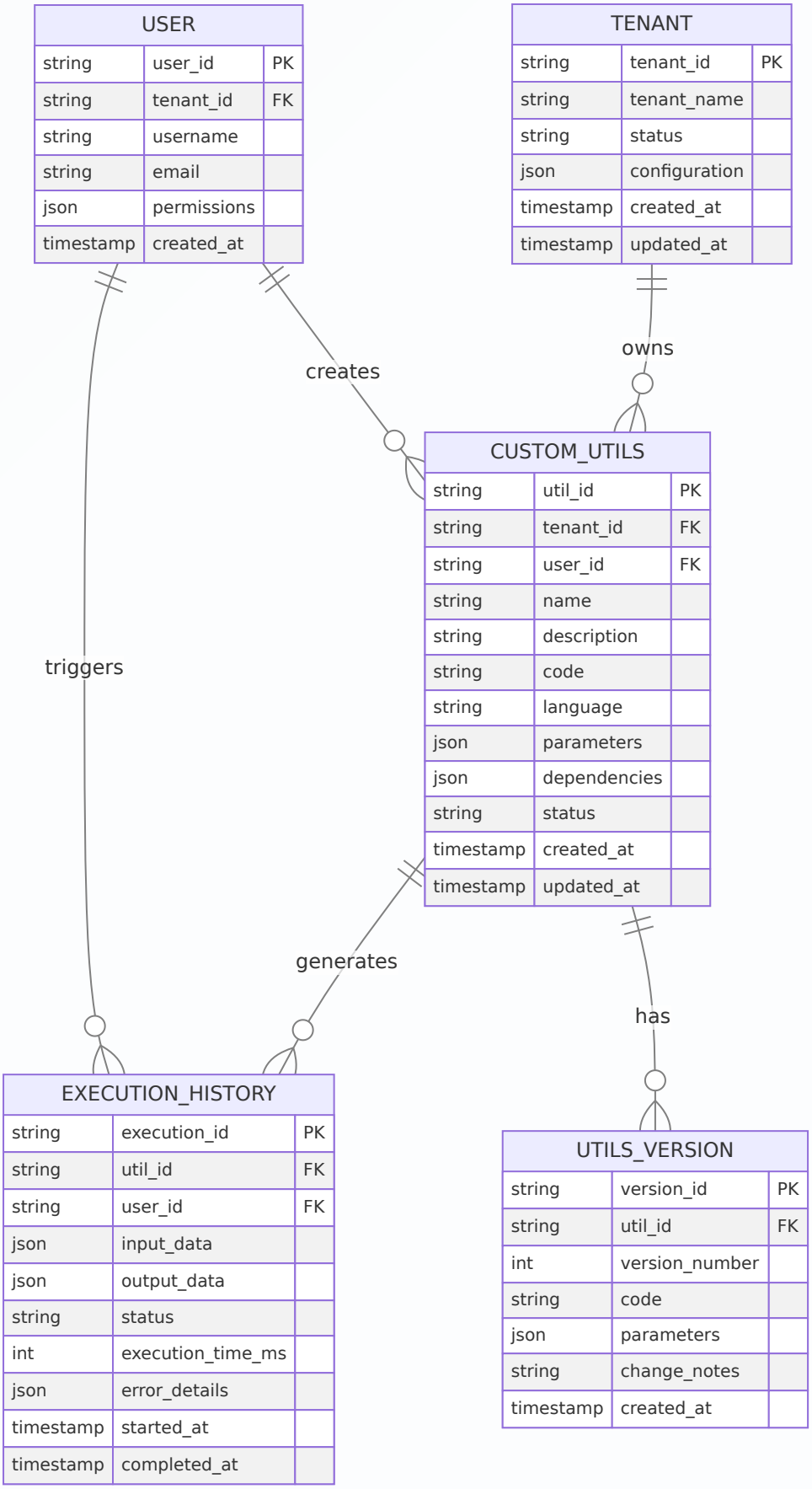
- **Purpose**: Executes utility code in isolated containers
- **Responsibilities**:
  - Create and manage execution containers
  - Execute Python code safely
  - Monitor execution performance
  - Handle execution results and errors
- **Key Features**:
  - Sandboxed execution environment
  - Resource limiting and monitoring
  - Timeout and error handling
  - Parallel execution support

Validation Service

- **Purpose**: Validates utility code for security and compliance
- **Responsibilities**:
  - Static code analysis
  - Security vulnerability scanning
  - Compliance checking
  - Performance impact assessment
- **Key Features**:
  - AST-based code analysis
  - Blacklisted function detection
  - Resource usage prediction
  - Security rule enforcement

Data Architecture

Data Model Overview



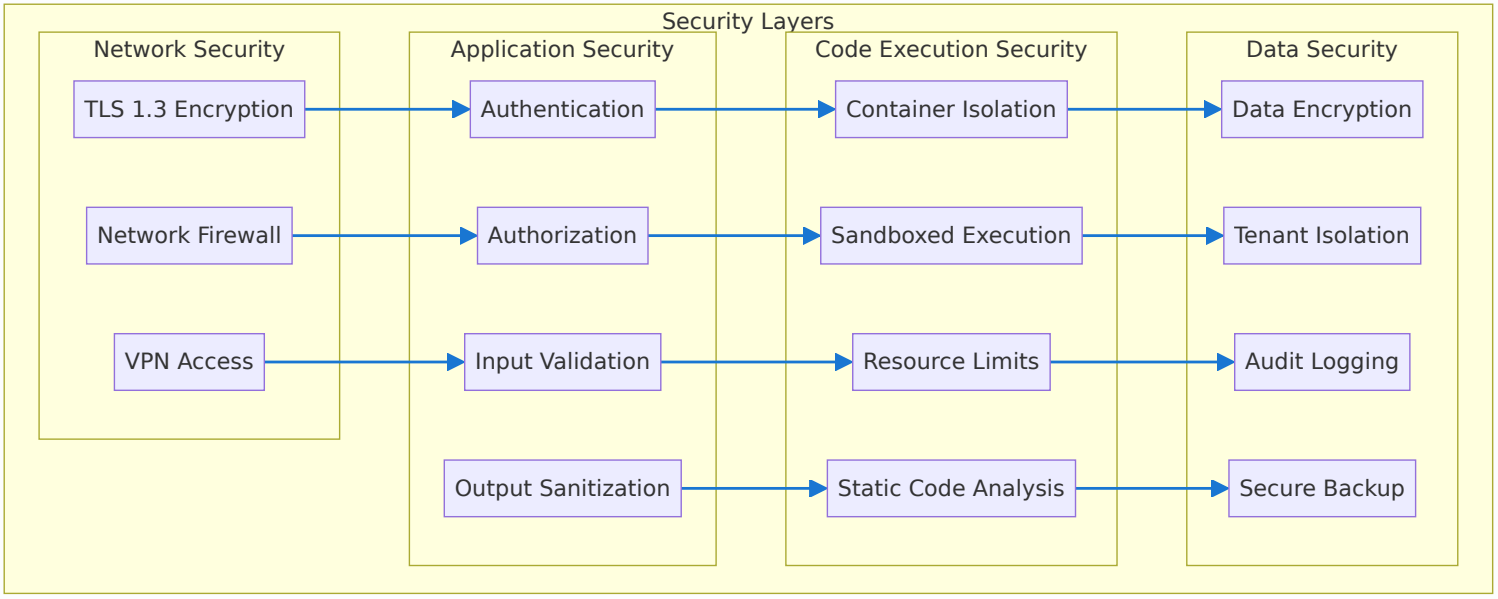
Data Storage Strategy

- **Primary Data Store**: MongoDB for flexible document storage
- **Caching Layer**: Redis for frequently accessed data

- **File Storage**: File system or object storage for large utility code files
- **Multi-tenancy**: Database-level tenant isolation with tenant-specific collections

Security Architecture

Security Layers

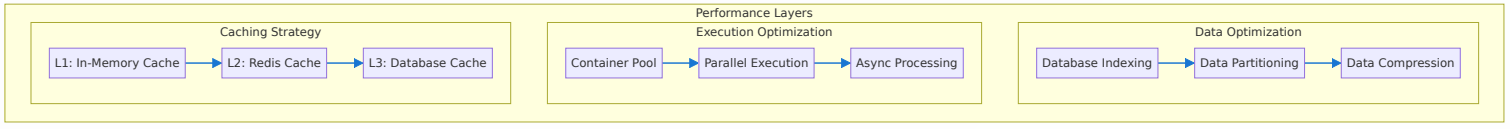


Code Execution Security

- **Container Isolation**: Each utility execution runs in a separate Docker container
- **Resource Limits**: CPU, memory, and execution time limits enforced
- **Network Isolation**: Containers have no network access by default
- **File System Restrictions**: Read-only file system with limited write access
- **Security Scanning**: Static analysis before execution

Performance Architecture

Performance Optimization Strategies

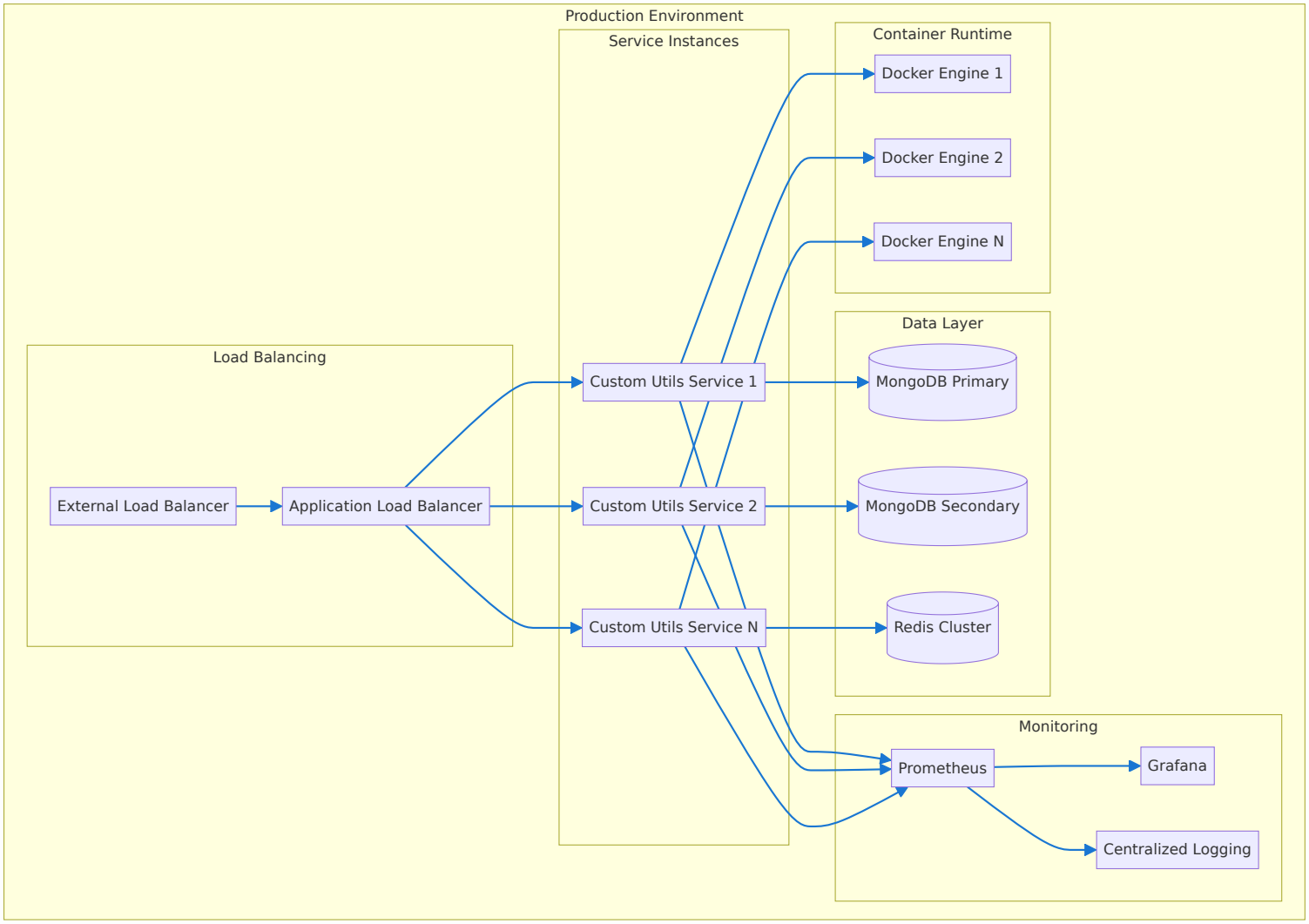


Scalability Considerations

- **Horizontal Scaling**: Multiple service instances behind load balancer
- **Container Pool Management**: Pre-warmed containers for faster execution
- **Database Sharding**: Tenant-based data distribution
- **Async Processing**: Non-blocking execution for long-running utilities
- **Resource Monitoring**: Real-time performance tracking and alerting

Deployment Architecture

Deployment Strategy



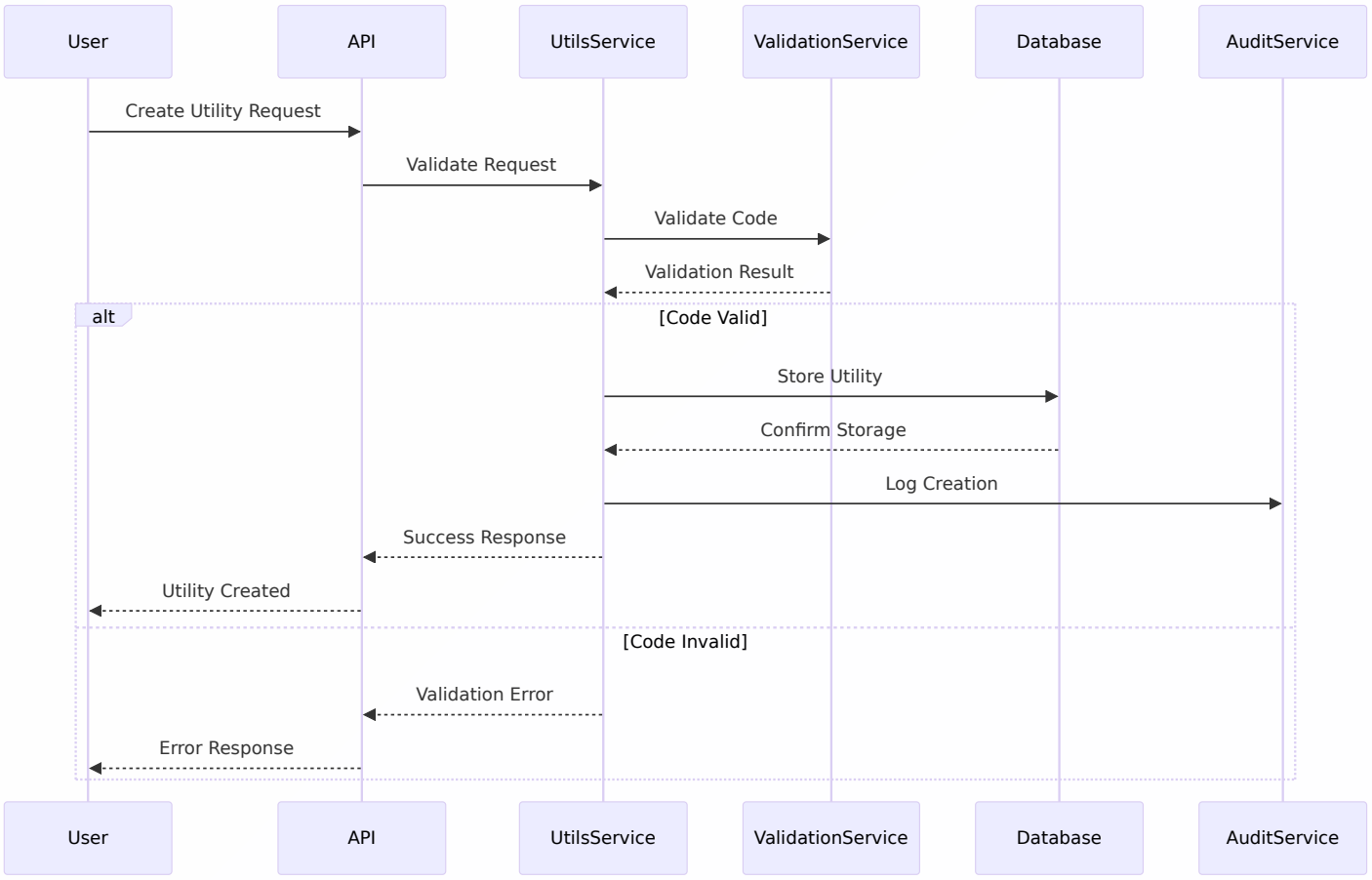
Infrastructure Requirements

- **Compute Resources**: CPU and memory allocation for service and container execution
- **Storage**: Persistent storage for database and file storage

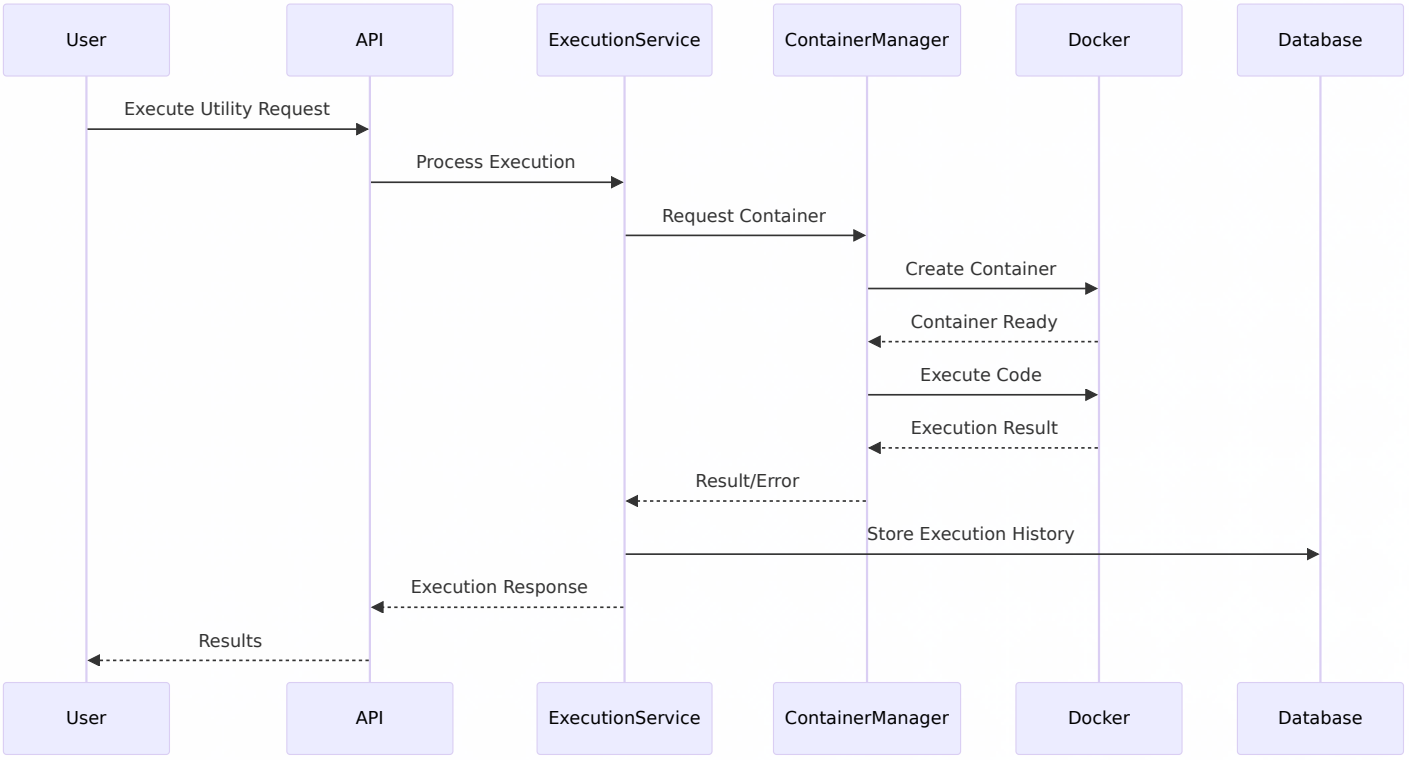
- **Network**: Low-latency network for inter-service communication
- **Security**: Network segmentation and access controls
- **Monitoring**: Comprehensive observability and alerting

Process Flows

Utility Creation Flow



Utility Execution Flow



Conclusion

The Securaa Custom Utils Service provides a robust, secure, and scalable platform for custom utility management and execution. The architecture emphasizes security through container isolation, performance through multi-tier caching, and scalability through microservice design patterns.

Key architectural benefits include:

- Secure code execution in isolated environments
- Multi-tenant data isolation and security
- Scalable microservice architecture
- Comprehensive audit and monitoring capabilities
- High availability and fault tolerance