KEA

(Kubernetes Empowerer to API)

Requirements and analysis model

Product description

The product is a platform for deploying, managing, and scaling machine learning models in production. It offers a secure, flexible environment for automating ML tasks like model versioning, routing, and monitoring. With Kubernetes integration and containerization support, it's designed for developers, ML engineers, and enterprises needing scalable, reliable ML infrastructure.

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Project repo: https://github.com/fanglores/Advanced-Software-Design

This report: https://github.com/fanglores/Advanced-Software-Design/blob/master/Practice%20Tasks/Final_Task/K8C_FinalTask1_(Task8).pdf

Roles

ML Engineer

Description: This role joins professionals involved in the development, deployment, and monitoring of ML models. They want to simplify the deployment process, automate API documentation, and ensure efficient request validation and caching, ultimately enhancing their workflow and model performance.

API Consumer

Description: This role includes all users interacting with APIs to integrate ML models into their applications. They want to access reliable and well-documented APIs, enabling seamless integration of ML models into their business applications and ensuring optimal performance and usability.

Personas

ML Engineer (Maria, 32 years old)

Goals:

- Deploy and version ML models in Kubernetes.
- Automatic deploy and further documentation.
- Flexibility for different ML frameworks.

Pain points:

- Manual API documentation.
- Difficulties in monitoring model performance.

Backend Developer (Alexander, 28 years old)

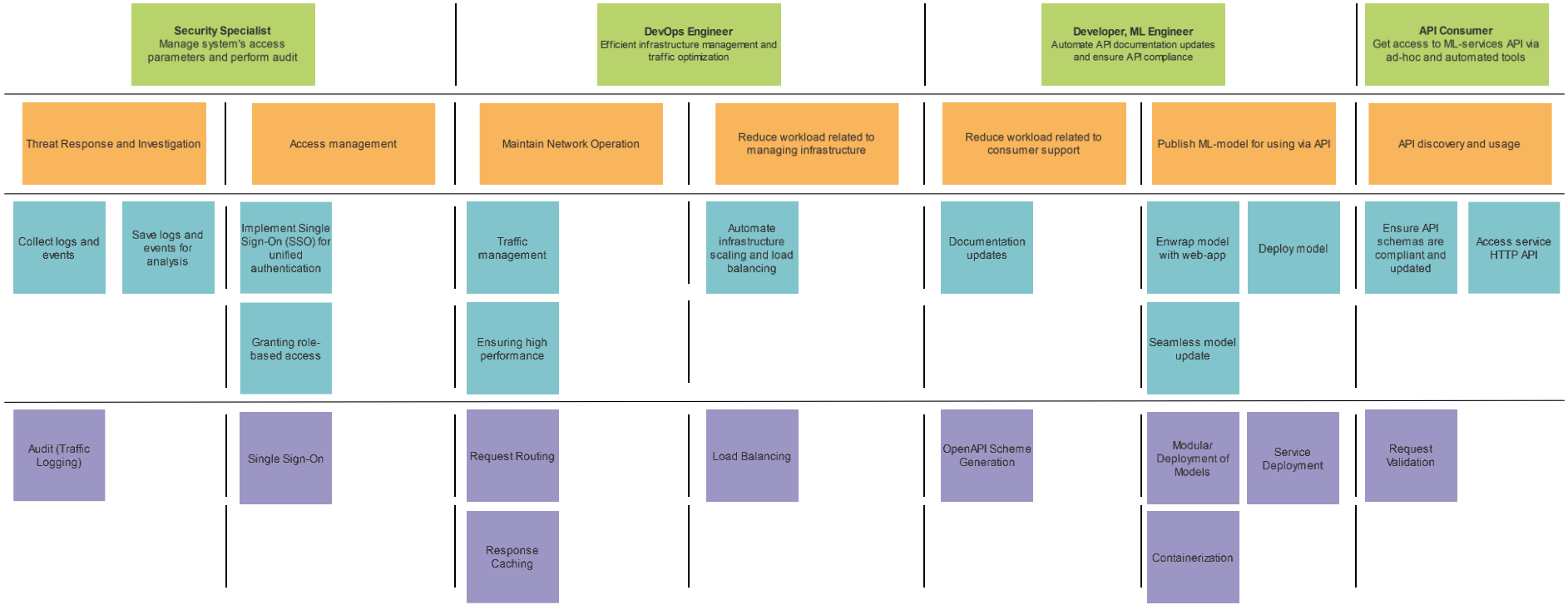
Goals:

- Integration of the API gateway into existing infrastructure.
- Use automatic OpenAPI schema generation.
- Manage access rules.
- Scalable and secure deployment of ML models.

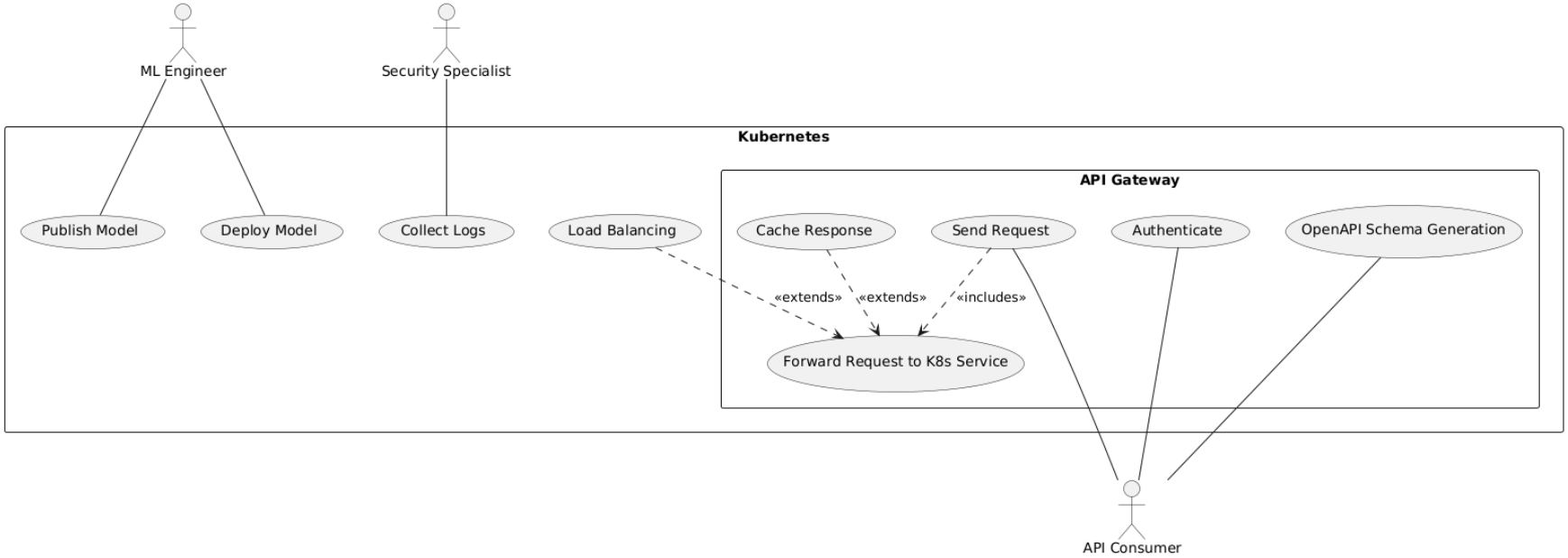
Pain points:

- Incomplete or outdated API documentation.
- Challenges with integrating authorization and managing access control.
- Challenges with integration and corporate standards.

Story map


Security Specialist
Manage system's access parameters and perform audit
DevOps Engineer
Efficient infrastructure management and traffic optimization
Developer, ML Engineer
Automate API documentation updates and ensure API compliance
API Consumer
Get access to ML-services API via ad-hoc and automated tools
Threat Response and Investigation
Access management
Maintain Network Operation
Reduce workload related to managing infrastructure
Reduce workload related to consumer support
Publish ML-model for using via API
API discovery and usage
Collect logs and events
Save logs and events for analysis
Implement Single Sign-On (SSO) for unified authentication
Granting role-based access
Traffic management
Ensuring high performance
Automate infrastructure scaling and load balancing
Documentation updates
Enwrap model with web-app
Deploy model
Seamless model update
Ensure API schemas are compliant and updated
Access service HTTP API
Audit (Traffic Logging)
Single Sign-On
Request Routing
Response Caching
Load Balancing
OpenAPI Scheme Generation
Modular Deployment of Models
Containerization
Service Deployment
Request Validation

Use case diagram

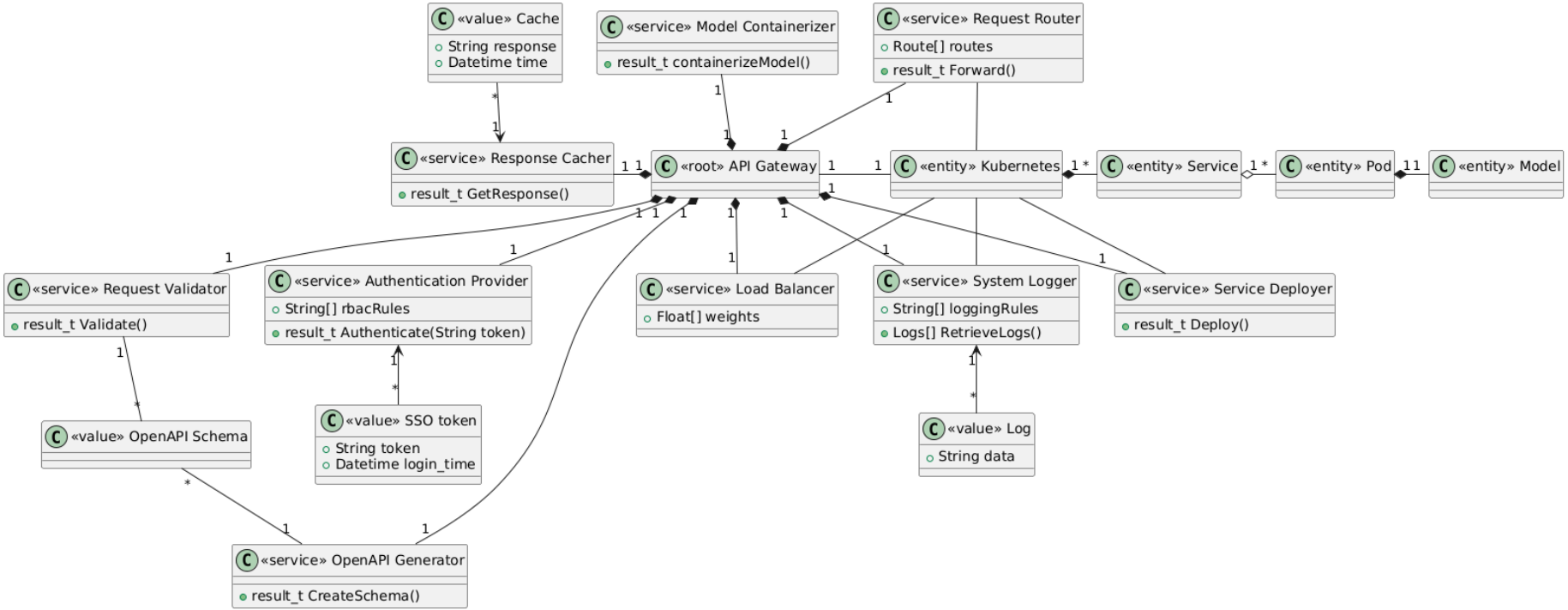


https://github.com/fanglores/Advanced-Software-Design/tree/master/General/UseCases

Interaction analysis

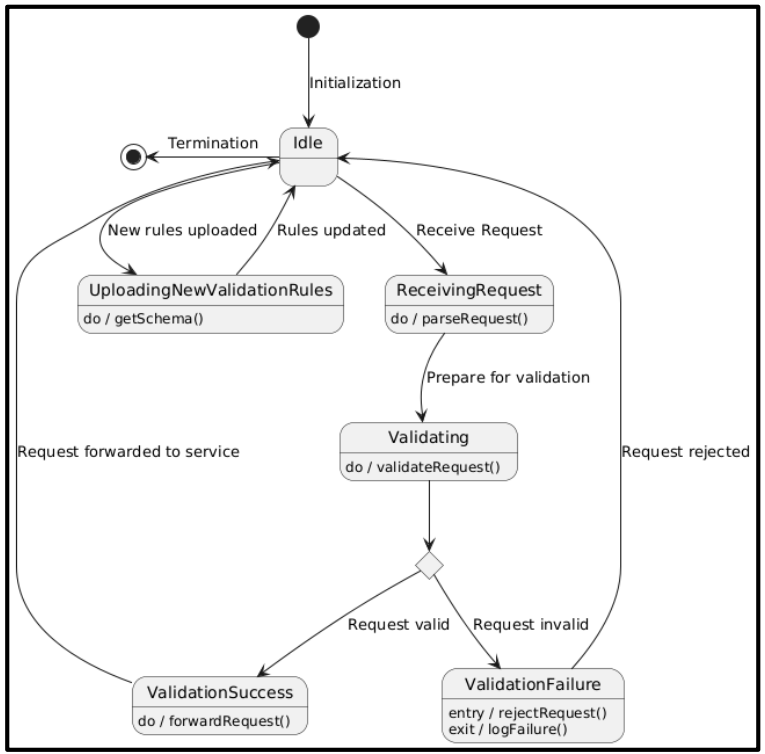
Use Case	Cooperation Name	Used Roles	Candidate Classes
Forward Request	Route Request	Router, Request, Receiver	Request Router, Request, K8s
Load Balancing	Distribute Load	Load balancer, weights, ML sevices	Load Balancer, K8s, Pod, ML Service
Authenticate	Validate Authentication	Request, Authenticator, SSO Keys	Authentication Provider, SSO Key, Request
Cache Response	Cache Responses	Request, Response, Cache, Cache validator	Response Cacher, Cache, Request, Response
Collect Logs	Log System Events	Logger, Log, ML service, API Gateway	System Logger, Log, ML Service, API Gateway
Deploy Model	Deploy Service	Deployer, K8s, Pod, ML service	Service Deployer, Pod, K8s, ML Service
Publish Model	Containerize Model	Containerizer, Pod, K8s, ML model	Model Containerizer, Pod, K8s, ML Service
OpenAPI Schema Generation	Generate API Definition	ML service, OpenAPI schema, Generator	OpenAPI Generator, OpenAPI Schema, ML Service

Final class diagram

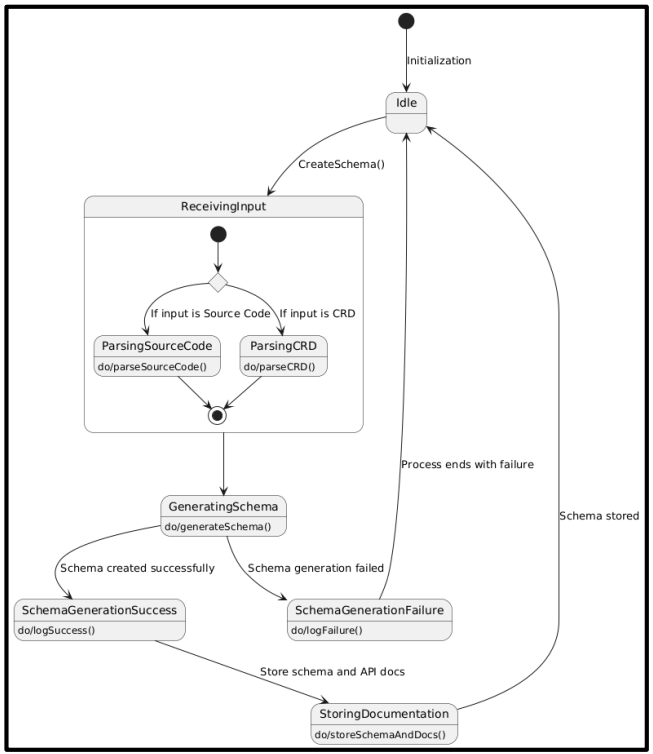


Detailed behaviour

Request Validator

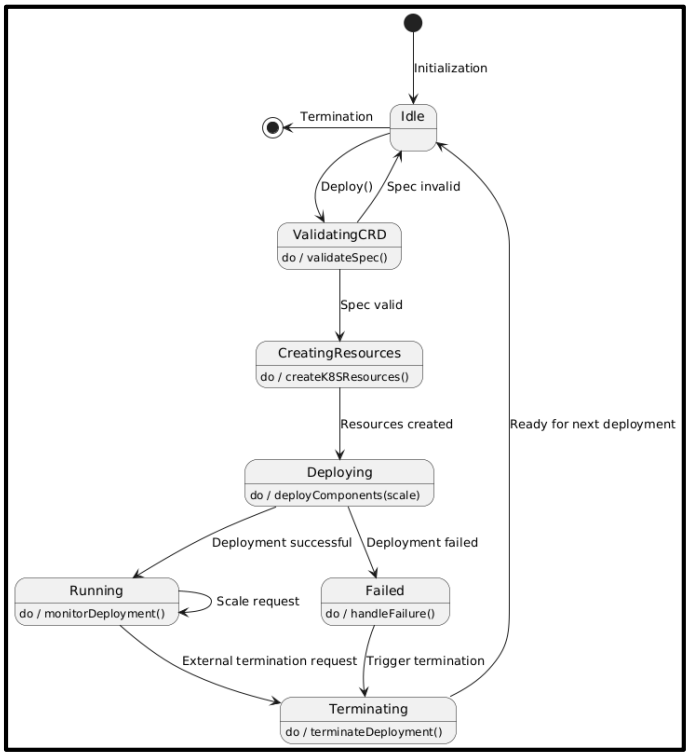


OpenAPI Schema Generator

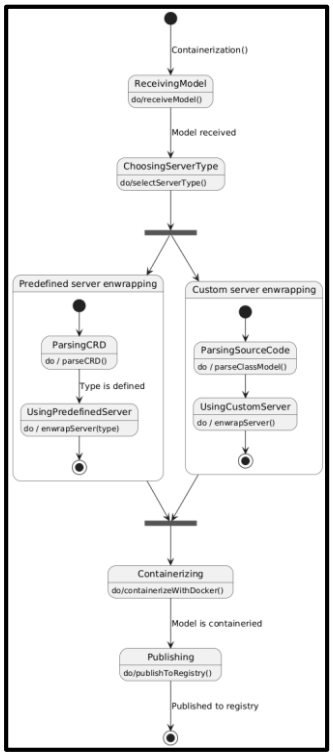


Detailed behaviour

Service Deployer



Model Containerizer



Repository structure

Repository structure

```
.
├── product_img.jpg
├── README.md
├── General/
│   ├── Domain_description_en.md
│   ├── Task_description_en.md
│   ├── DFD0/
│   ├── StoryMap/
│   └── UseCases/
└── Practice Tasks/
    ├── Final_Task/
    ├── Task_1/
    ├── Task_2/
    ├── Task_3/
    ├── Task_4/
    ├── Task_5/
    ├── Task_6/
    └── Task_7/
```

Tools Used:

- Github
- Drawio
- Planttext

Team and roles

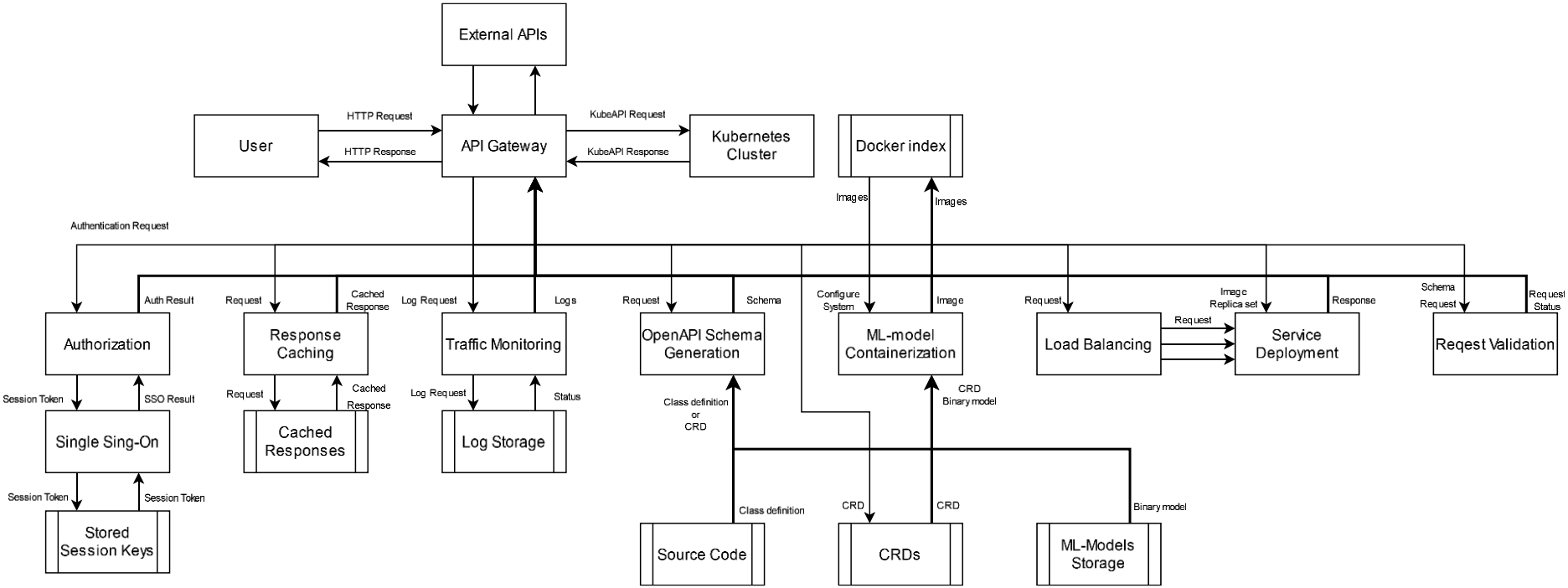
Roles, Personas, Story Map, CRC Cards	Use cases, Interactions Analysis	DFD, Classes Diagram, Repository Management	Domain analysis, Story Map, Behavior model
Tsurkan Daniel Tg: @crazy_deyzi	Dandamaev Gadji Tg: @dandamaev	Tsaturyan Konstantin Tg: @fanglores	Smolkin Mikhail Tg: @m0hnatik

Thanks for attention!

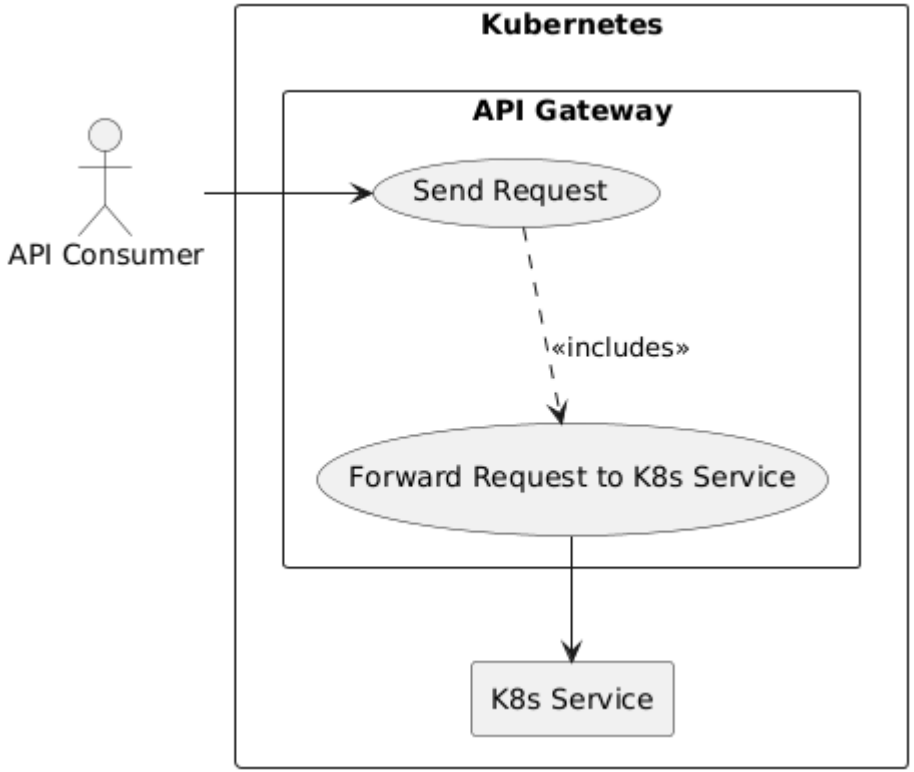
Now we are ready to answer your questions!

Extra slides

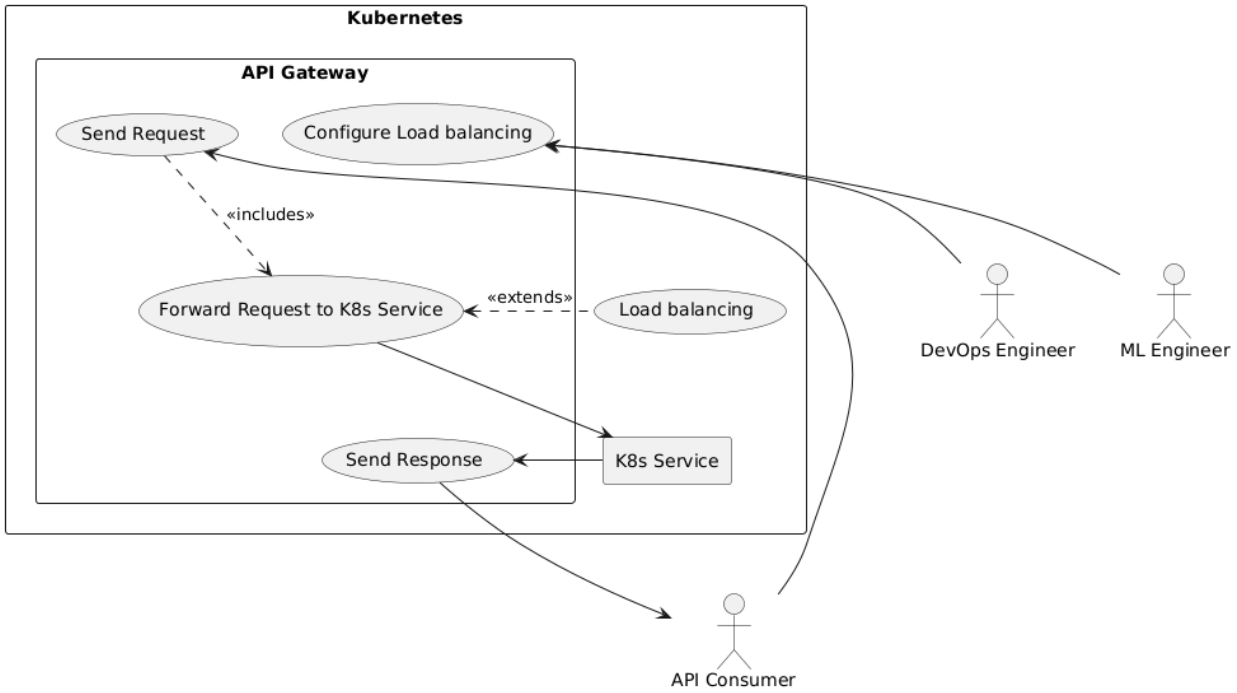
DFD (Level 0)


External APIs
User
HTTP Request
HTTP Response
API Gateway
KubeAPI Request
KubeAPI Response
Kubernetes Cluster
Docker index
Images
Images
Authentication Request
Auth Result
Request
Cached Response
Log Request
Logs
Request
Schema
Configure System
Image
Request
Image Replica set
Response
Schema Request
Request Status
Authorization
Response Caching
Traffic Monitoring
OpenAPI Schema Generation
ML-model Containerization
Load Balancing
Request
Service Deployment
Reqest Validation
Session Token
SSO Result
Request
Cached Response
Log Request
Status
Class definition or CRD
CRD Binary model
Single Sing-On
Cached Responses
Log Storage
Session Token
Session Token
Class definition
CRD
CRD
Binary model
Stored Session Keys
Source Code
CRDs
ML-Models Storage

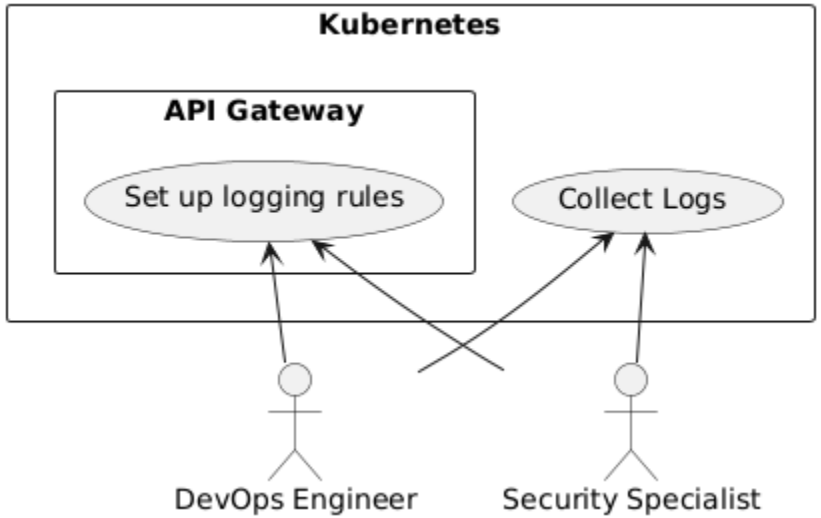
Use Cases: Requests routing



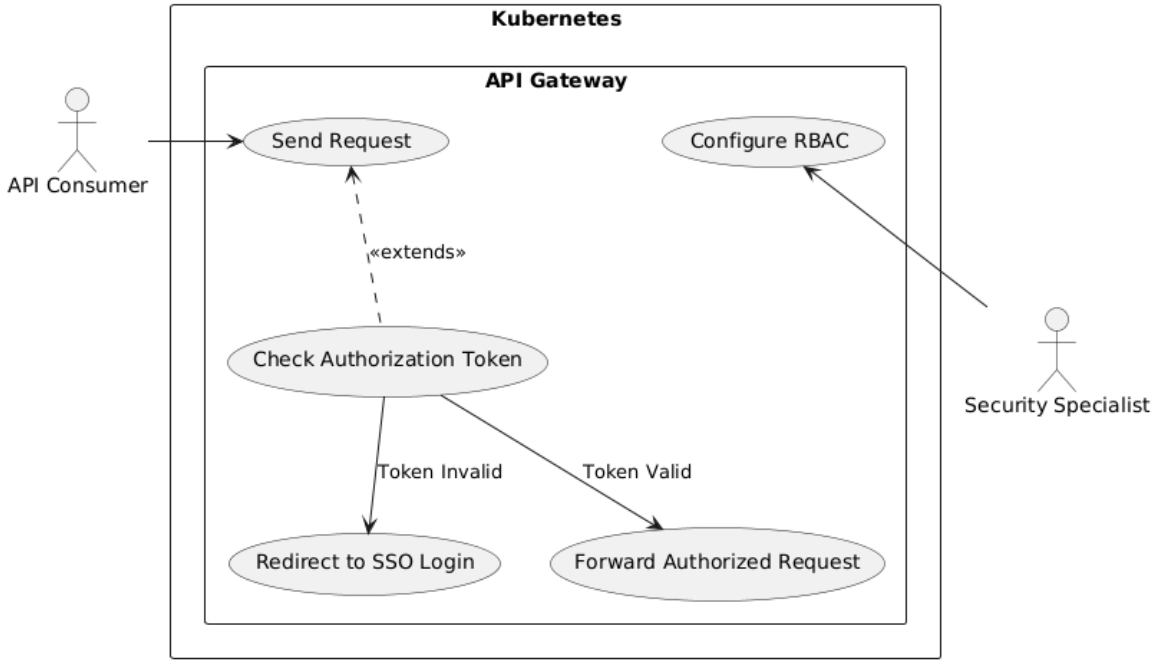
Use Cases: Load balancing



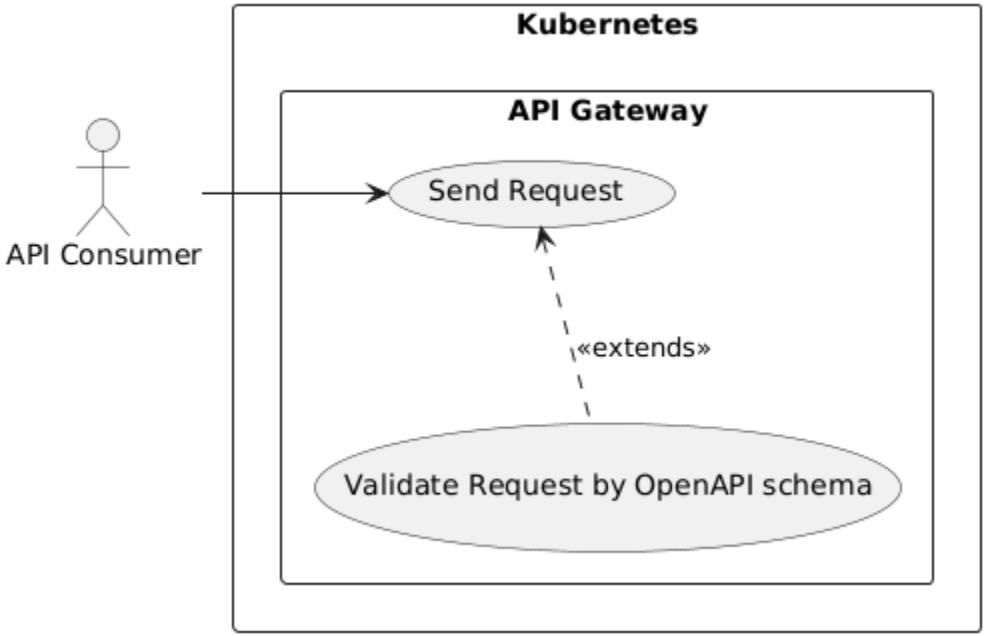
Use Cases: Audit and Logging



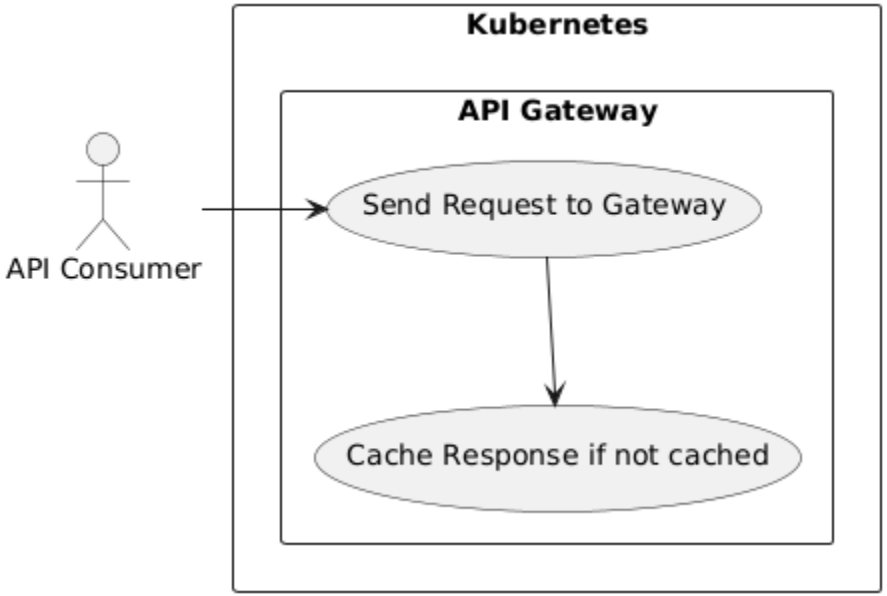
Use Cases: Authorization (SSO)



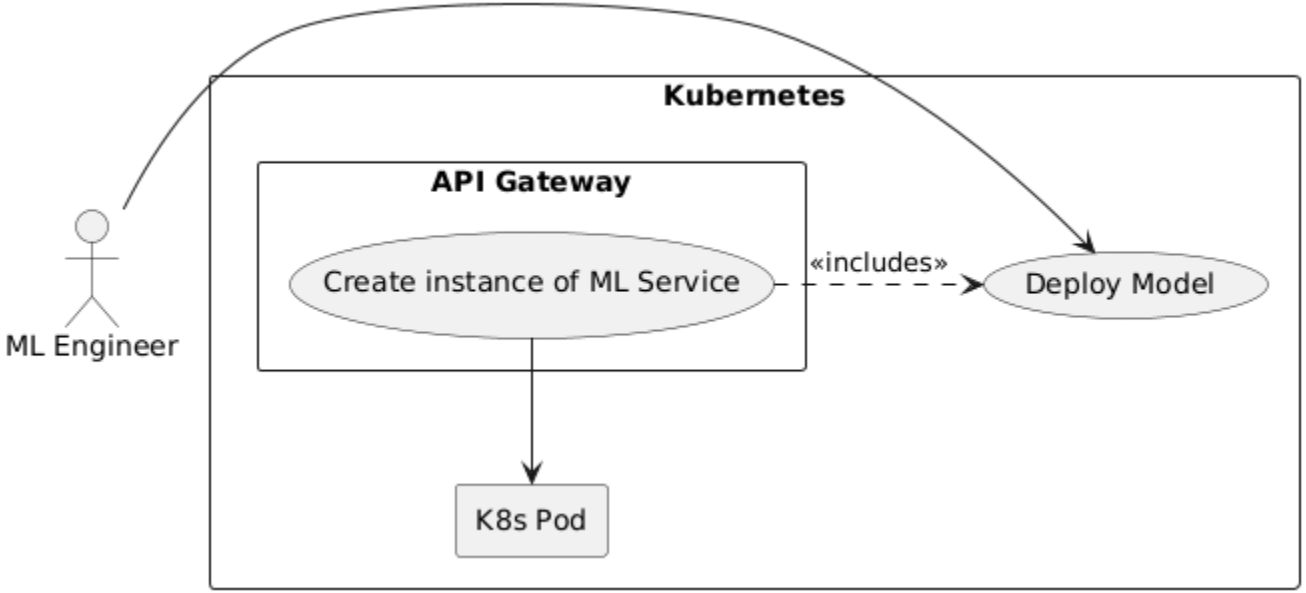
Use Cases: Request Validation



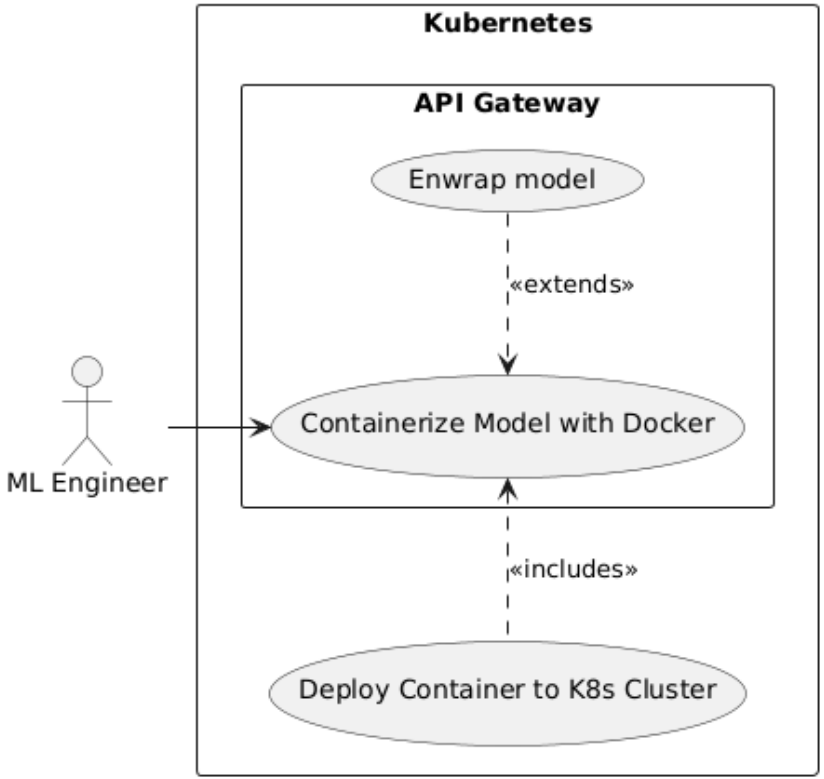
Use Cases: Responses Caching



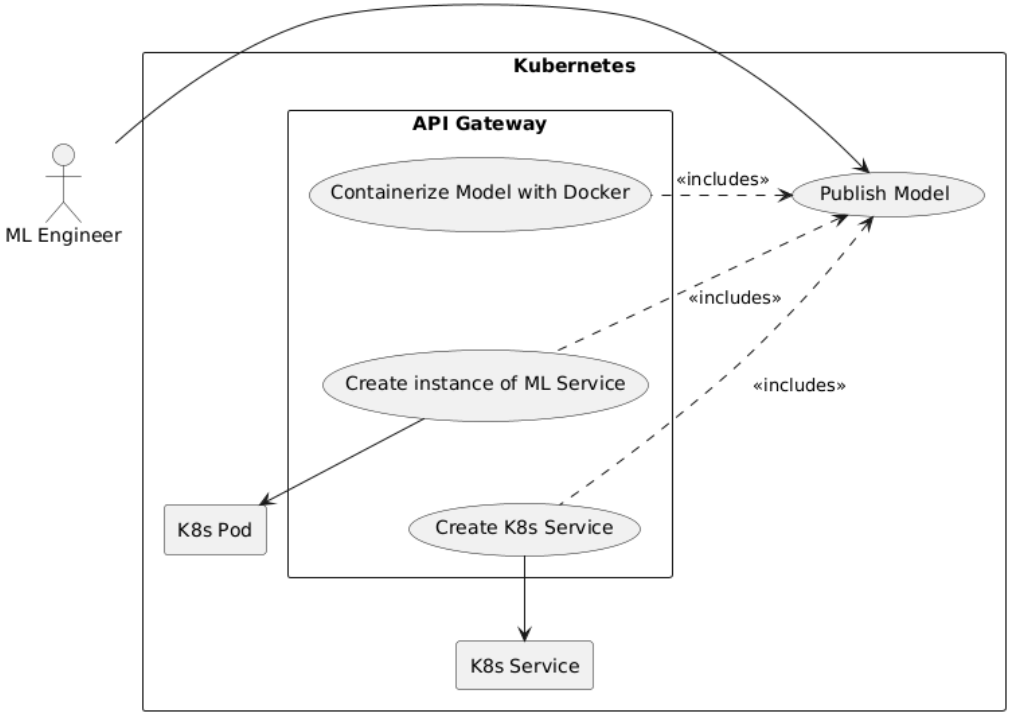
Use Cases: Modular Deployment of Models



Use Cases: Containerization



Use Cases: Service Deployment



Use Cases: Auto-Documentation