The renewed PaaS Orchestration system architecture

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PIANO NAZIONALE DI RIPRESA E RESILIENZA
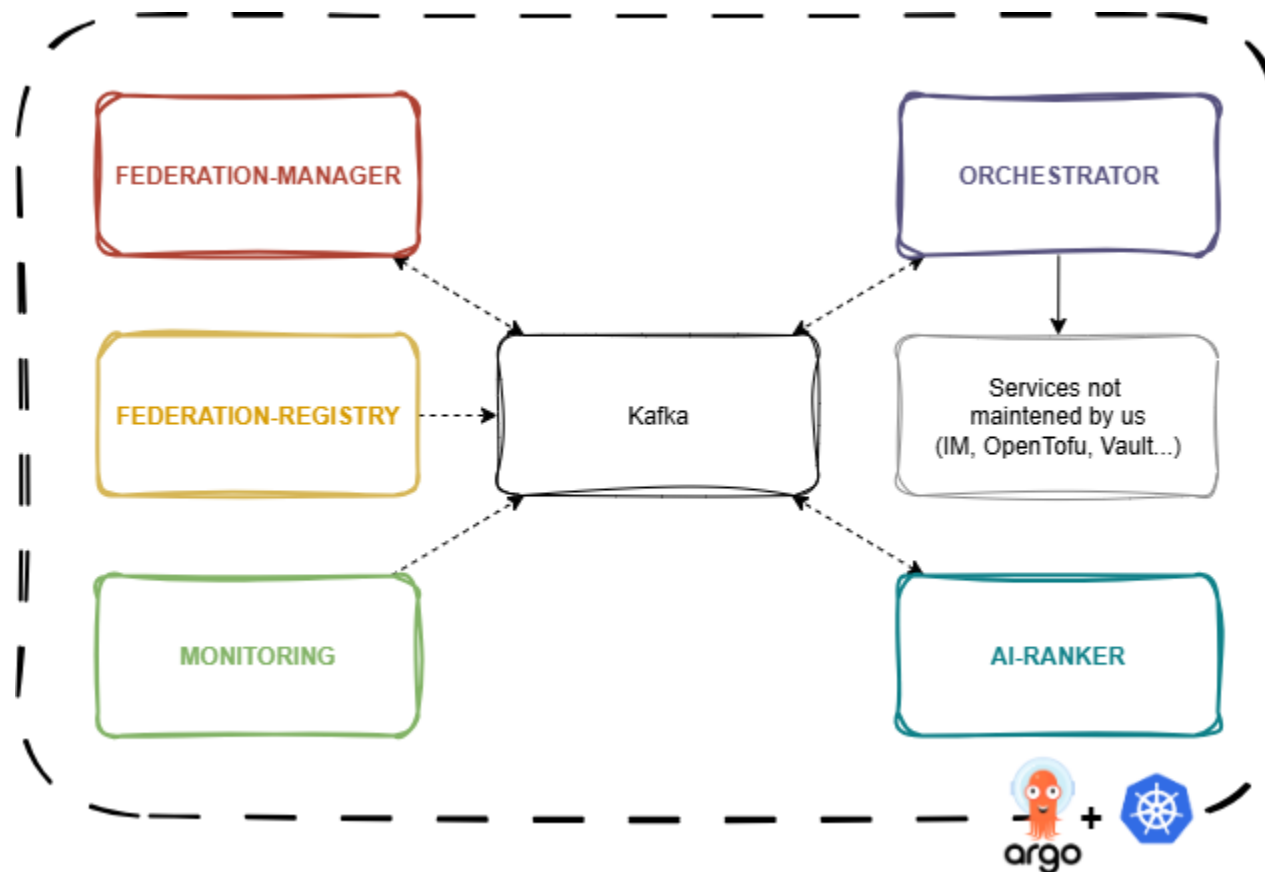
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Starting point
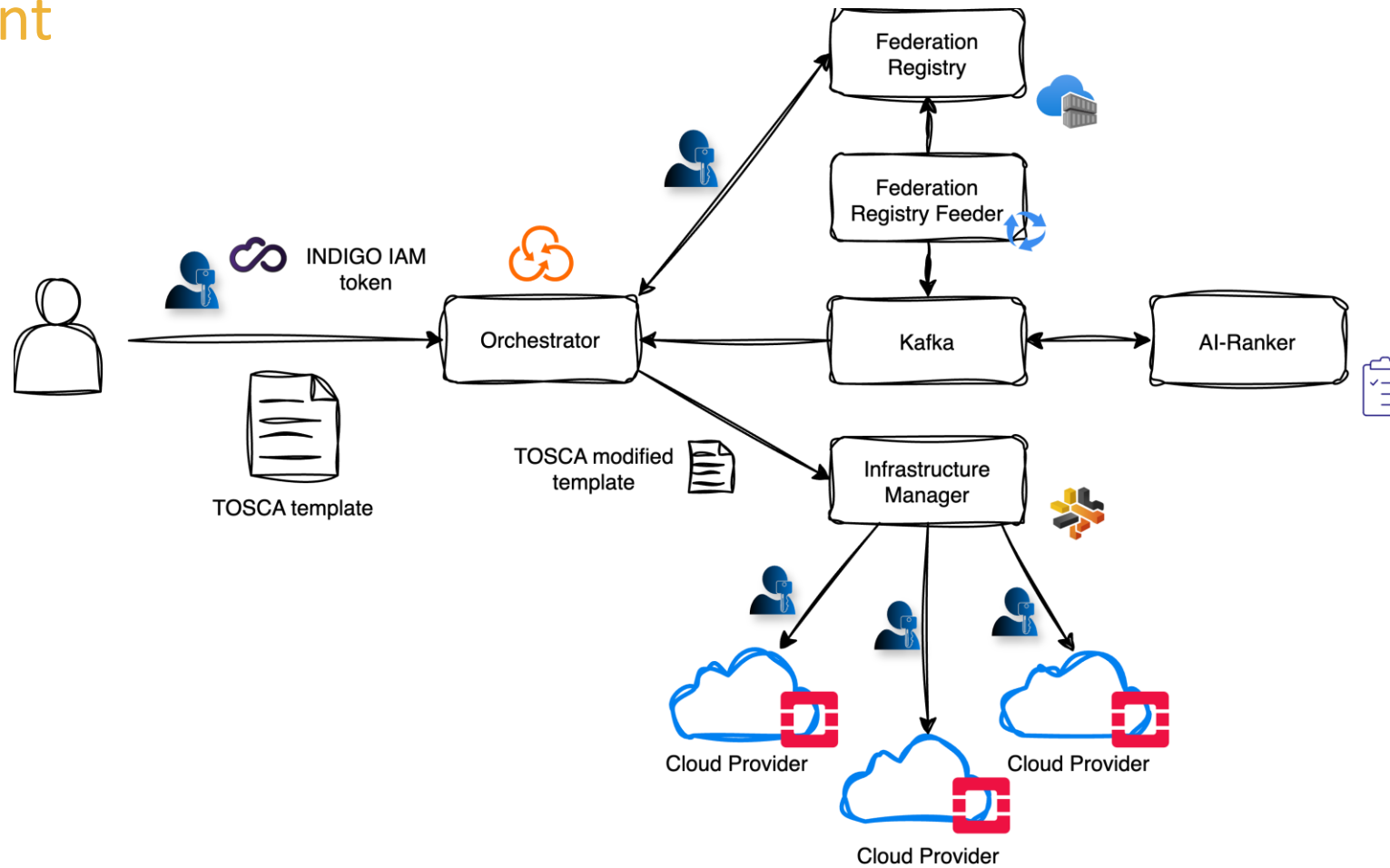
Final destination

- Kafka
- Federation-Manager
- Federation-Registry
- Monitoring
- AI-Ranker
- Orchestrator
- Other services (not developed by us)
- Kubernetes cluster + ArgoCD

Kafka

Tool used to collect data to share among the micro-services and trigger automated tasks
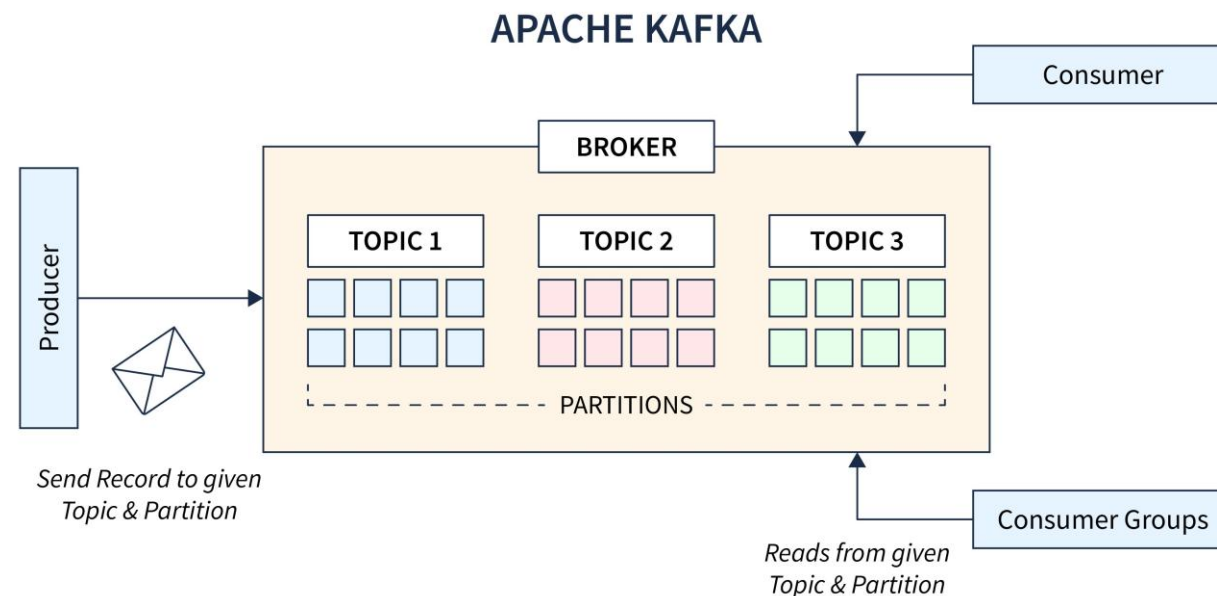
Requirements:

➢ High Availability

Execution plan:

➢ Documentation

➢ Ansible role

➢ Deployment in production

➢ Define message retention time in topics

➢ Evaluate data dump on S3 storage for topics

Known or possible problems:

➢ How to manage region replication/disaster recovery?

APACHE KAFKA

Send Record to given Topic & Partition

Reads from given Topic & Partition
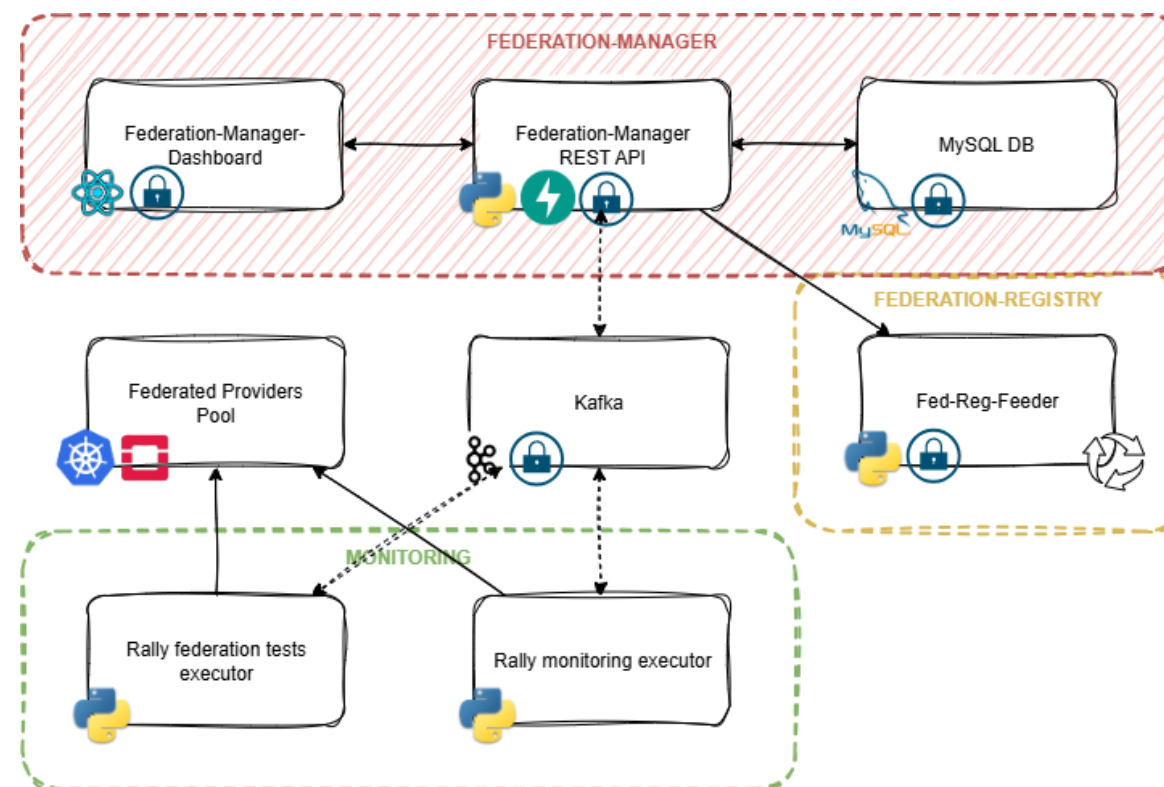
Federation-Manager

Micro-service used to manage the provider federation procedure and new scientific groups on boarding

Requirements:

➢ Kafka

➢ OPA

Execution plan:

➢ Federation-Manager-Dashboard implementation

➢ Federation-Manager REST API implementation
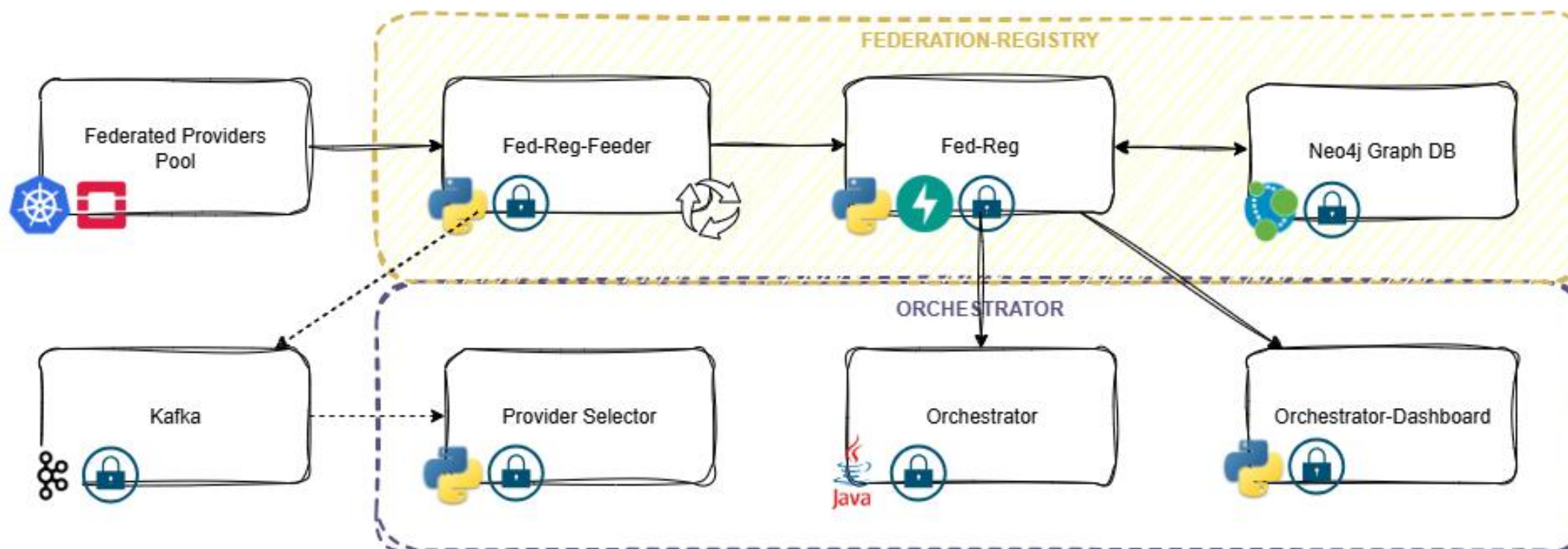
➢ Dedicated topics on Kafka

➢ Documentation

Federation-Registry (State of the Art)

Micro-service used to store federated provider configurations and SLAs details

Federation-Registry (Target architecture)

Micro-service used to store federated provider configurations and SLAs details
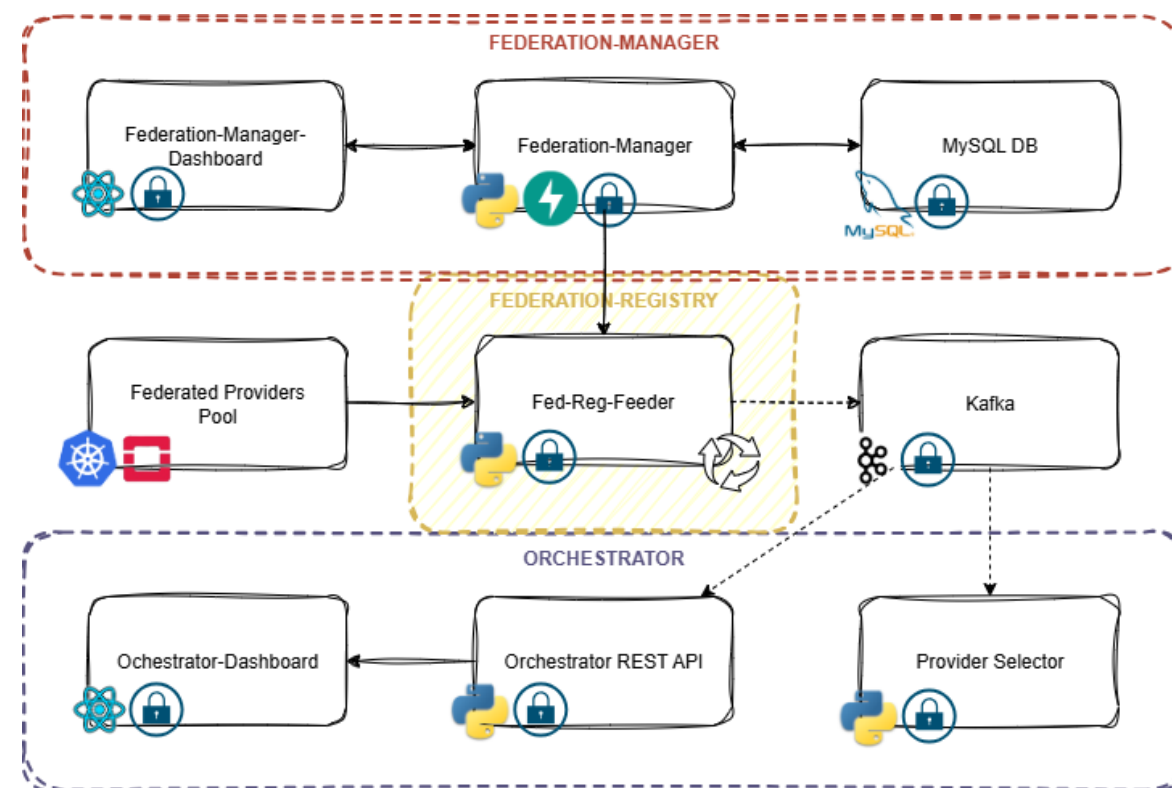
Requirements:

➢ Federation-Manager (currently using YAML files)

➢ Access to federated providers
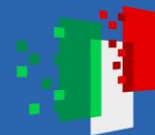 ➢ Currently using **OIDC-Agent** and **ops** user.

Execution plan:

➢ Fed-Reg-Feeder: Complete support for Kubernetes clusters

➢ Fed-Reg-Feeder: Read configuration details from Fed-Mgr

➢ Fed-Reg-Feeder: Add support for RadosGW providers

➢ Fed-Reg-Feeder: Add support for Rucio services

➢ Remove Federation-Registry and Neo4j DB

Known or possible problems:

➢ Long running tokens used by the feeder generate problems with the application (restart required)

➢ OIDC-Agent needs account re-authentication (Client-credentials instead of user-based acces to federated providers?)

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Monitoring (Federated resources)

Set of tools to monitor federated providers status and collect usage metrics
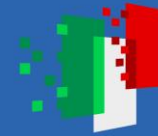
Requirements:

➢ Access to federated providers

➢ Kafka

Execution plan:

➢ Rally federation tests executor implementation

➢ Rally monitoring executor implementation

➢ Metrics collector design and implementation

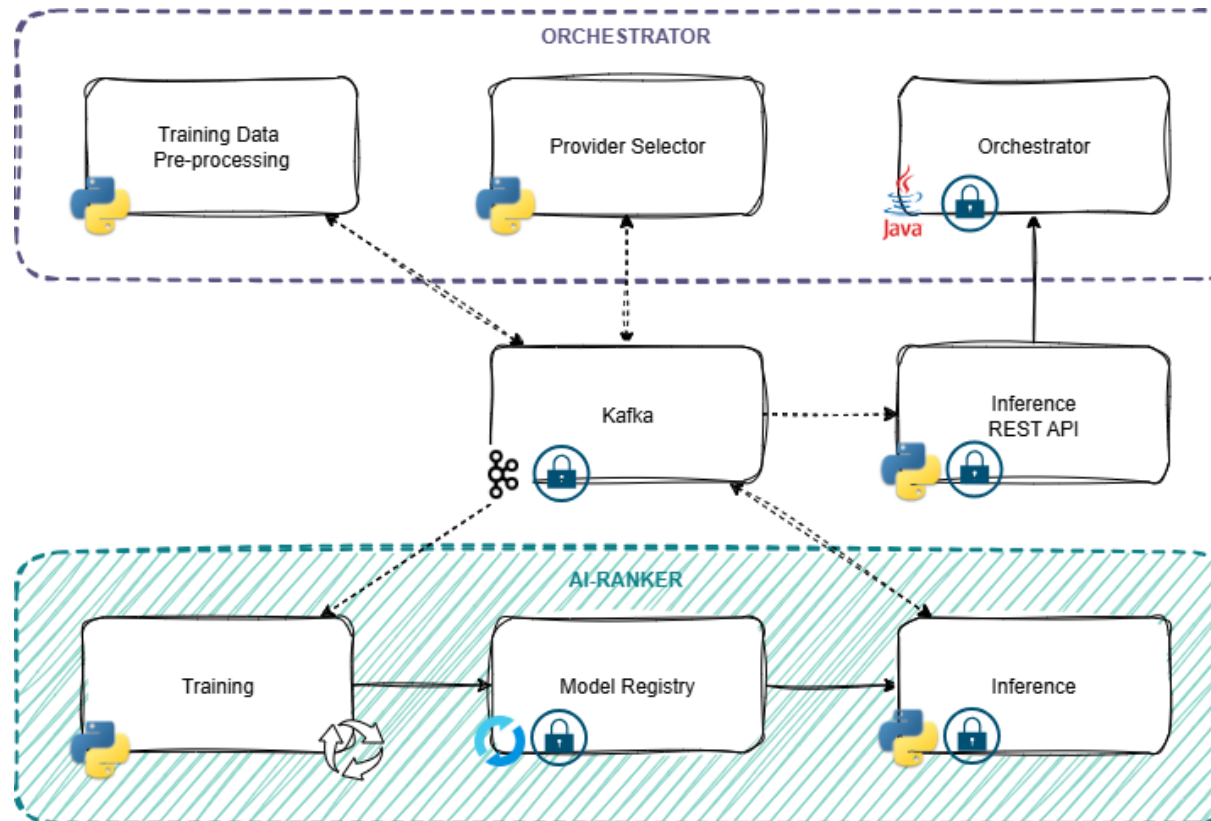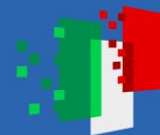➢ InfluxDB installation and configuration

➢ WP1 Graphana connection
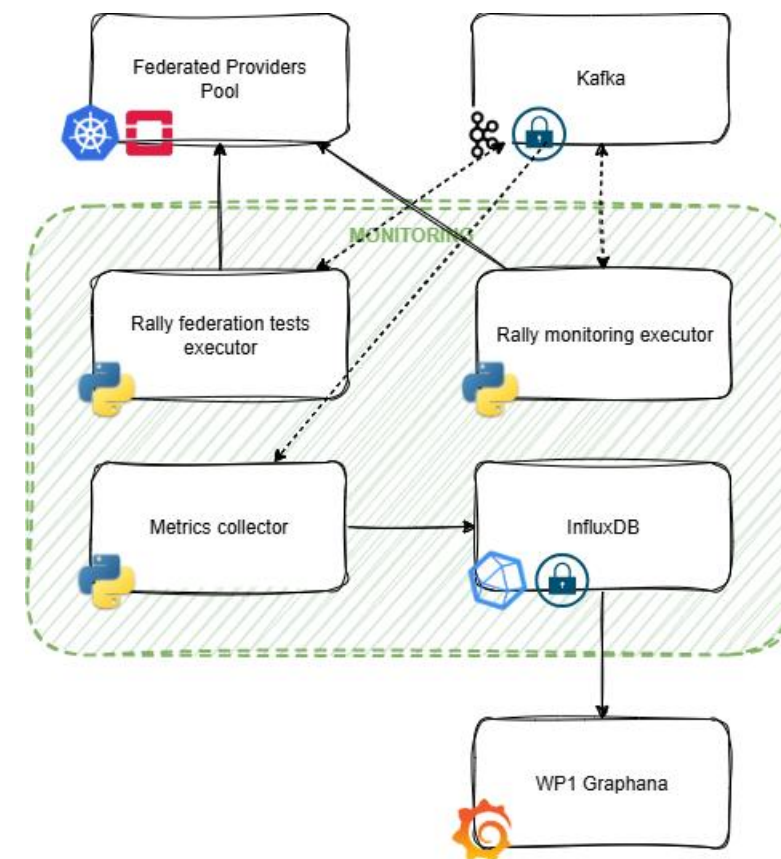
AI-Ranker (State of the Art)

Micro-service used to rank federated providers using ML techniques

AI-Ranker (Target Architecture)

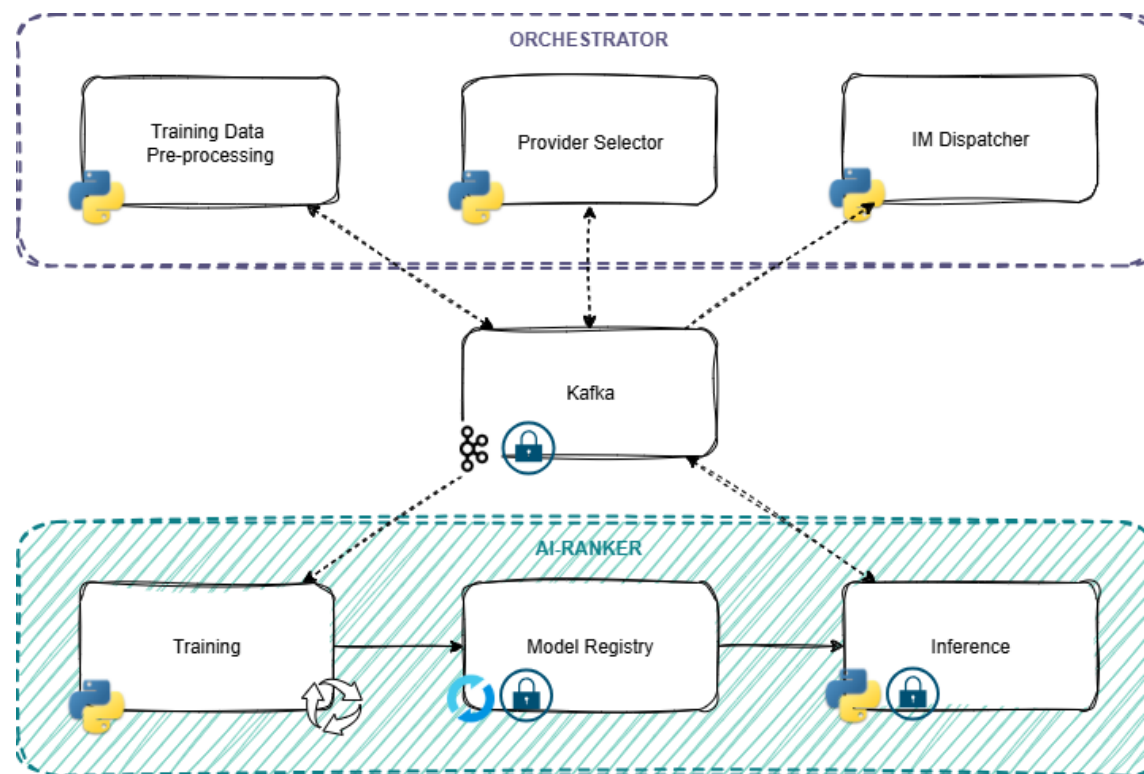*Micro-service used to rank federated providers using ML techniques*

Requirements:

➢ Kafka

Execution plan:

➢ Detect and manage edge cases

➢ Metrics definition for deployments targeting kubernetes providers
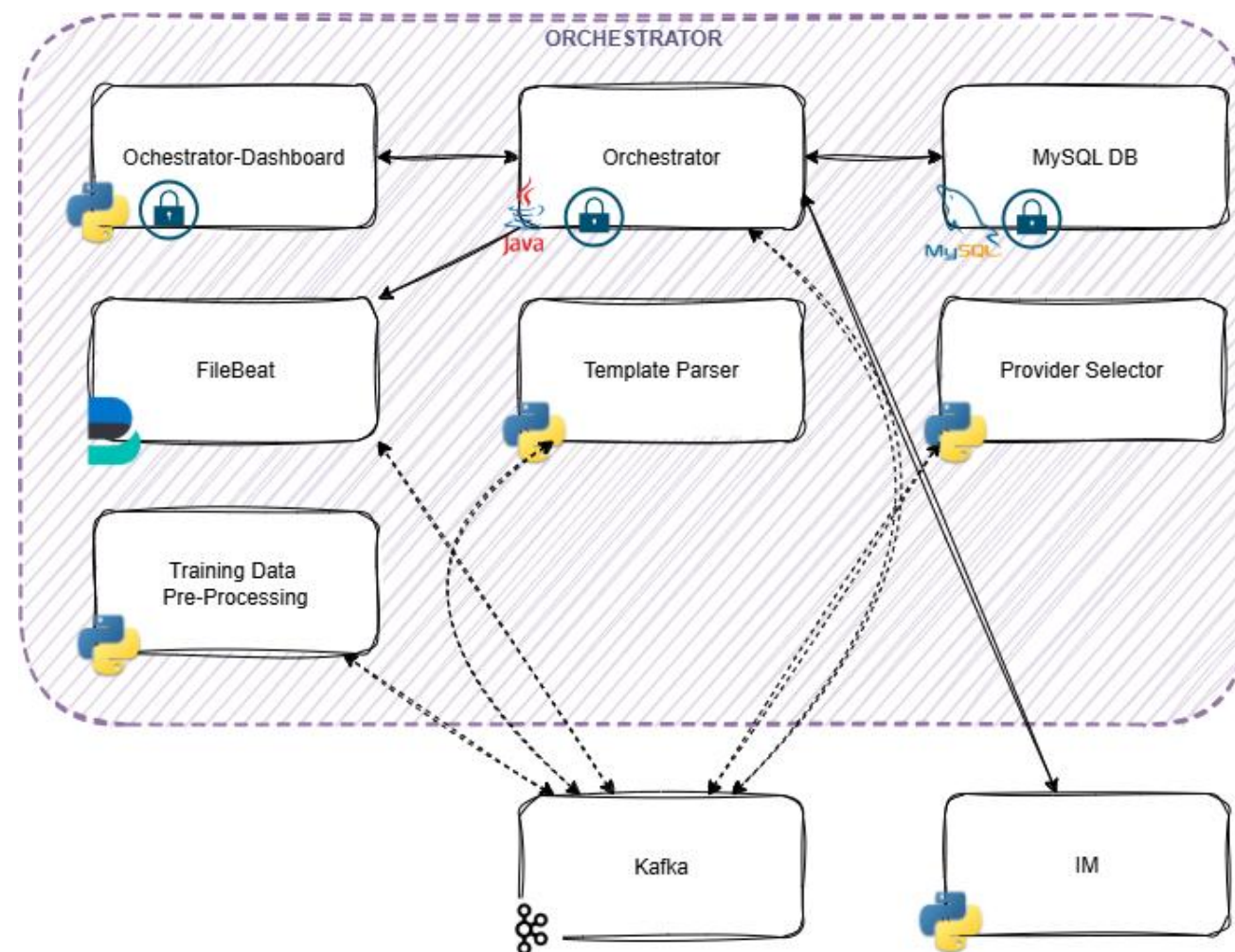
Known or possible problems:

➢ Inference is reading again the whole training topic

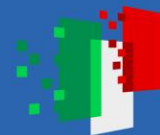➢ If the model registry is not available the Inference fails?

Orchestrator (State of the Art)

Set of components aiming to find a ranked list of federated providers where to deploy a user infrastructure and manage that deployment

Orchestrator (1)

Set of components aiming to find a ranked list of federated providers where to deploy a user infrastructure and manage that deployment

Requirements:

➢ Kafka

➢ OPA

Execution plan:

➢ REST API revision and implementation

➢ Implementation of r/w logic on Kafka topics from the REST API

➢ Code refactoring of «PaaS-Mon» components

➢ Define and implement the error collector component

➢ Orchestrator-Dashboard (python) update

Orchestrator (2)

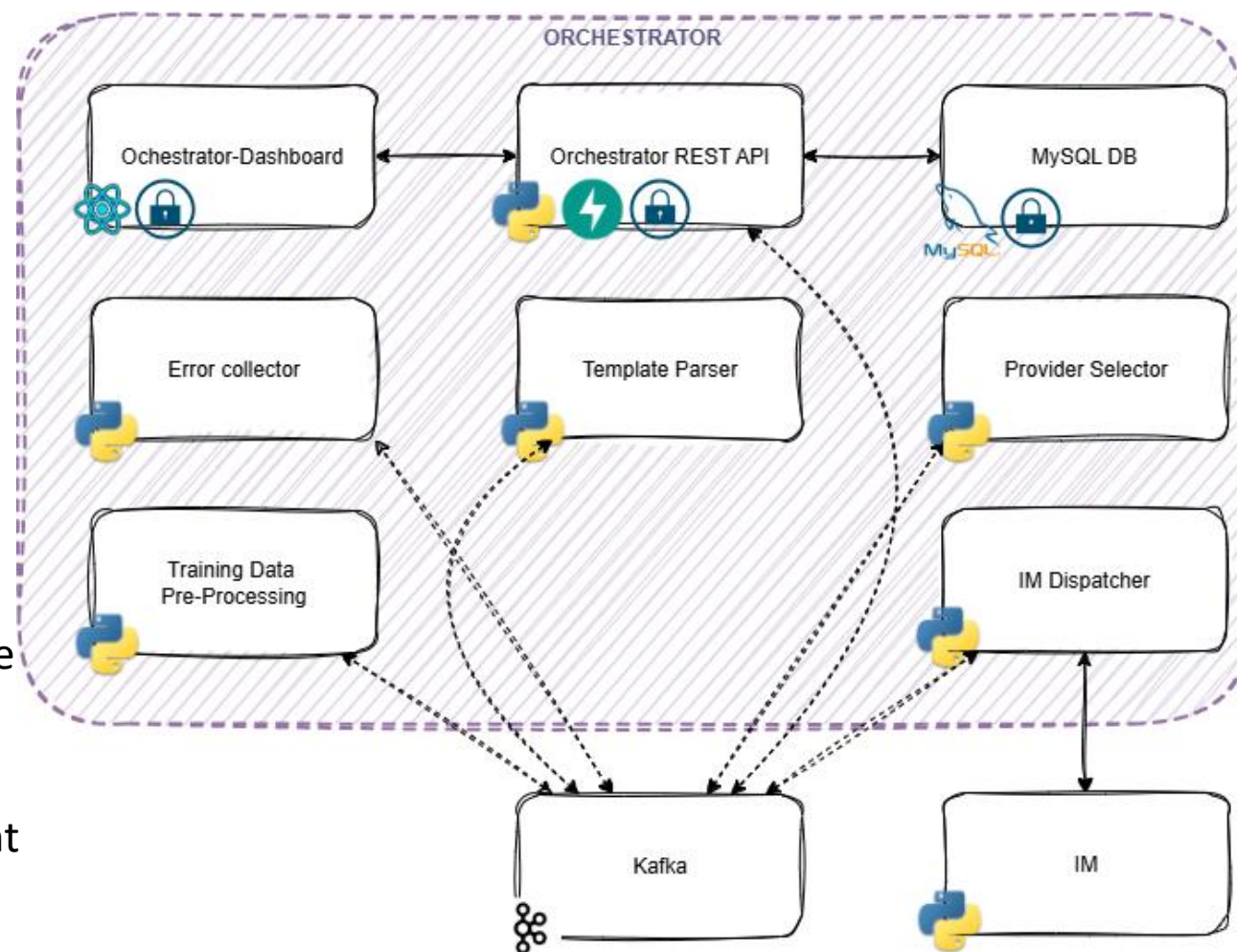*Set of components aiming to find a ranked list of federated providers where to deploy a user infrastructure and manage that deployment*

Execution plan:

➢ Integration of openstack-tosca-parser into the template parser component

➢ IM Dispatcher implementation for both Openstack and Kubernetes providers

➢ Use the typer library to develop the correspoding CLI (orchent no more needed)

➢ Orchestrator-Dashboard (TypeScript) implementation

Known or possible problems:

➢ Improve message version management

➢ Avoid components unexpected termination
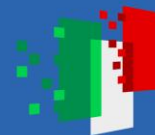
➢ Multithreading management on IM Dispatcher
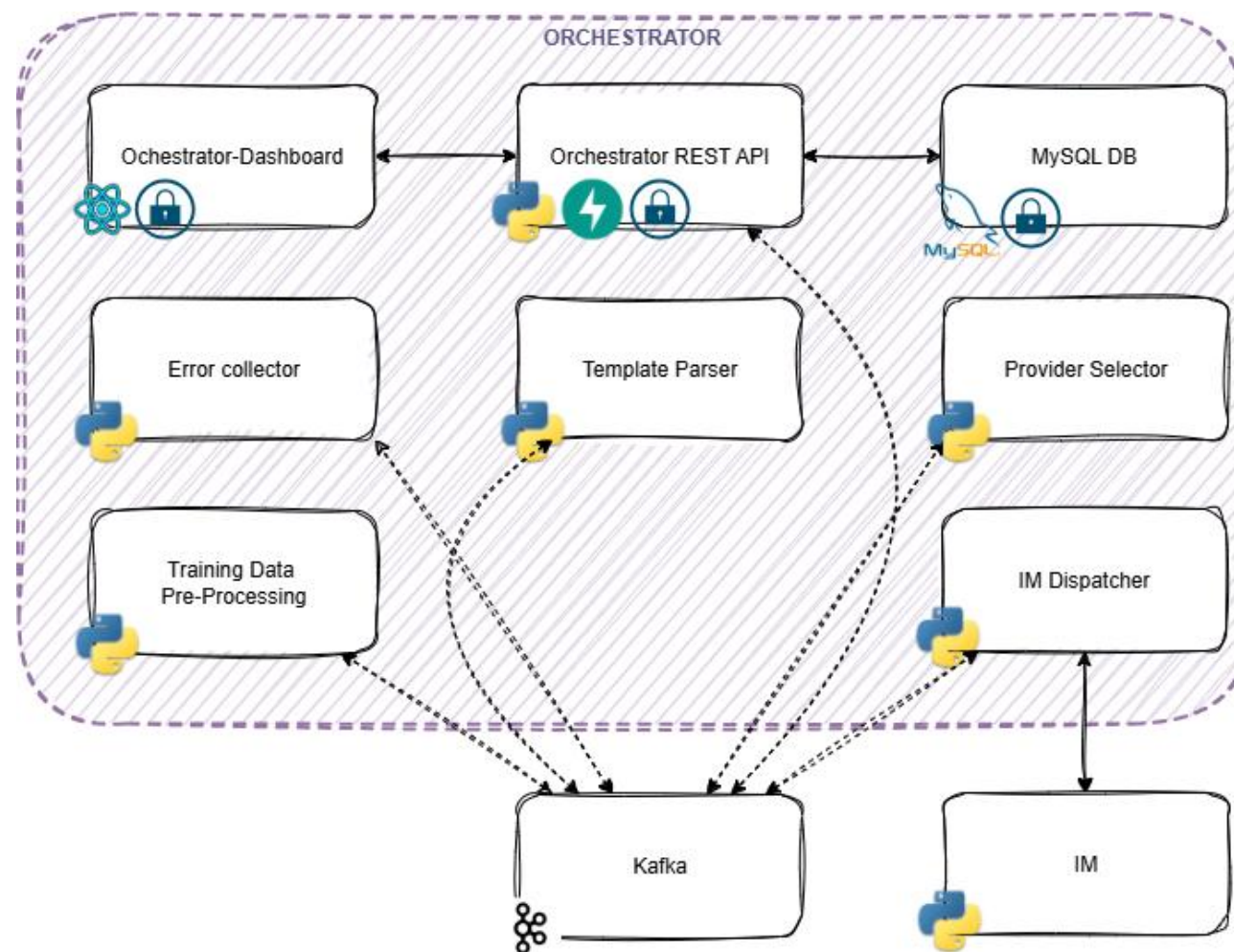
CVMFS Integration

Requirements:

➢ Communication with the Hashicorp vault

➢ Communication through rabbitmq with the CVMFS publisher

Execution plan:

➢ Edit the Orchestrator-Dashboard settings page to

    ➢ Submit the creation of a new CVMFS repository

    ➢ List CVMFS repositories

Kubernetes + ArgoCD

➢ Cluster kubernetes with 3(more?) VM + ArgoCD on top of it
  ➢ Production: <u>one cluster on Bari and another one on CNAF</u>
  ➢ Pre-production
  ➢ Development
  ➢ ArgoCD must support OIDC authentication and authorization
    ➢ To define access level

➢ New private repository on baltig with the **production** and **pre-production** configurations

➢ Service migration from VM + docker to Kubernetes
  ➢ Convert docker-compose to kubernetes YAML (Already started for Fed-Mgr and Fed-Reg - kompose)
  ➢ Convert ansible-role and playbook into YAML for ArgoCD

➢ How to manage passwords and secrets (Sealed Secrets)

Before the end of the year

➢ **Production**

  ➢ Kafka + AI Ranker + «PaaS-Mon» components -> Gioacchino e Luca

➢ **Pre-production**

  ➢ ArgoCD + Kubernetes -> Francesco, Mauro e Luca

  ➢ Fed-mgr (deployed over k8s) -> Alessandra, Ettore, Jacopo e Giovanni

  ➢ IM Dispatcher (REST API, deployed over k8s) -> Caterina, Giovanni e Luca

➢ **Prototypes**

  ➢ REST API (Deployment creation through command line) -> Giovanni

  ➢ Dashboard python upgrade to communicate with the new REST API -> Michele

Conferences and publications

Conferences

- ➤ [ECAI](#) (25-30 Ottobre, Bologna)
- ➤ [ISGC](#) (16-21 Marzo, Taipei)
- ➤ [CHEP](#) (25-29 Maggio, Bangkok)
- ➤ Workshop di CCR (May-June)
- ➤ [ICCSA](#) (30 Giugno - 3 Luglio, Braga, Portogallo)

Topics

- ➤ Fed-Mgr
- ➤ Deployment su Kubernetes+ArgoCD
- ➤ AI-Ranker evolution
- ➤ …

Goal: publish the new architecture of the PaaS Orchestration system in a peer-reviewed journal by July 2026. Possible journals:

- ❖ [Transaction on cloud computing](#)
- ❖ [Journal of Cloud Computing Springer](#)
- ❖ [Computing Springer](#)

- ❖ [Future Generation Computer Systems](#)
- ❖ [Journal of Systems and Software](#)
- ❖ [Cluster Computing](#)

Thank you

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