ITUEvents

Demonstration of machine learning function orchestrator (MLFO) via reference implementations (ITU-ML5G-PS-024)

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ITU

AI/ML in 5G Challenge

Applying machine learning in communication networks

ai5gchallenge@itu.int

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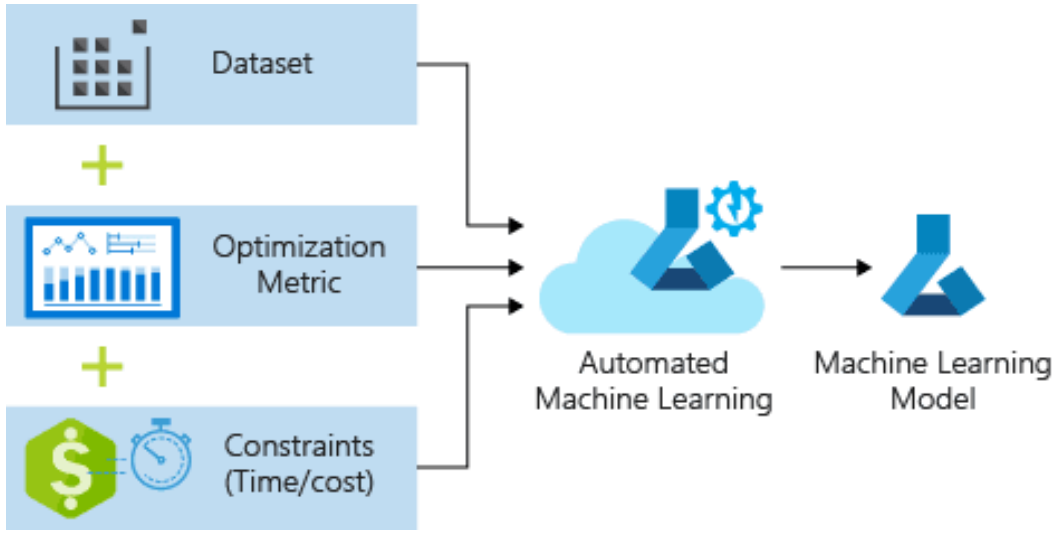
Agenda

- Background
- Functionalities of MLFO
- MLFO Architecture
- Specific concepts: Sequence Diagrams
- Reference Implementation challenge
- Evaluation Criteria
- Participation & Submission Guidelines
- Timeline

Background

- Most network operators rely on data scientists to create a ML pipeline
- This ML pipeline if not managed and orchestrated appropriately is subject to bottleneck



Background (Cont..)

Specifically, MLFO addresses the following challenges:

- [b-ITU-T Y.ML-IMT2020-Use-Cases] envisages different ML frameworks/ libraries

  Example: training of deep learning, tree-based, and linear models require three different ML frameworks

  Example: different big data handling tools and libraries, e.g., messaging brokers, data processing engines, etc.

- ML pipeline using these tools/libraries is time-consuming and requires a set of specialized skills

Background (Cont..)

- Compatibility issues for i**ntegration of** [b-ITU T FG-ML5G-I-151] [ML5G-I-203], and [ITU-T Y.3174] need repetitive/complex code
- Lack of standardized ML orchestration mechanism:
  - complex/expensive ML pipelines
  - handover issues, e.g., bottleneck
  - production issues, e.g., glue code, hidden-dependencies, feedback loops, and pipeline nets
- Other challenges for ML pipeline include:
  - ML model update, chaining, monitoring, evaluation, pipeline splitting, model deployment, and management &coordination of multiple ML pipeline instances across the network

Background (Cont..)

- Uber, Netflix, Google, Facebook, and Airbnb: in-house ML orchestration platforms
- Cloud service providers, e.g., Amazon and Google: ML pipeline orchestration services
  - Do not address requirements of diverse use cases [b-ITU-T Y.ML-IMT2020-Use-Cases]
  - Do not offer integration with [ML5G-I-203], [b-ITU T FG-ML5G-I-151], and [ITU-T Y.3174] frameworks
- In-house ML orchestration: significant investments & no actual benefits within an industry setting.

MLFO Functionalities

Functionalities of the MLFO:

- MLFO can monitor & manage ML pipeline
- Policy-based ML pipeline deployment
- Optimal placement of ML pipeline nodes in the network
- Intent-based specification
- Standard representation & interoperable integration of data handling [ITU-T Y.3174], [b-ML5G-I-148], and ML marketplaces [ITU-T Y.ML-IMT2020-MP]
- Chaining/split of ML pipeline nodes, selection of ML models, monitoring model performance, reselection and update
- Like NFVO, MLFO decouples ML functions from the underlying network

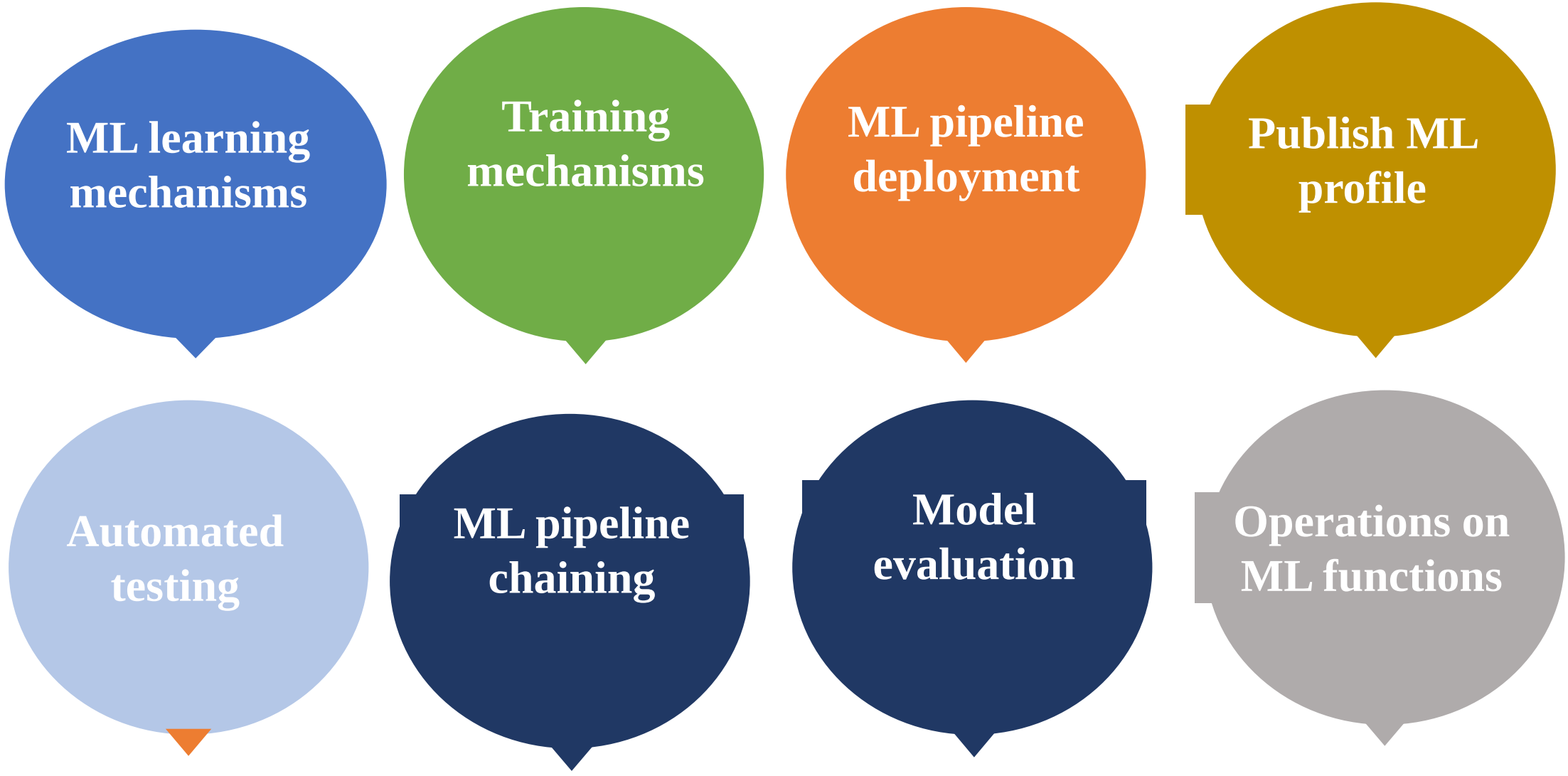
NOTE- This reduces ML pipeline operational costs with accelerated new offerings

Requirements for MLFO

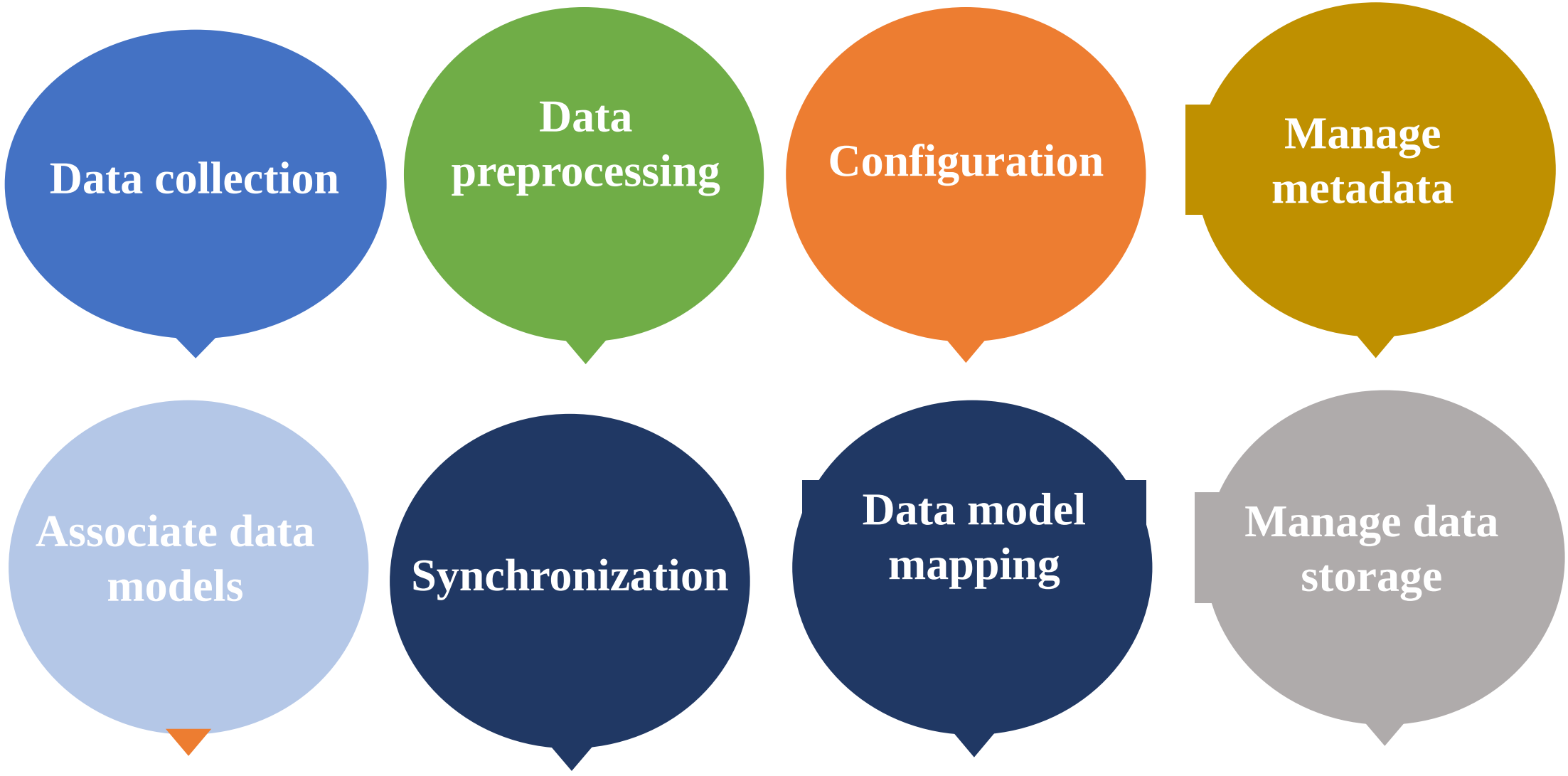
High-level requirements of MLFO:

1. Model Management
2. Data Management
3. ML Pipeline Management
4. Closed Loop System
5. Intent and Policy Management
6. Communication Management

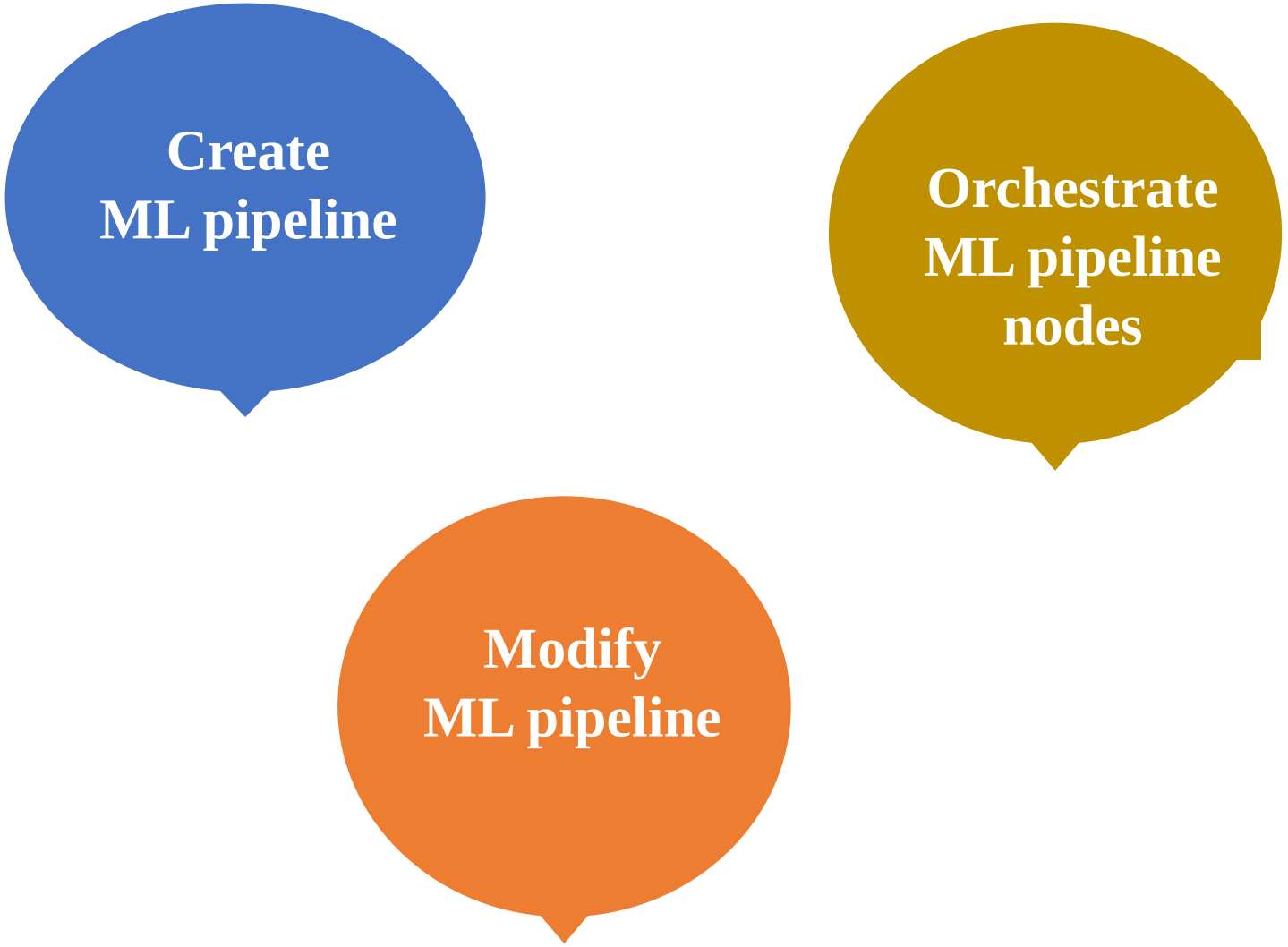
1. Model Management



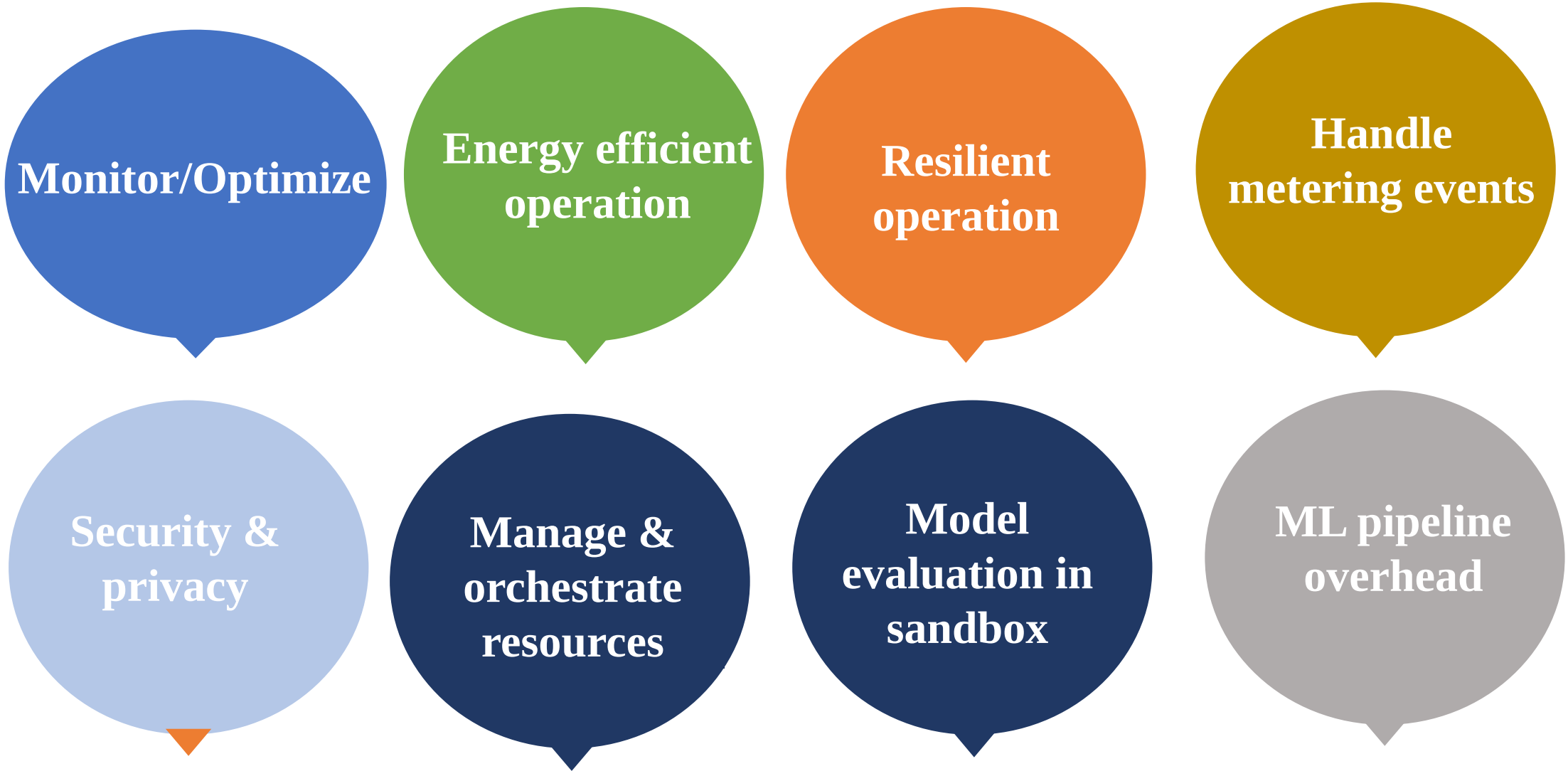
2. Data Management



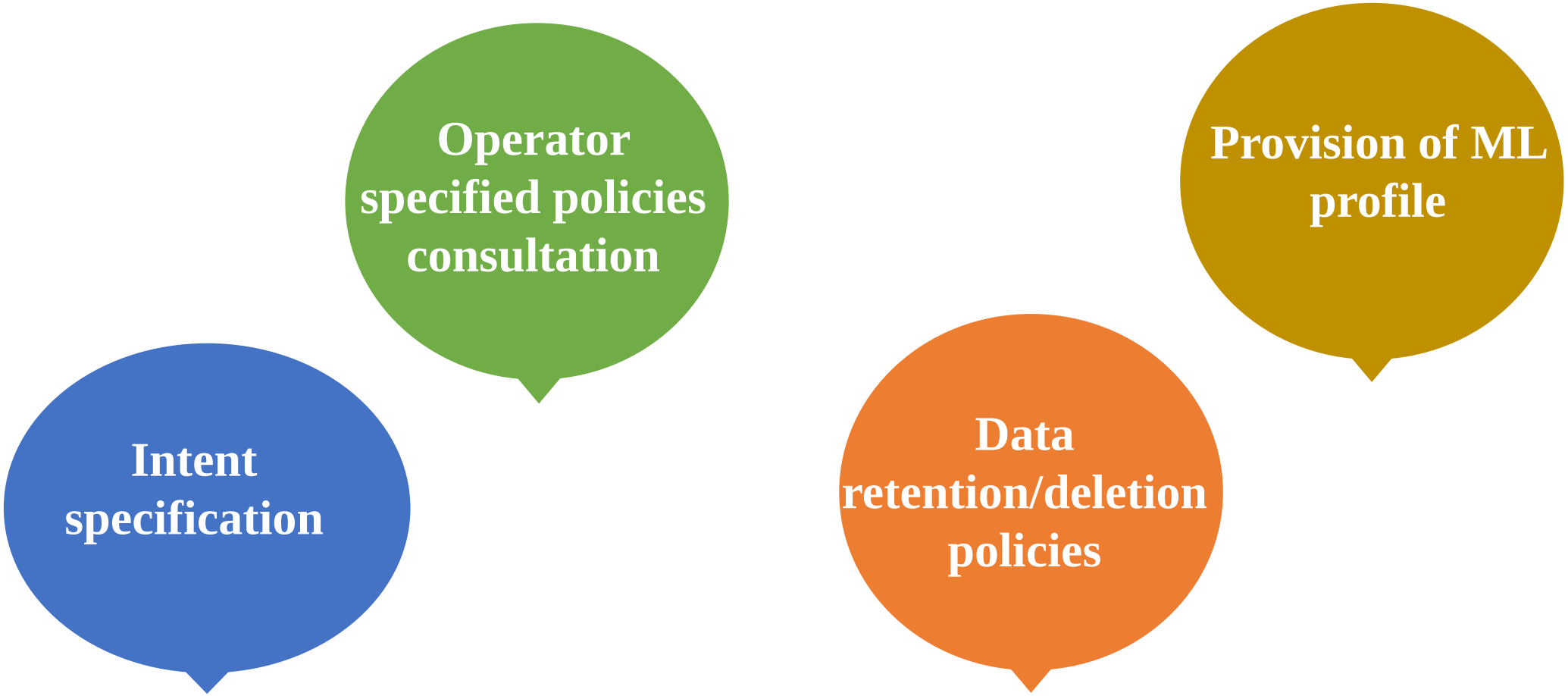
3. ML Pipeline Management



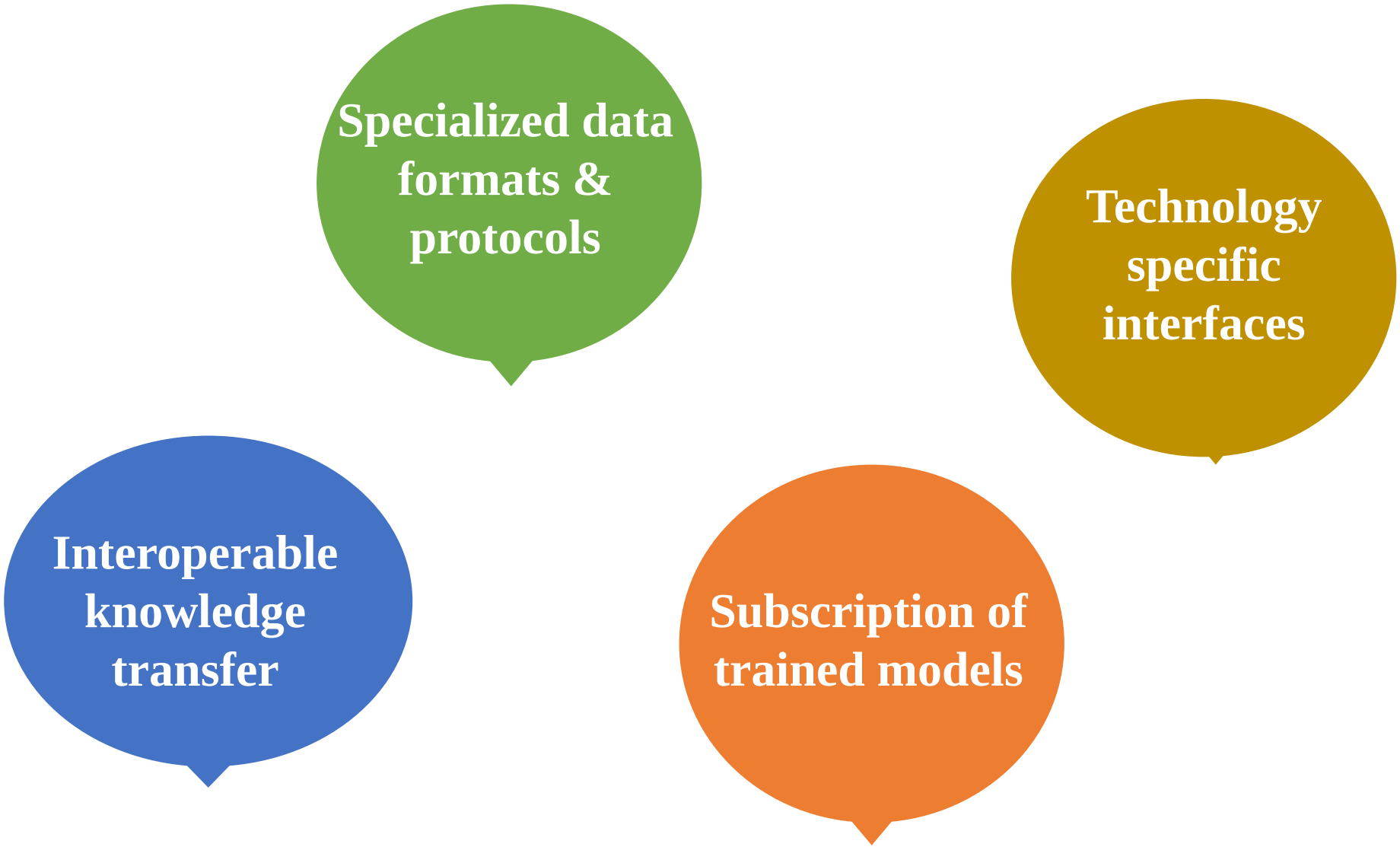
4. Closed Loop System



5. Intent and Policy Management



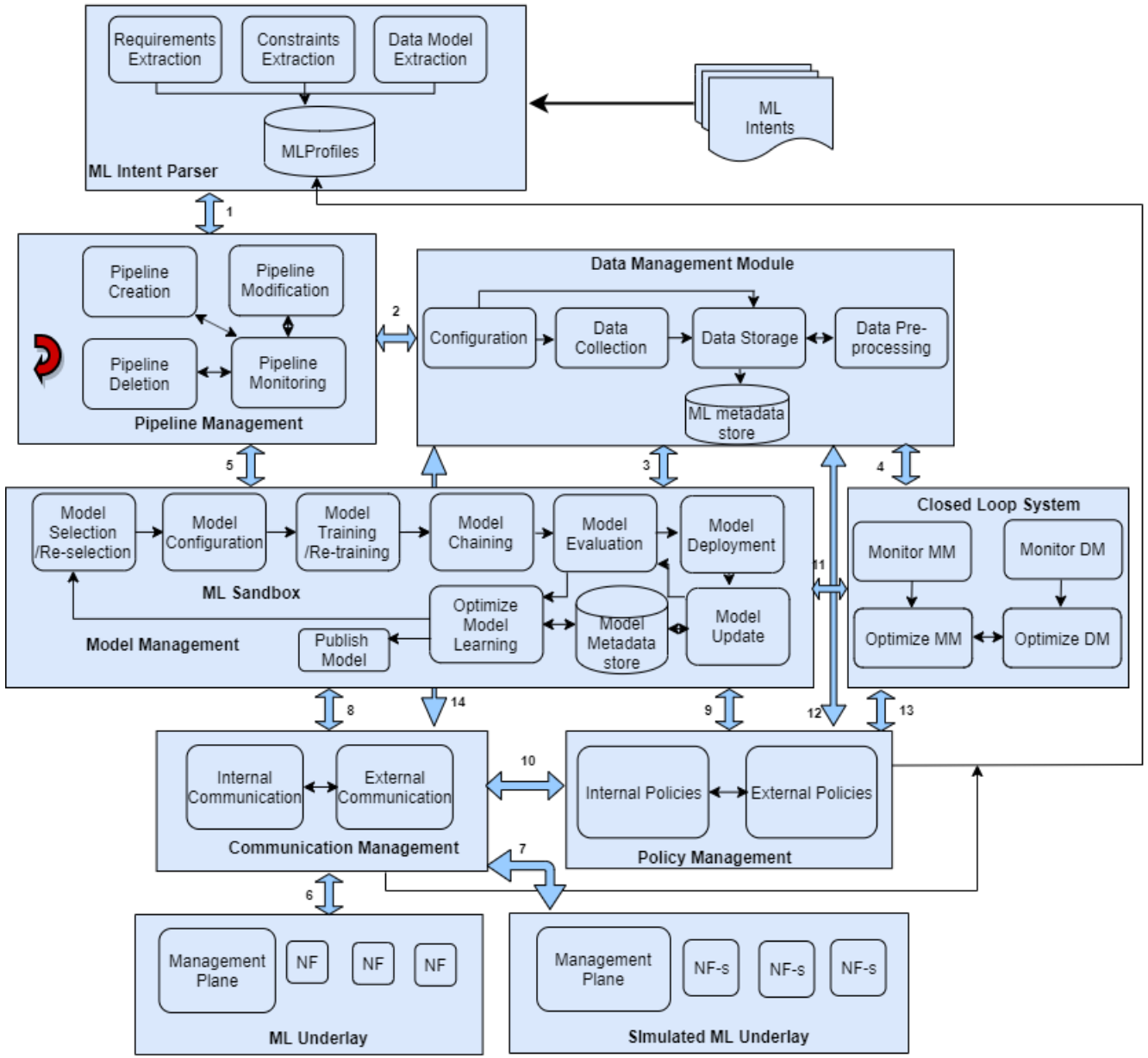
6. Communication Management



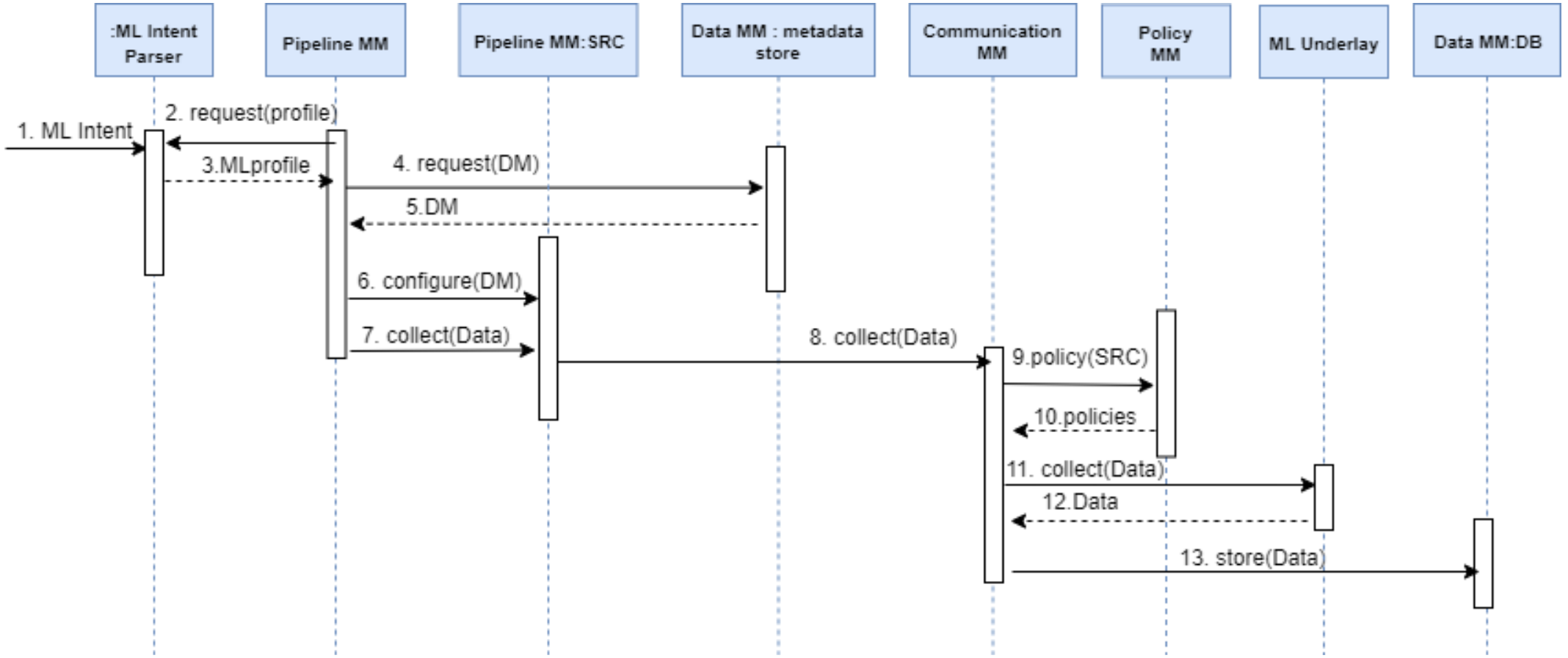
: Simulated Network Functions

: Data Management Module

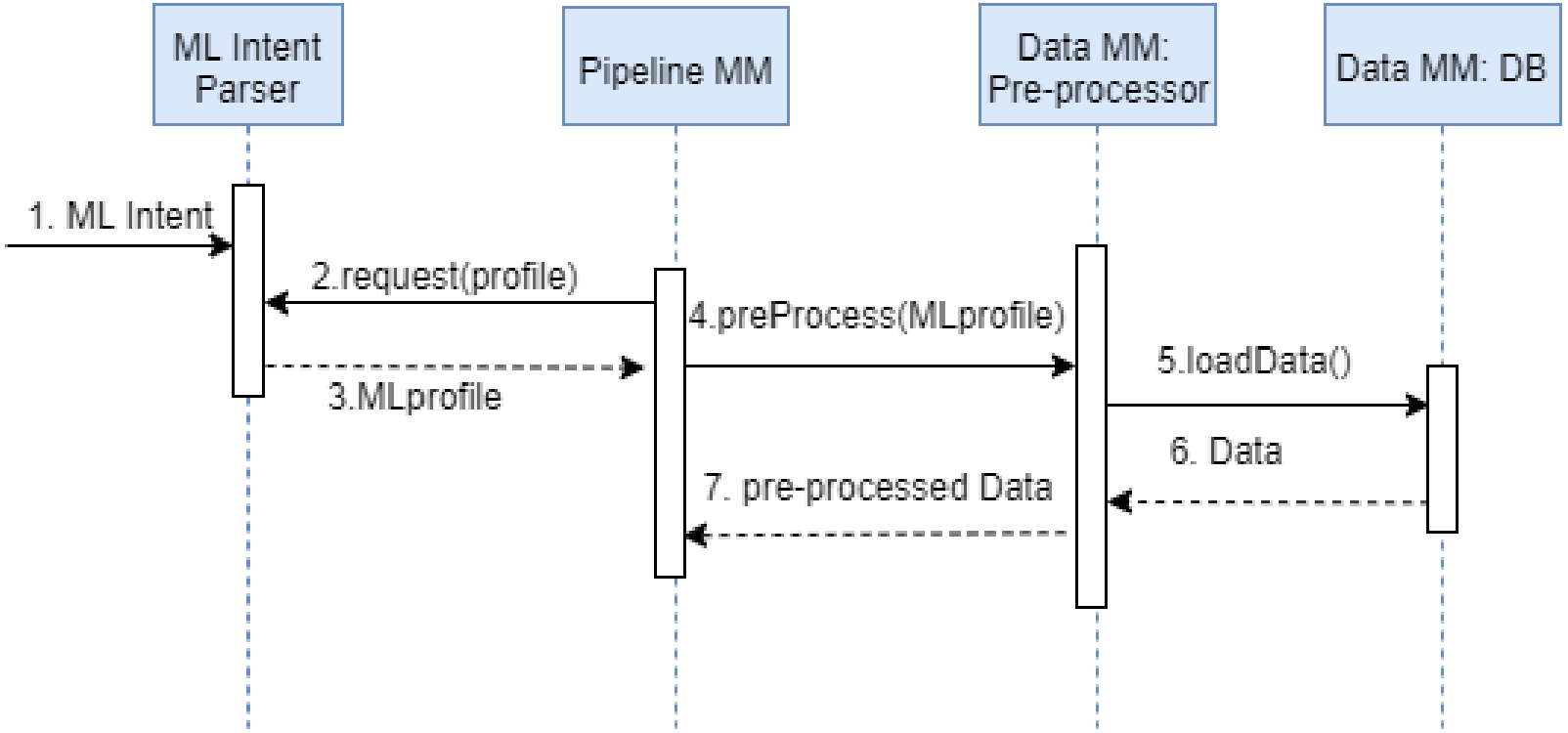
: Model Management Module



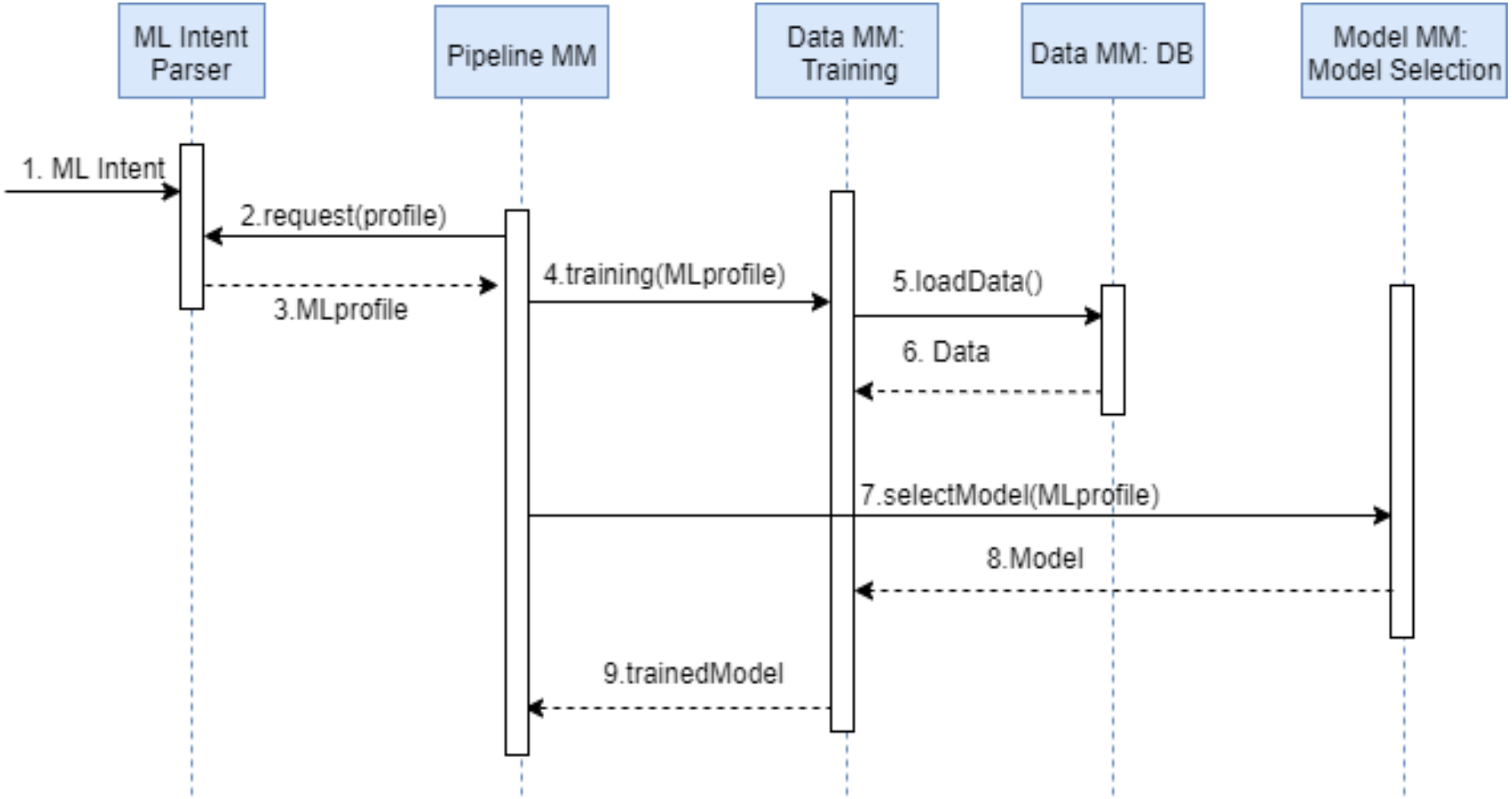
Specific concepts: Data Collection



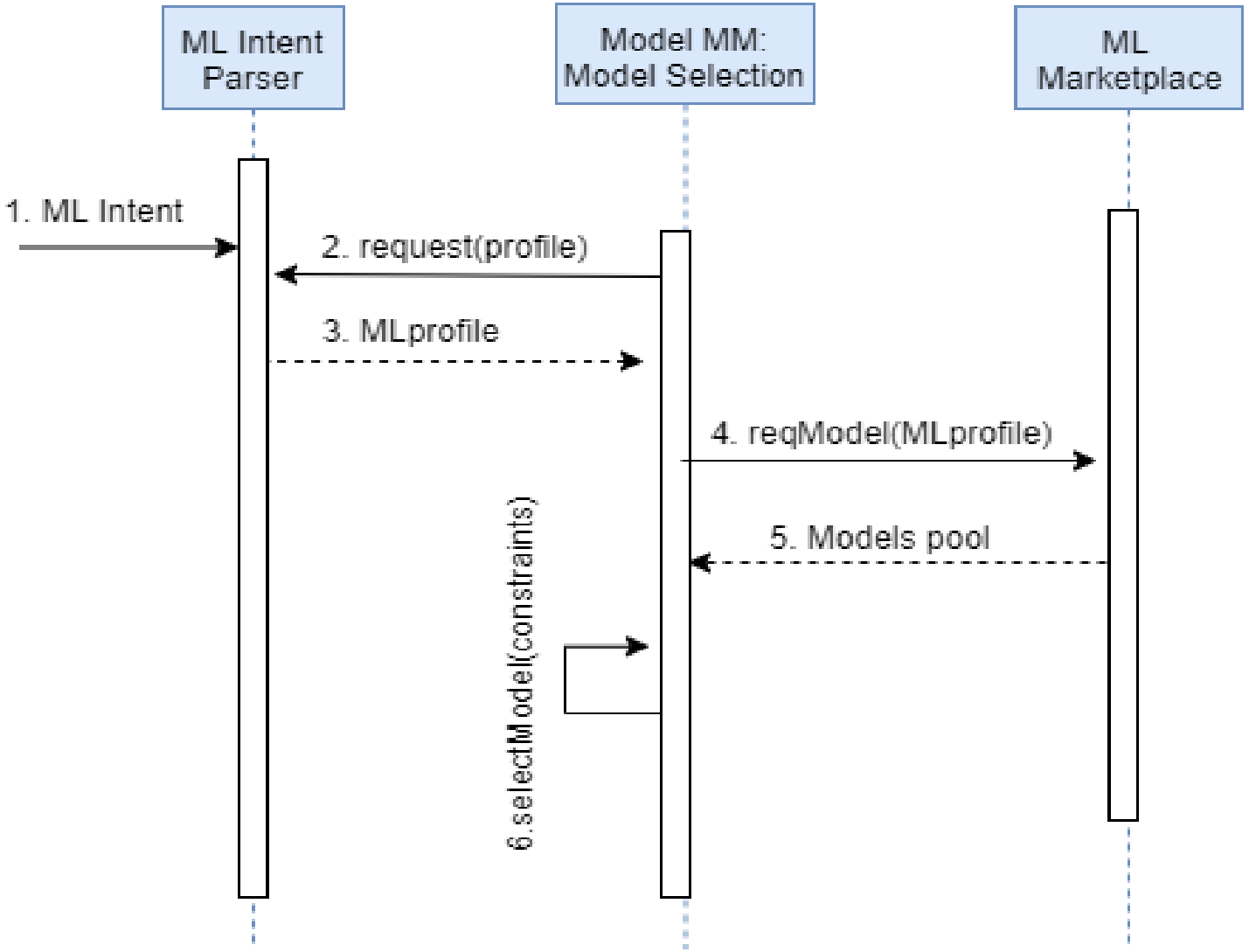
Specific concepts: Data Pre-processing



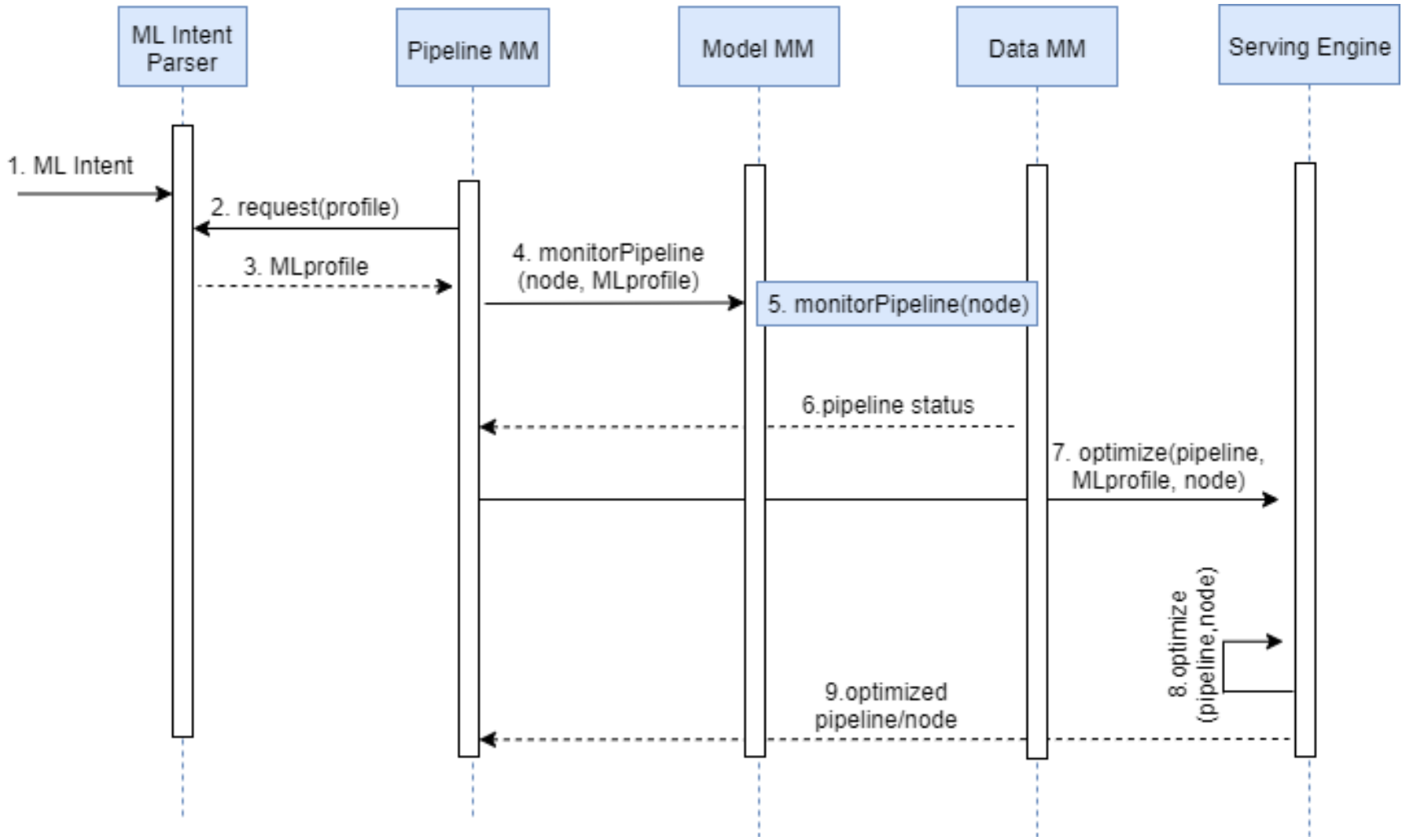
Specific concepts: Model Training



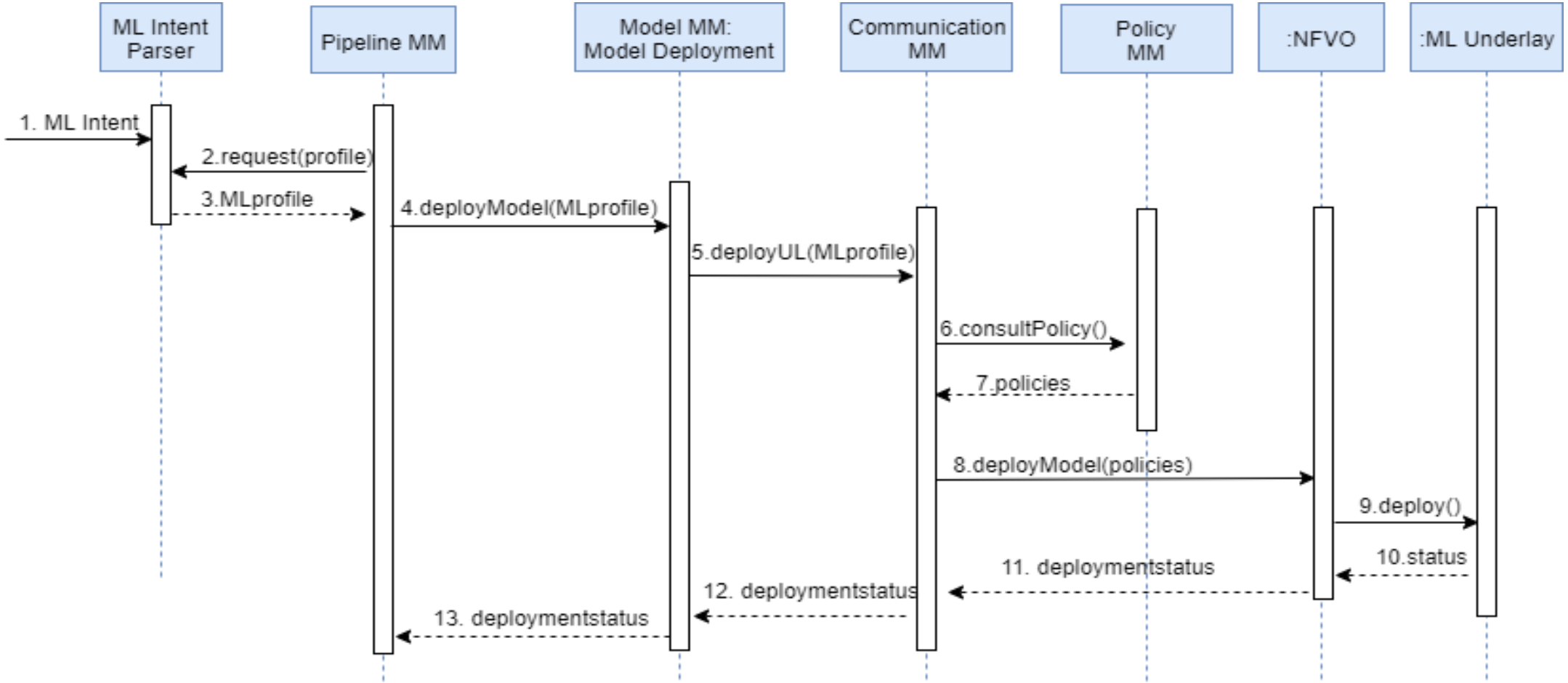
Specific concepts: Model Selection



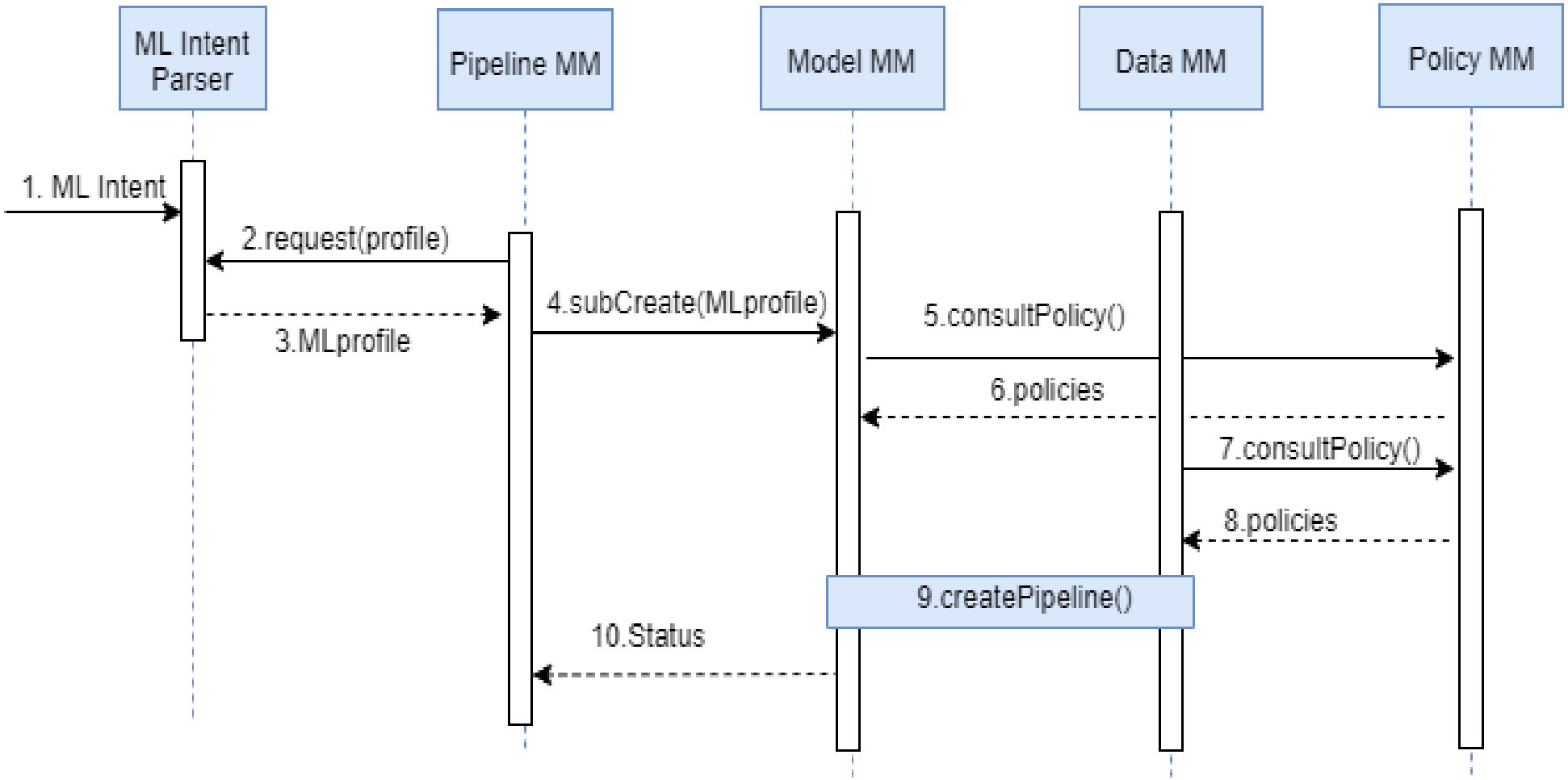
Specific concepts: Optimization Flow



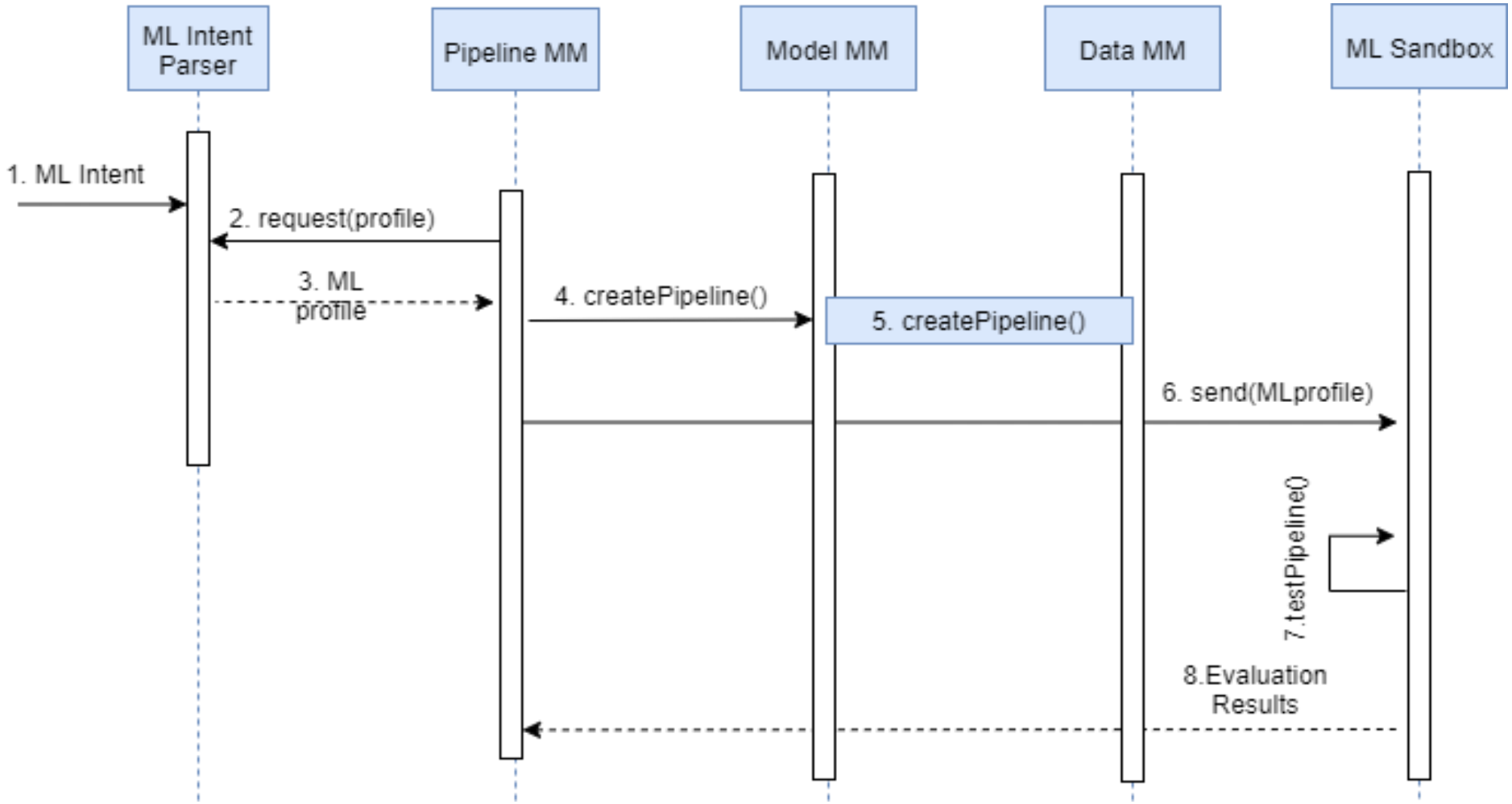
Specific concepts: Model Deployment



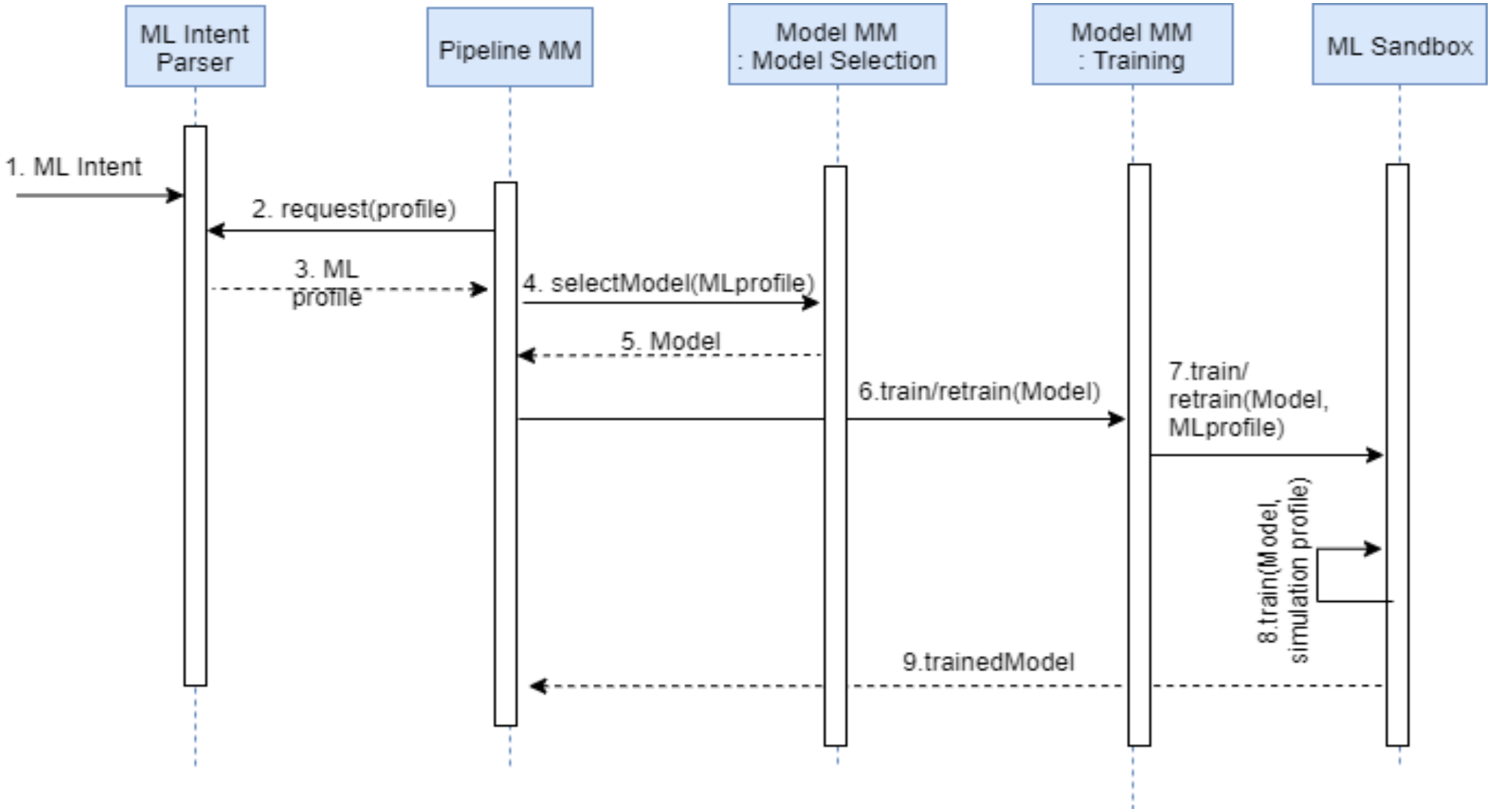
Specific concepts: ML pipeline creation



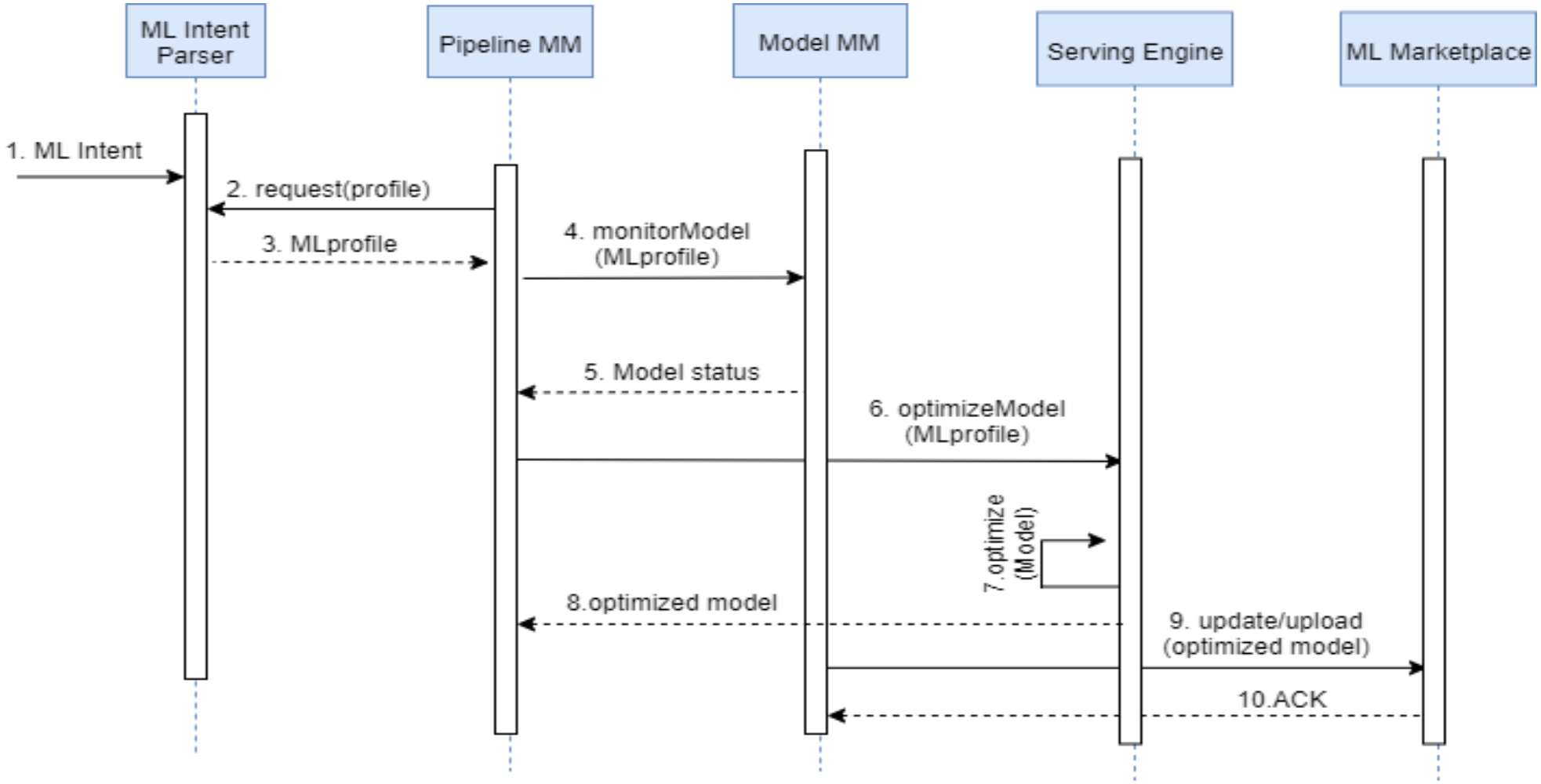
Specific concepts: ML Pipeline Testing



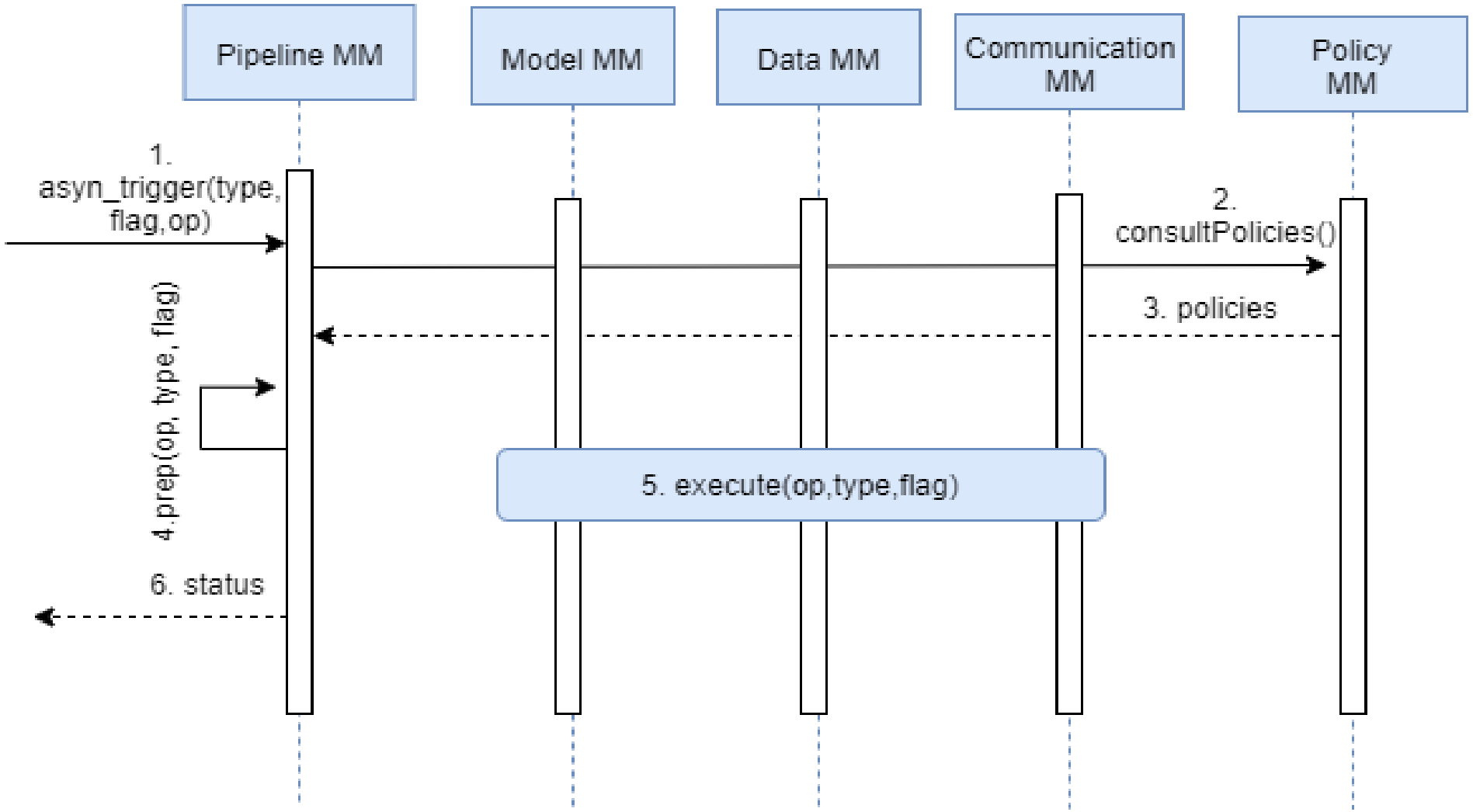
Specific concepts: ML sandbox-assisted model training/retraining

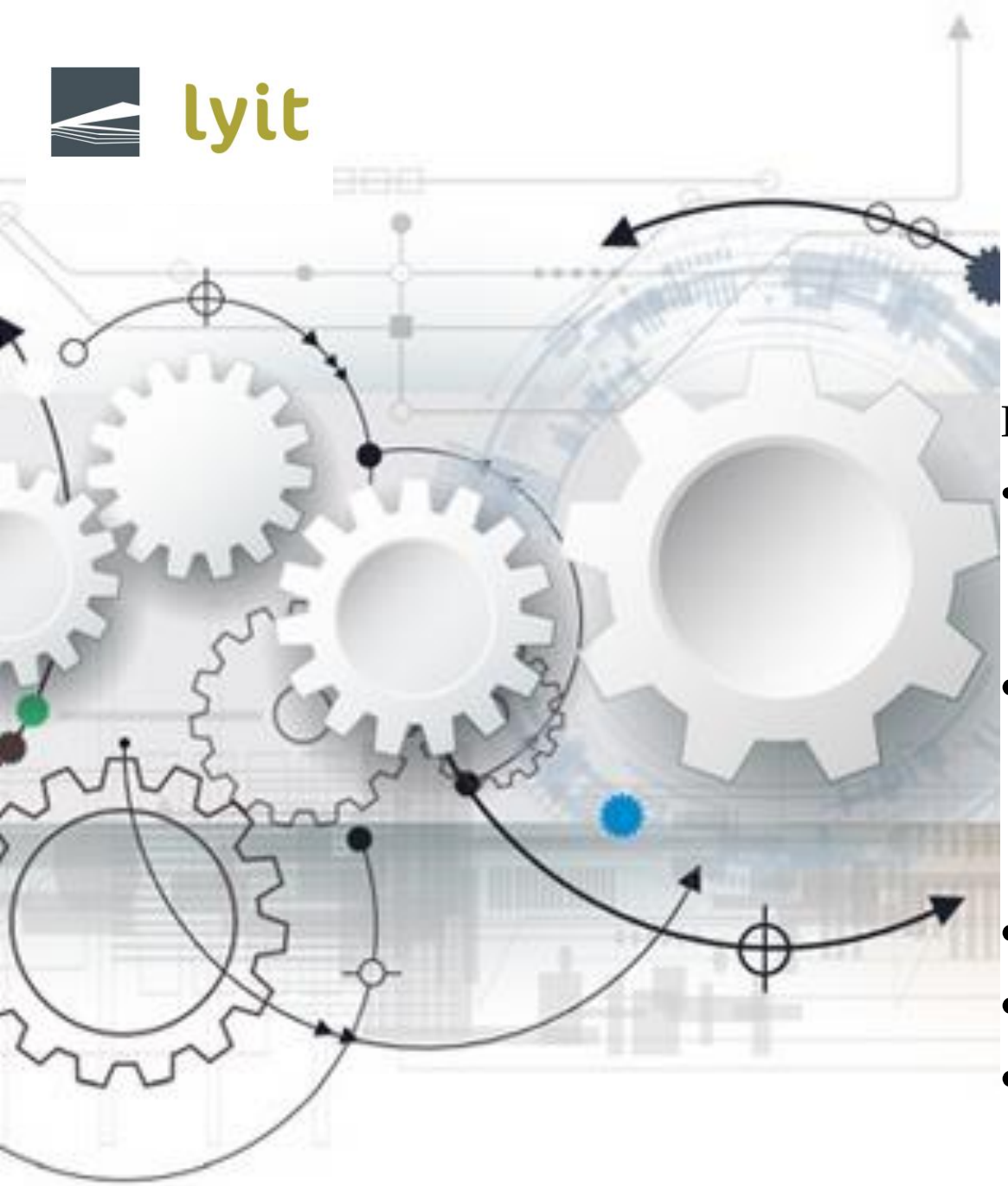


Specific concepts: Model update in marketplace



Specific concepts: Asynchronous operation execution





MLFO Reference Implementation Challenge

Implementation of specific concepts including:

- Handling ML Intent from operator: a mechanism for operator specify ML use cases via the ML Intent as specified in [ITU-T Y.3172]
- Control of model management, e.g., selection, training and deployment using MLFO

  NOTE- No dataset is required for the model management implementation, only meta-data should suffice
- Interaction with ML Marketplace
- Handling of asynchronous operations
- Any other concepts as discussed earlier

Evaluation Criteria

Our competition schedule is divided into two stages: Phase I and Phase II. These two stages need to submit different competition works.

Phase I

Project (full marks: 40)	Evaluation Standard
Selection of concept demo (10 marks)	1. Clarity of demo statement Traceability to ITU-T specifications. Proof of concept demo plan
Design methodology (15 marks)	1. Clarity in demo goals Use case diagram/flow chart Architecture diagram Opensource used
Test Setup & Timeline (15 marks)	1. Details of the test setup Tracing to requirements and design.
Total	40 marks

Phase II

Project (full mark: 60)	Evaluation Standard
Report and PPT (20 marks)	Detailed report including: i) Demo problem statement, ii) Motivation, iii) Challenges, iv) Milestones achieved, v) Methodology: system design, flow chart, vi) Results and discussion vii) Conclusion
DEMO completion (40 marks)	Demonstratable solution: PoC which maps to the MLFO specification is a must. Points to take care: Flexibility in possible extensions, potential adaptations and integrations, complete scenario.
Total	60 marks

Participation & Submission Guidelines

1. Create an ITU account for challenge registration
2. Register for ITU AI/ML in 5G
3. Complete the ITU AI/ML in 5G Challenge Participants Survey with **ITU-ML5G-PS-024**
4. You can work as an individual or a team of maximum 4 members
5. A **GitHub repository** should be available shortly to host the code from contestants

All the information here: https://www.lyit.ie/LYIT-ITU-T-AI-Challenge

Timeline

Registration Deadline: 21st August 2020

Global Round duration: August - November 2020

Phase I submission: 20th September 2020

Phase II submission: 20th October 2020

Evaluation: October 30th- November 15th

Winners (top 3) official announcement: November 30th

Awards and presentation: December

Thank You

Q&A

ITUEvents

AI/ML in 5G Challenge: “Round table + Open house”
07 August 2020

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