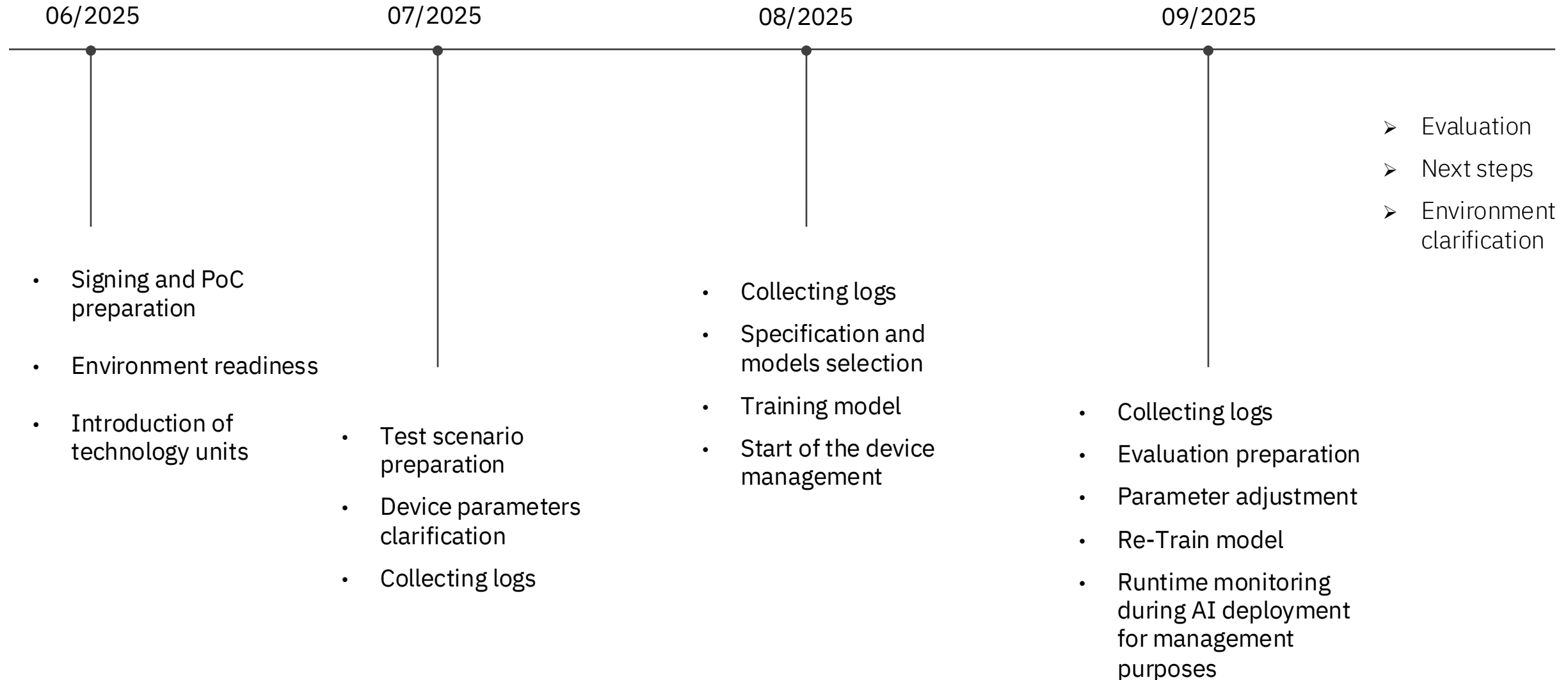




IBM + ELI Beamlines

PoC Final Presentation / Evaluation

PoC Timeline



Phase 0 – Scope /WBS

1. Integration of Black Box Twin (BBT) with room sensors & controls (MQTT)

- **During Phase 0, we will confirm or disprove the hypothesis presented by IBM, which should subsequently lead to a comprehensive building management concept.**
- Identify and document right room sensors and control systems for feasibility study
- Provision IBM environment for BBT with VPN access
- Establish MQTT connectivity and protocol setup
- Develop data ingestion pipeline for BBT
- Develop control pipeline from BBT to controls
- Perform initial connectivity tests
- Start persisting the room data for future analytics

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Phase 0 – Scope /WBS

2. Pre-training and deployment of BBT with initial data

- Provided and persisted data quality analysis
- Train BBT with historical room data (provided and persisted)
- Monitor BBT performance and collect operational logs
- Gather relevant metrics for evaluation

3. Retraining and deployment of BBT v2 with new data (Iteration 1)

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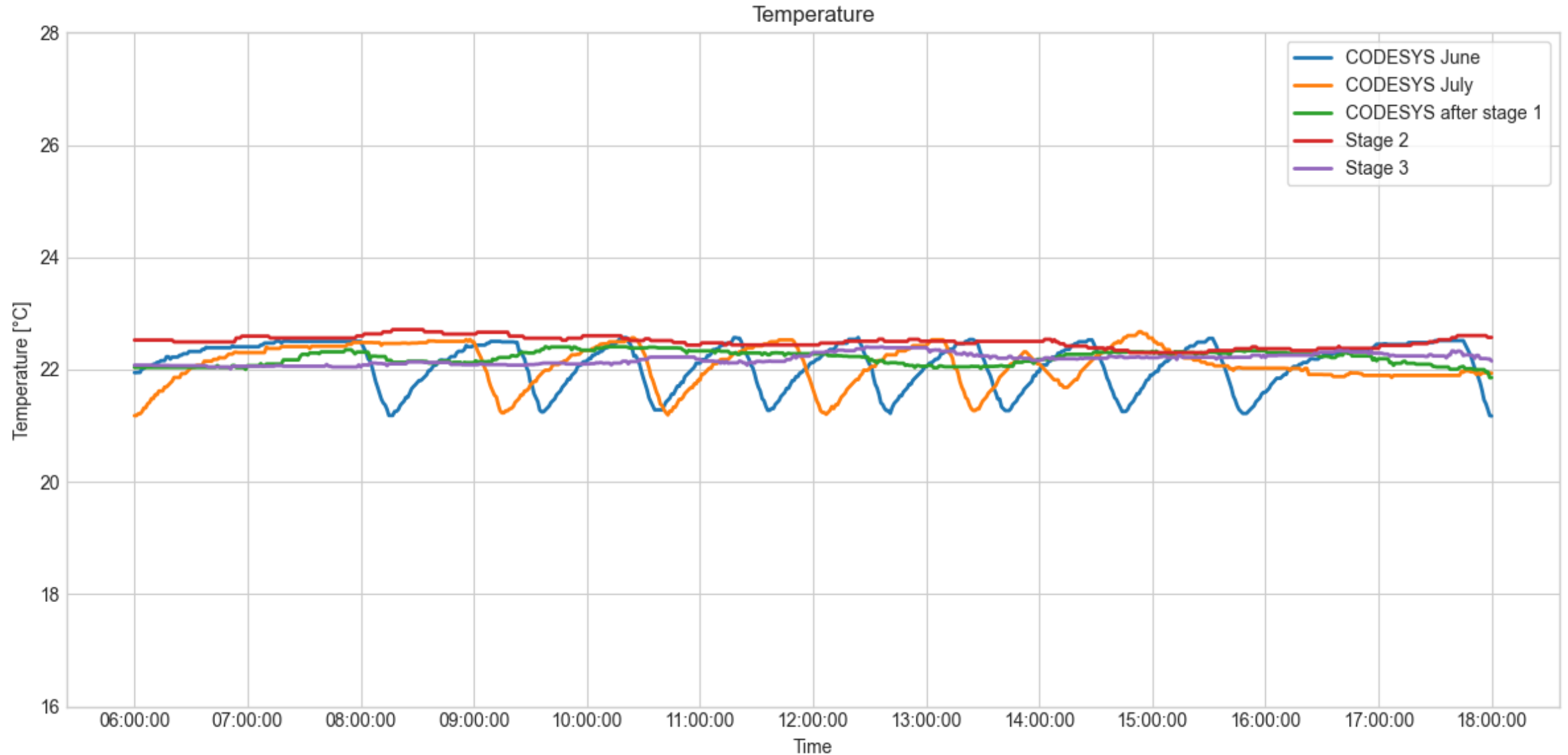


Table 1

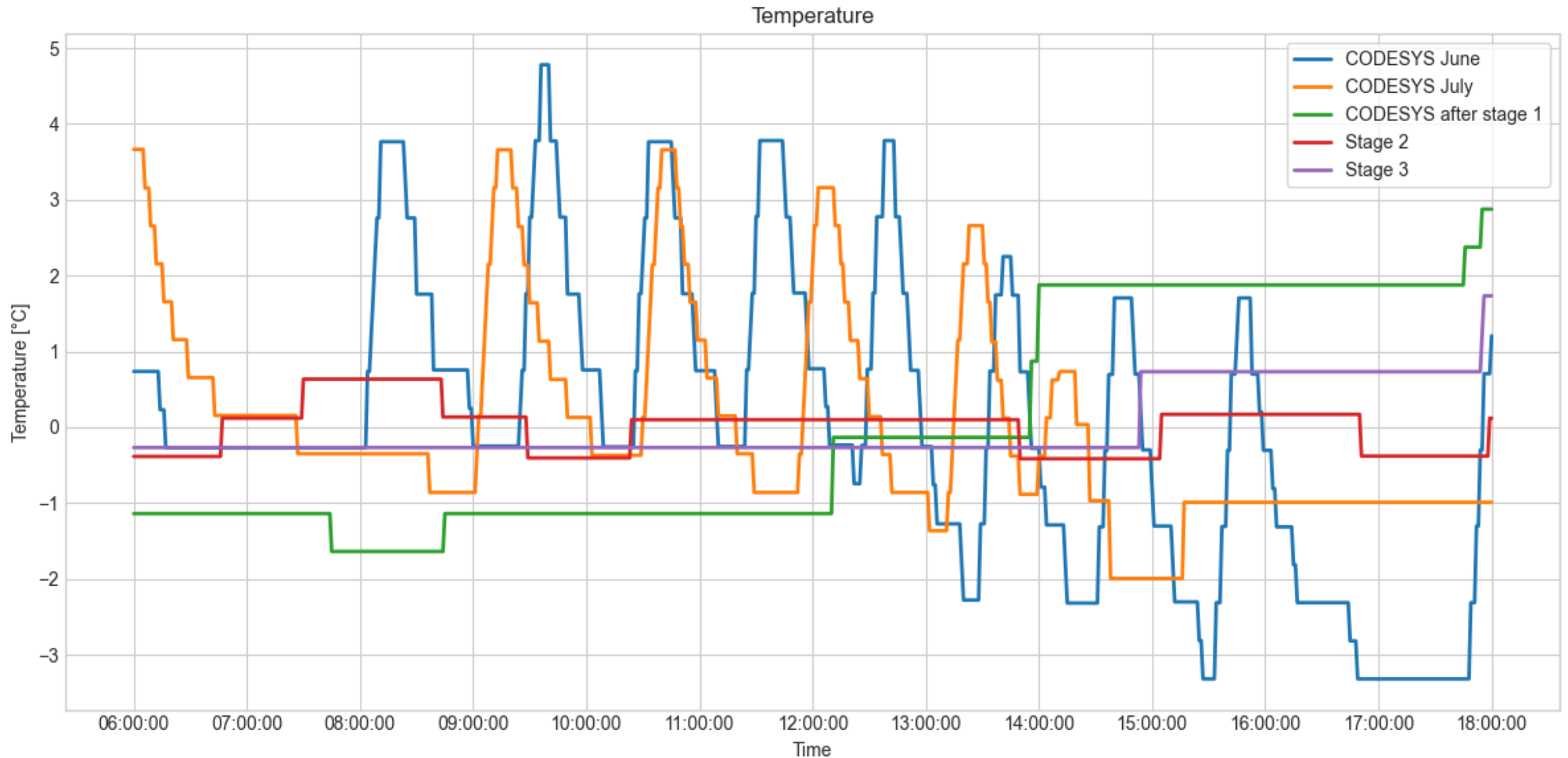
- **Stage 1** – running handcrafted control scenarios without model control (explore)
- **Stage 2** – running the model trained on the room data before the experiment
- **Stage 3** – running model trained on room data, including Stages 1 and 2

Measure	Metric	CODESYS (June) (19.6.-31.6.)	CODESYS (July pre stage 1) (1.7.-22.7.)	CODESYS (Post stage 1) (23.7.-24.8.)	Stage 2 Model (Baseline) (25.8.-27.8.)	Stage 3 Model (Retrained) (27.8.-29.8.)	Difference
Temperature	SMAPE (%)	1.995	1.784	1.312	13.007	9.648	-25.8 %
	Std (°C)	0.366	0.301	0.143	0.295	0.151	-48.8 %
	1% max deviation (°C)	0.493	0.376	0.166	0.318	0.170	-46.5 %
	10% max deviation (°C)	0.478	0.375	0.165	0.313	0.170	-45.7 %
Humidity	SMAPE (%)	8.639	2.844	4.759	20.444	15.935	-22.2 %
	Std (%)	4.321	1.36	2.16	2.77	1.892	-31.4 %
	1% max deviation (%)	4.39	1.38	2.16	2.96	1.899	-35.8 %
	10% max deviation (%)	4.378	1.37	2.16	2.91	1.897	-34.7 %

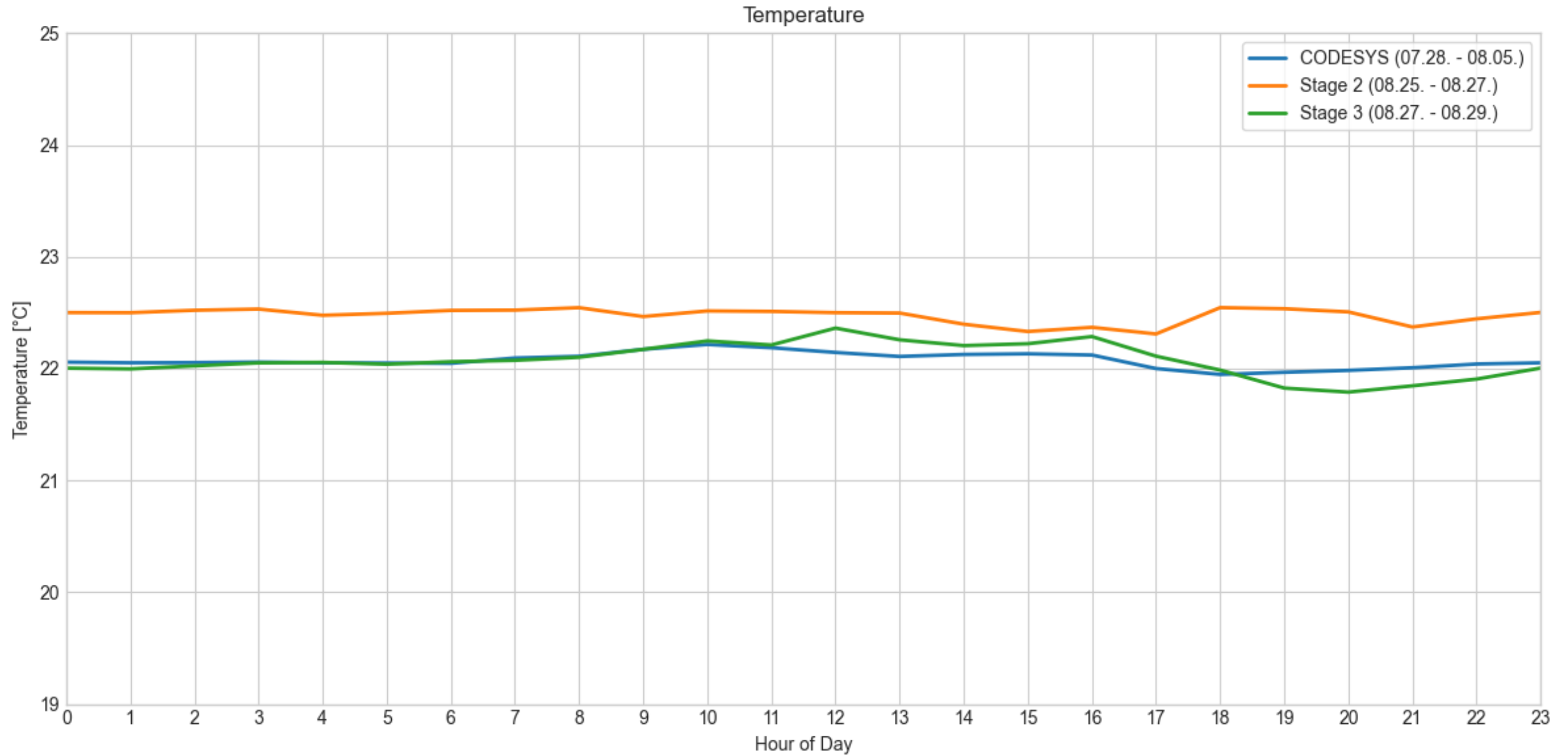
Graph Temperature - timeline



Graph Temperature - deviance



Graph Temperature - avg



Phase 0 - improvements

How to improve (Phase 1)

- Train on more data (operational data and from hand-crafted scenarios)
- Use larger model (because of HW constraints we used simple LSTM)
- Shorten calibration intervals (now 5 mins -> 1-2 mins)
- Collect more data – identified with Mr. Bernášek
 - Tracetek system,
 - Particle detector,
 - Lights, Doors,
 - Weather and Weather forecast
 - Additional sensors from building – for ex. overpressure in rooms, etc.

Road to Adoption

Phase 0 PoC Build

- Single room feasibility study
- Use case definition
- Model development
- Integration

Investment: 400k CZK

Phase 1 MVP Build

- Improving model accuracy
- Aligning operational parameters (latency, ...)
- Calibration scenario generation
- Automated testing
- Automated retraining
- Deployment on ELI

Investment: \$\$

Phase 2 Scale

- Setting-up data lakehouse
- Adding model monitoring
- Rolling out other rooms
- AI Technology delivery
- Finalize a deployment
- Continues testing / validating

Investment: \$\$\$

 IBM engagement

We are here

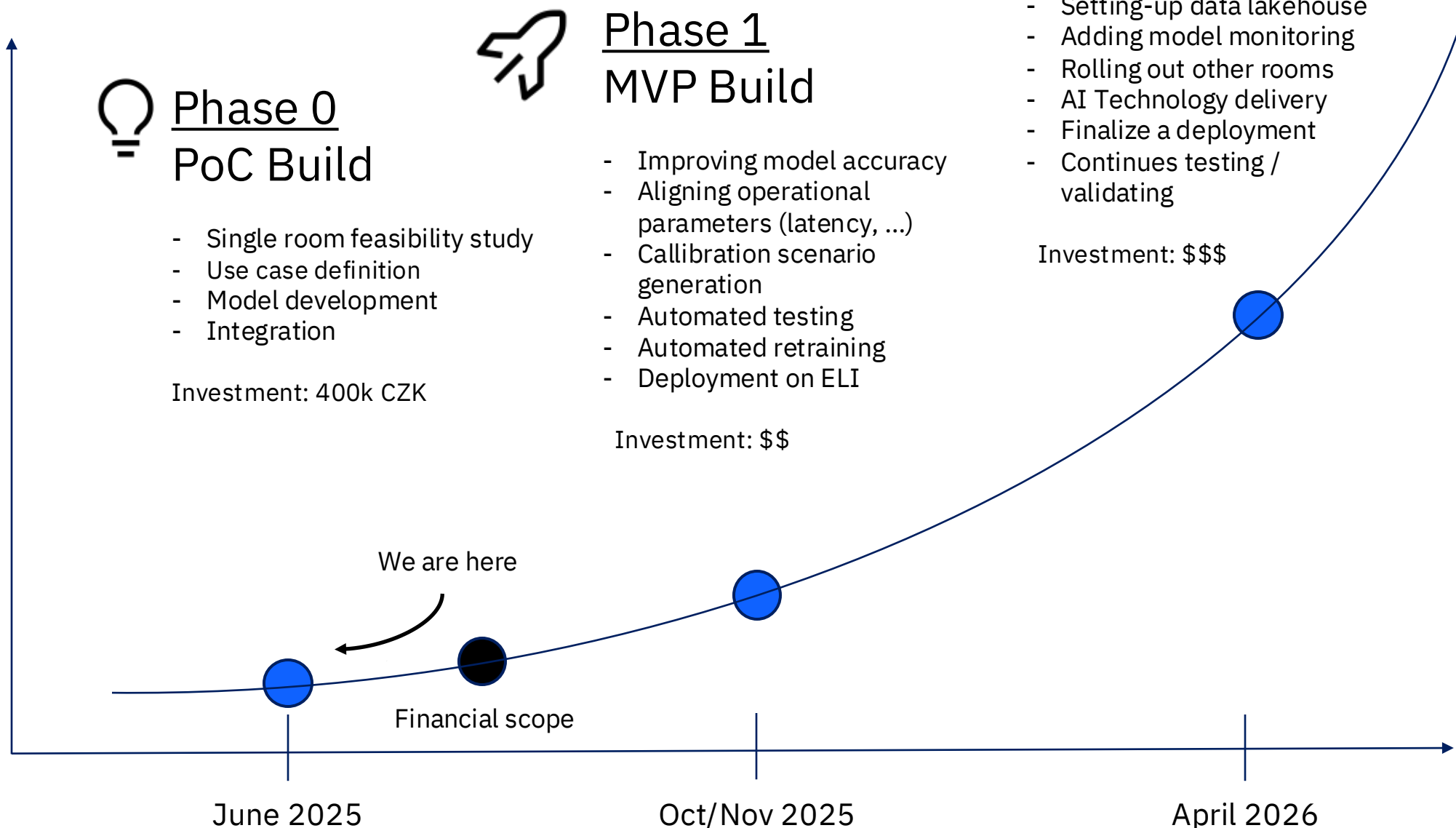
Financial scope

June 2025

Oct/Nov 2025

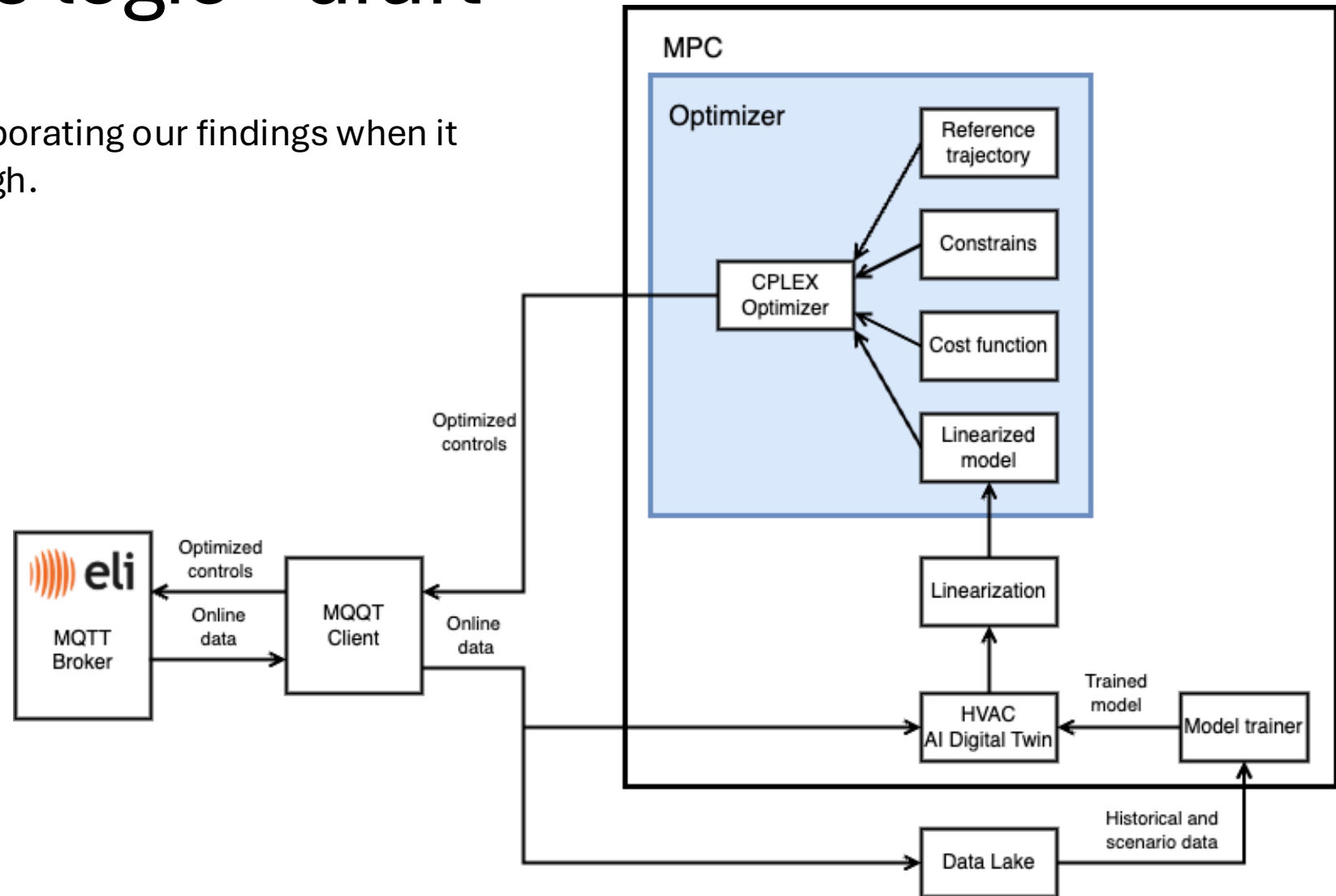
April 2026

Time

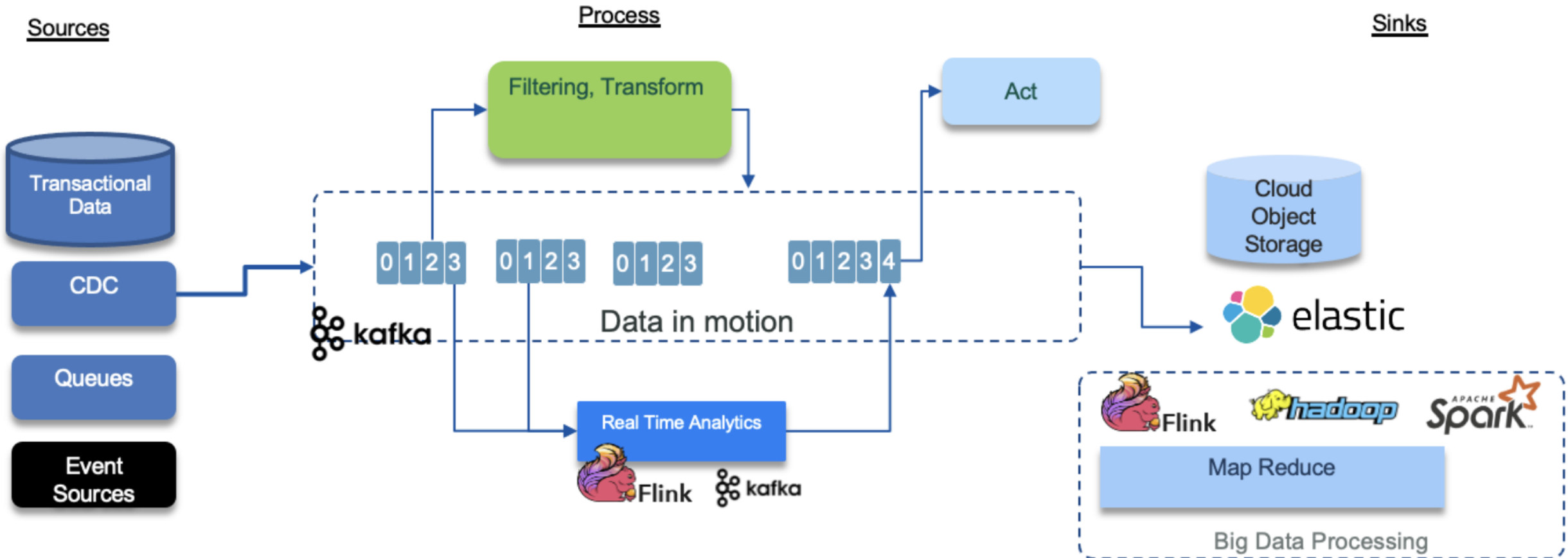


Architecture logic - draft

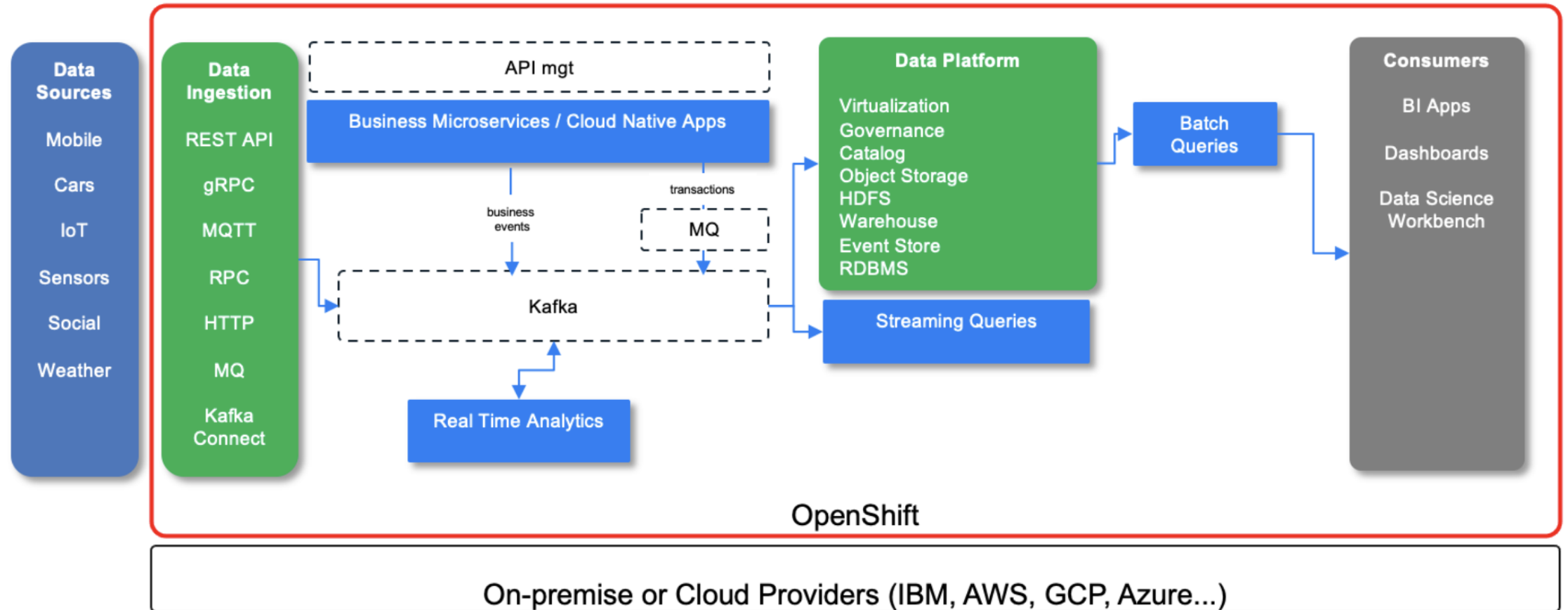
PQC how to adopt + incorporating our findings when it theoretically breaks through.



Architecture integration - draft



Modern datalake - draft



Thank you



Architecture block - draft

