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Agent-AI Assisted Parameter Tuning in Active Electrical Cables for Device Interoperability

Dr. Tingting Weng
Senior Staff Engineer, Marvell

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Introduction to AEC

Active Electrical Cables (AECs)

- Low latency
- Power saving
- Short-to-medium reach

112G PAM4

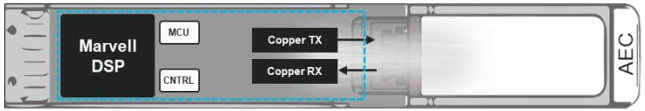
224G PAM4

GPU/Accelerator to ToR Switch

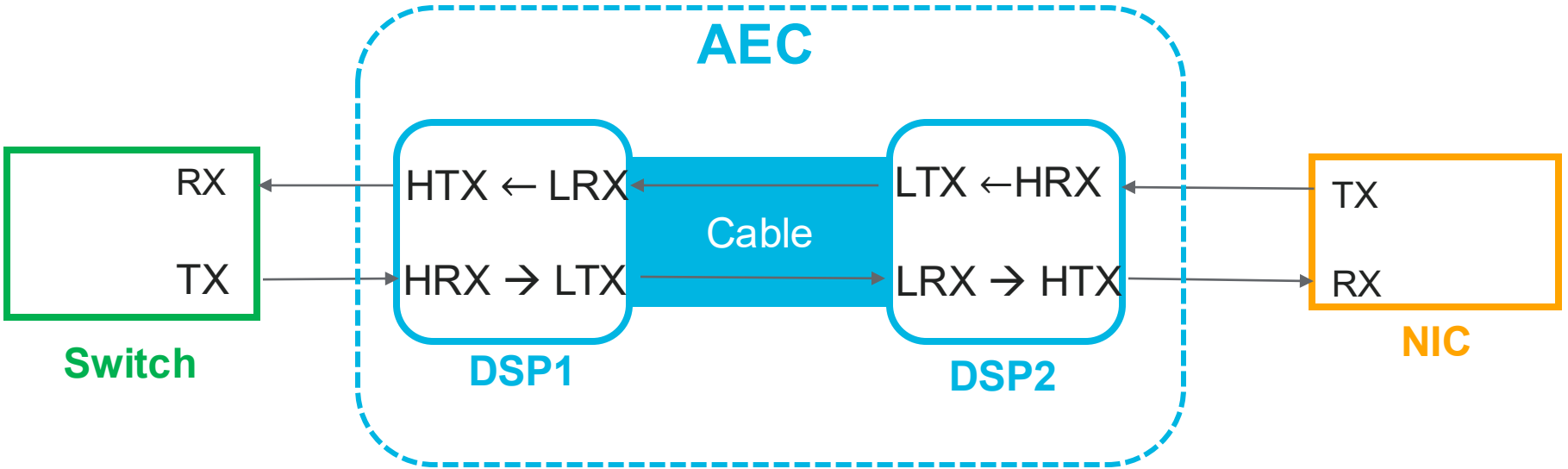
Server NIC/DPU to ToR Switch

Rack-to-Rack Switches

ToR Switch to Leaf/Spine



AEC Traffic Flow Example



Interfaces in Each DSP: Host Side (HRX, HTX) and Line Side(LTX, LRX)
Transmitter (TX) Parameters: e.g. TX FIR taps, Inner Eye
Receiver (RX) Parameters: e.g. CTLE, AFE Trim, DFE

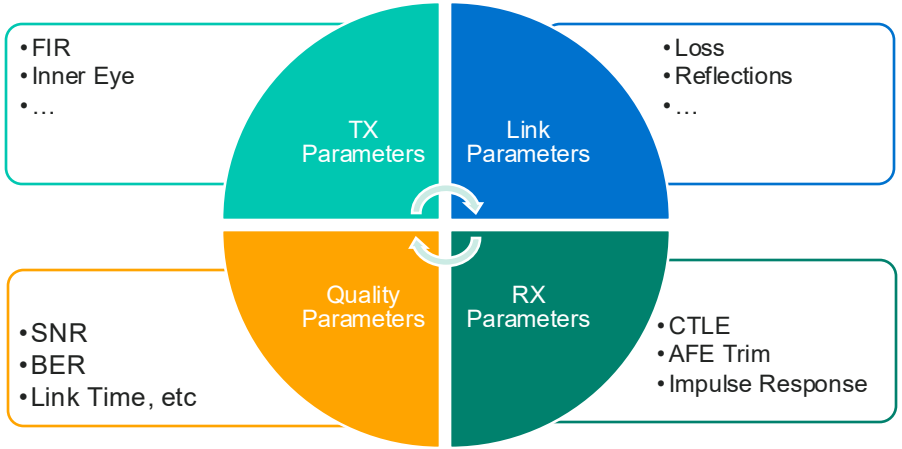
Motivation for AI Assisted AEC Tuning

Active Electric Cables Interop Combinations

- Switch: 4
- NIC: 2
- Ports: 32
- Lengths: 3
- Temperature: 3
- Voltage: 3
- Min Samples 10

~70K combinations

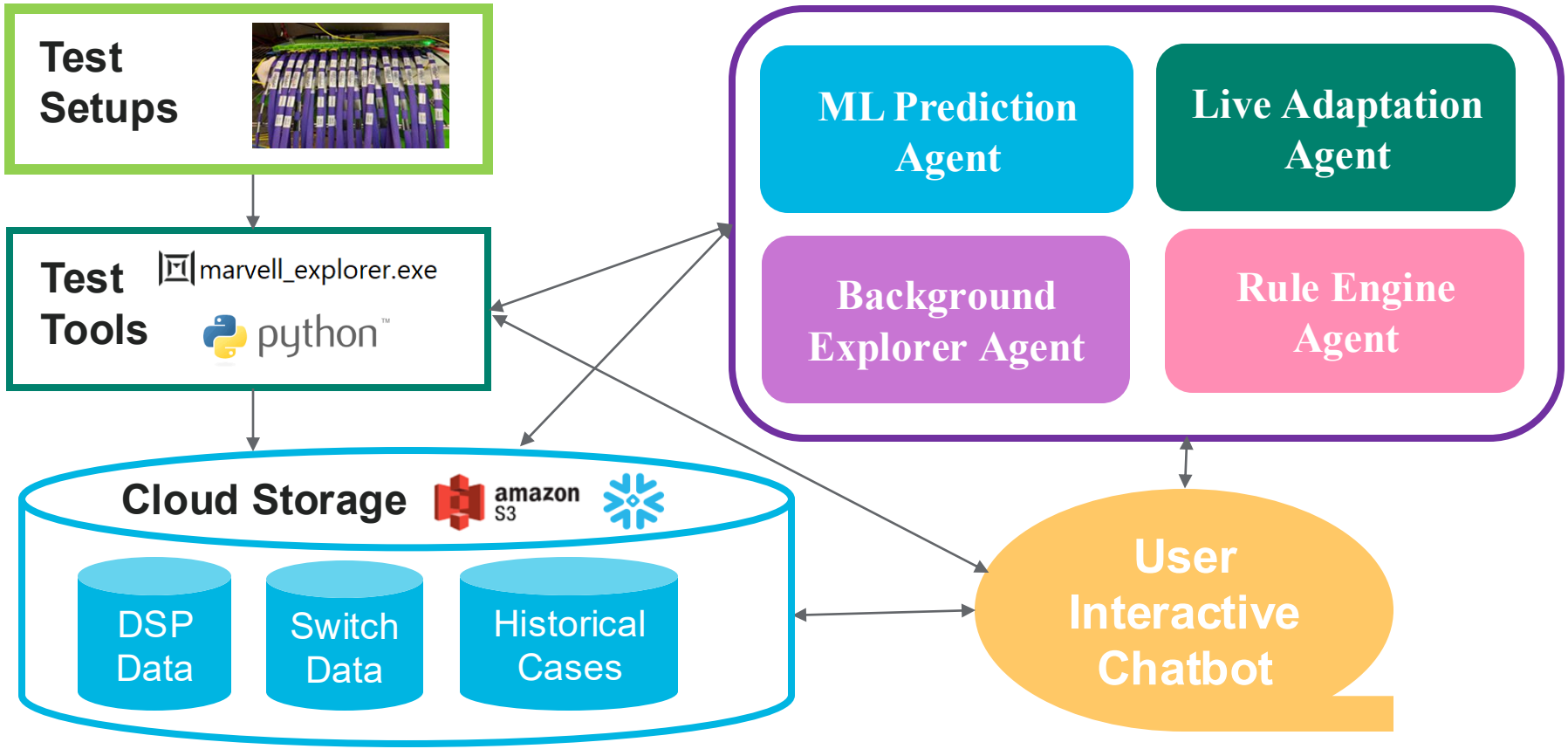
Parameter Complexity



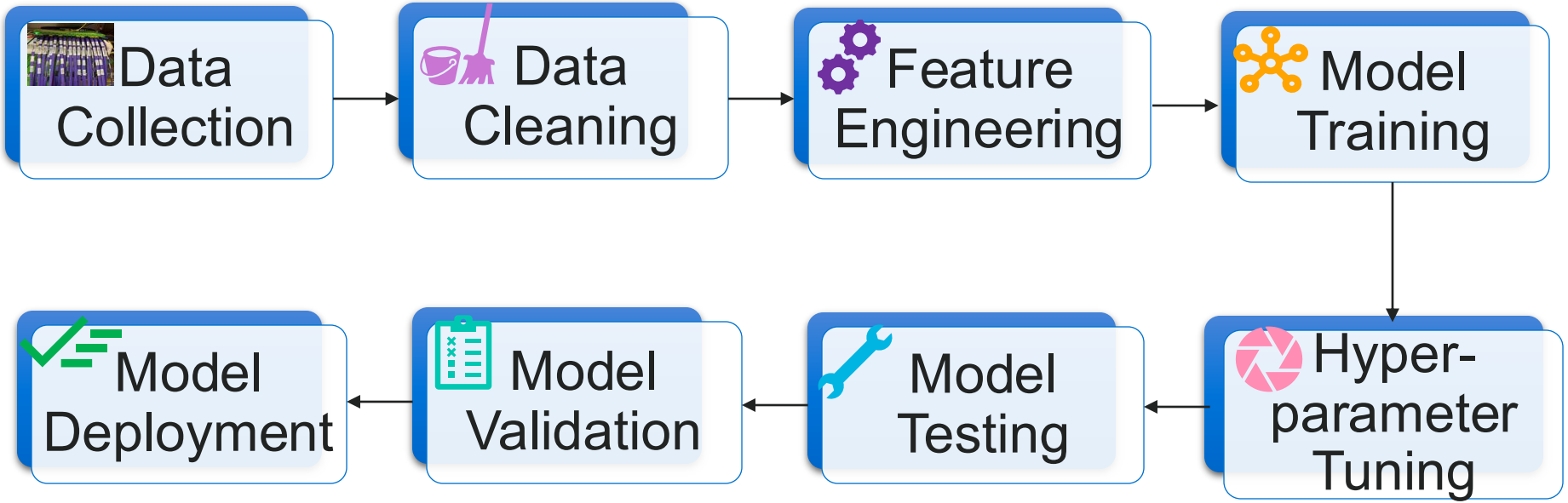
Challenges:

- Limited test data and constrained observability
- Algorithms are not robust/transferable
- Brute force grid search can be time consuming

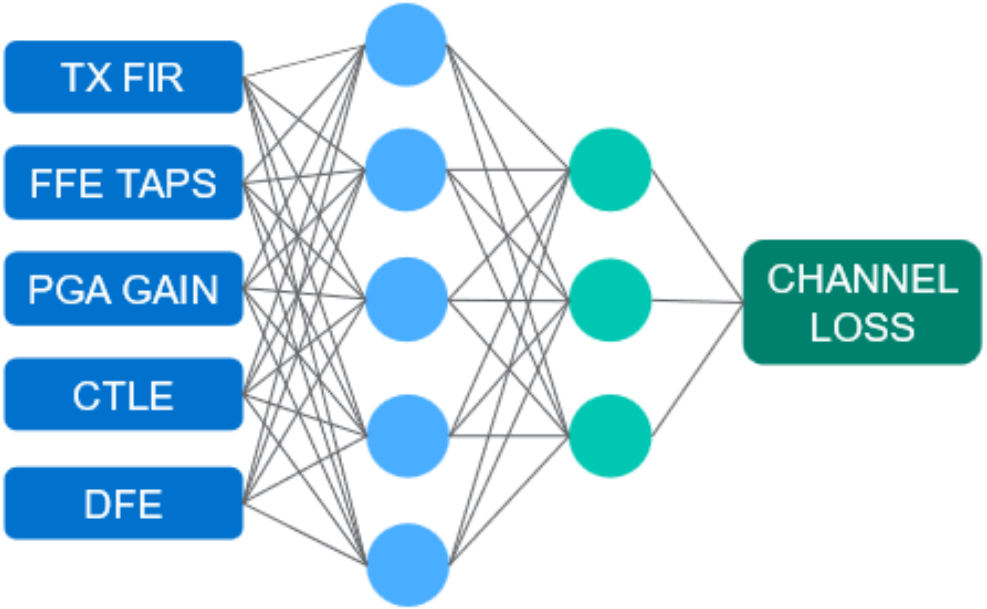
Multi-Agent AI Assisted AEC Tuning Framework

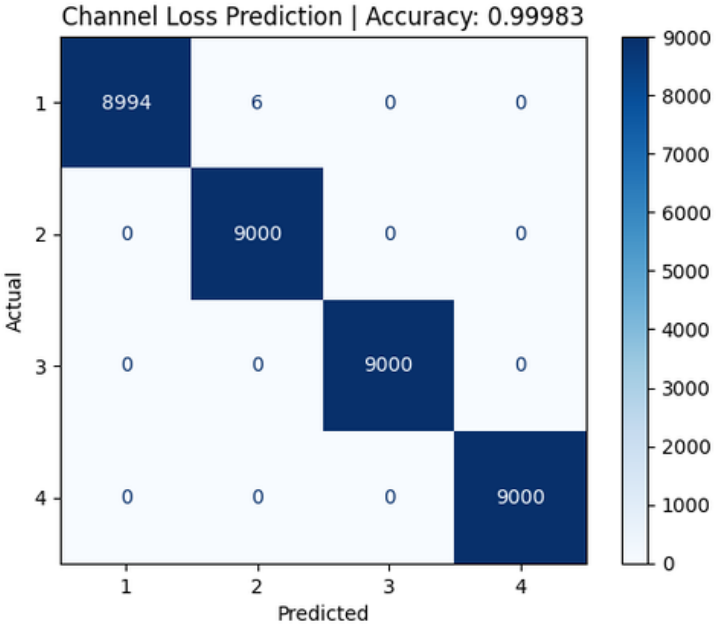


ML Prediction Agent

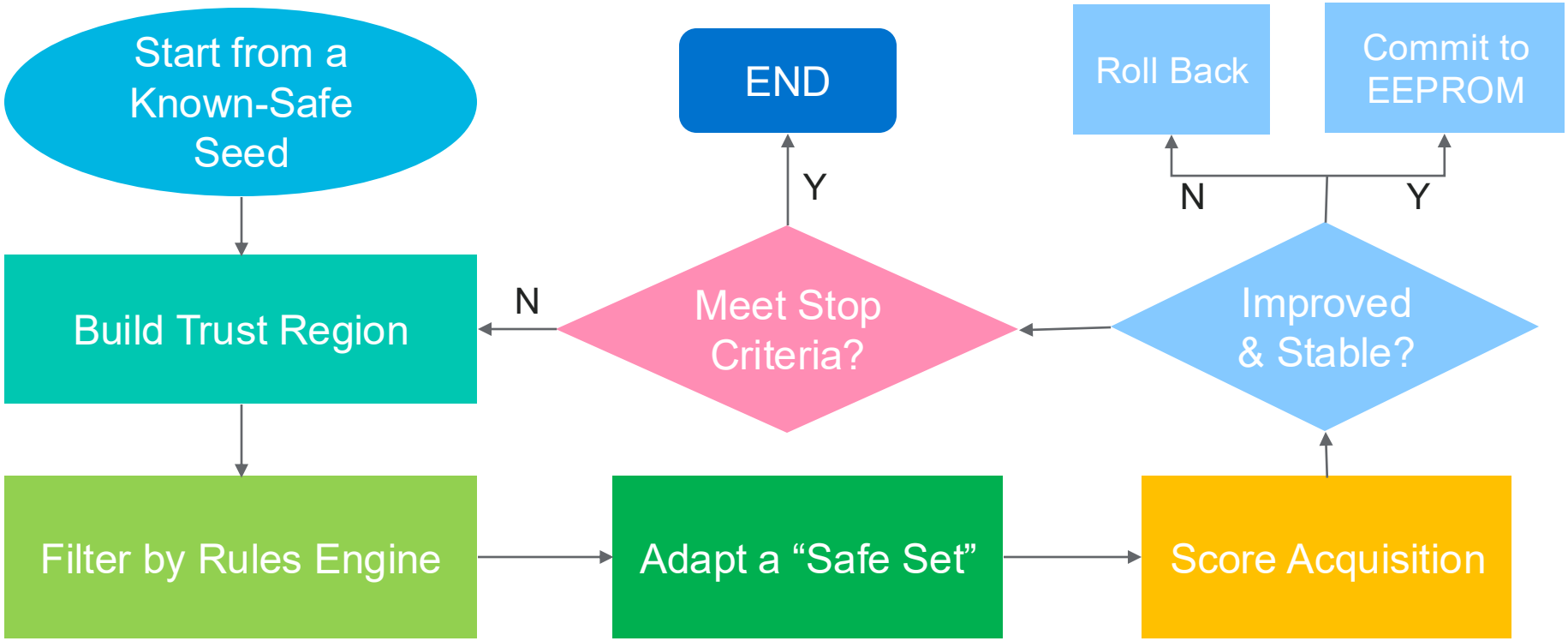


ML Prediction Agent Case Study



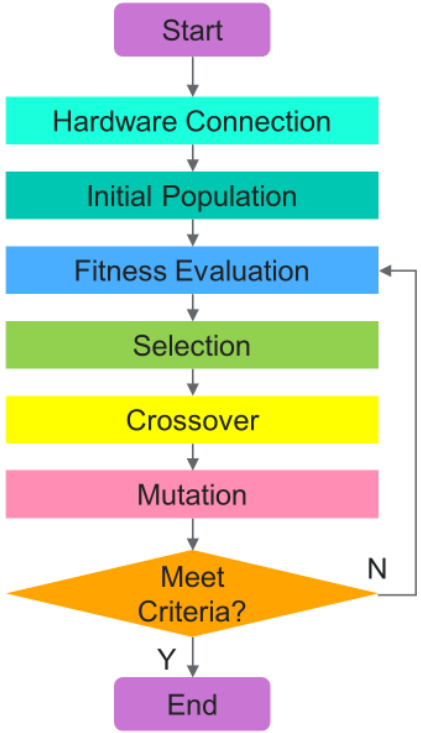


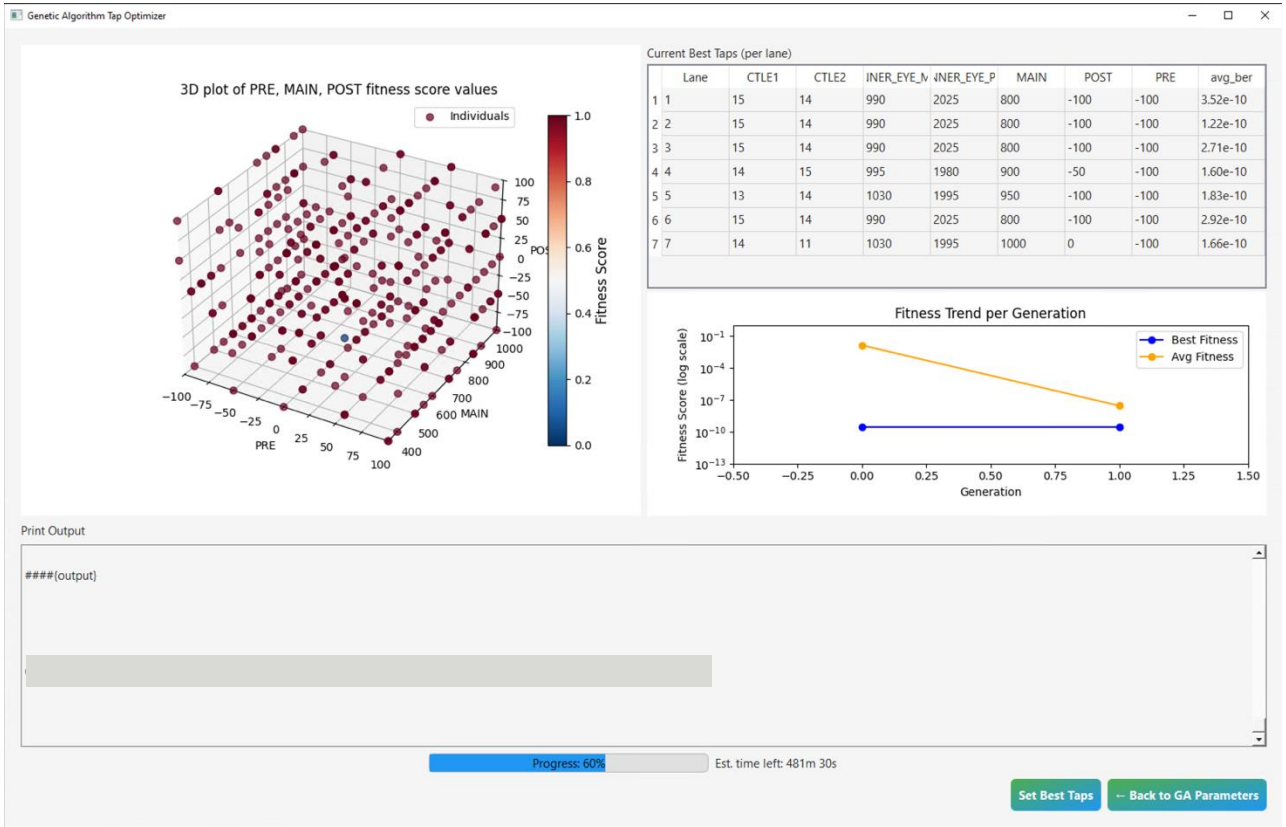
Live Adaptation Agent



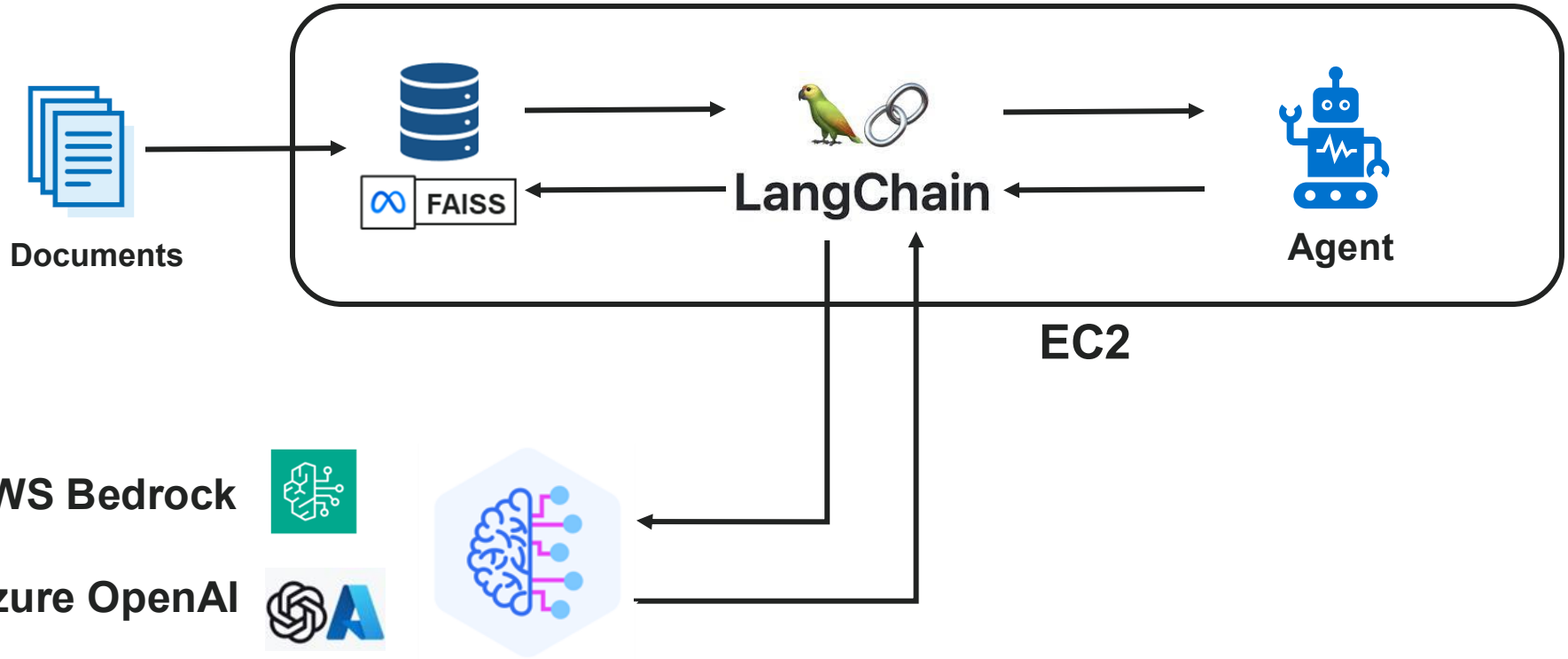
Background Explorer Agent (GA Based)

Genetic Algorithm

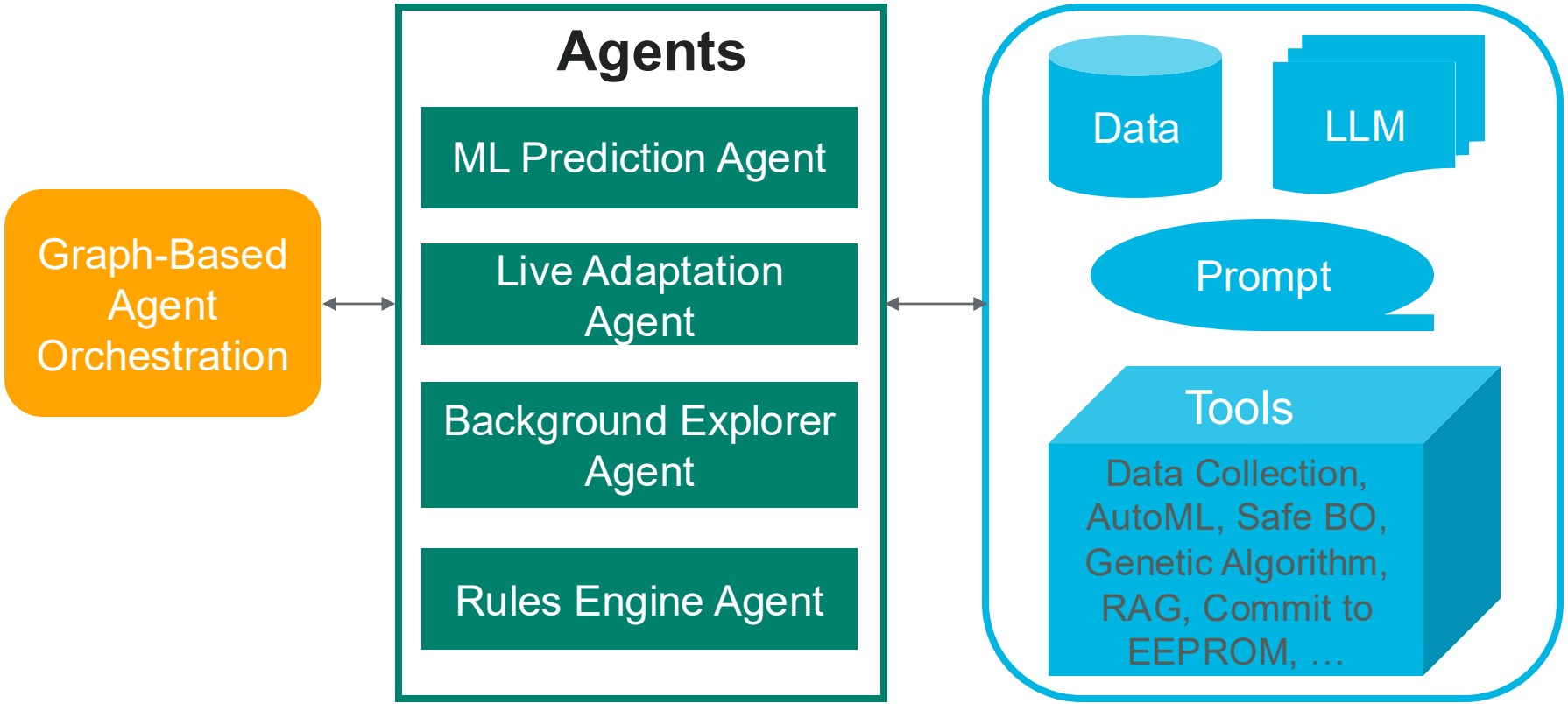




Rules Engine Agent (RAG Based)



Multi-Agent Orchestration



Summary

- **Multi-agent stack:** ML Prediction, Live Adaptation, GA Explorer, RAG Rules Engine.
- **Safety by design:** Signed guardrails, trust region, watchdogs, instant rollback.
- **Speed:** Bring-up/retune cut from days to hours; fewer maintenance windows.
- **Efficiency:** Eliminates manual sweeps; millisecond estimate; real-time micro-tuning.
- **Reliability:** Higher first-attempt link-up; stable under thermal/voltage/service events.
- **Interoperability:** Consistent across various devices; reusable profiles; easy to scale.

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Q&A

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Thank You

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