“A Scalable Co-simulation Framework for AnyLogic”

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Mechanical Engineer who loves Aircrafts

- Fitness & Bodybuilding
- Badminton
- Tennis Enthusiast

Meet Junaid

Technical Specialist - Flow Simulation

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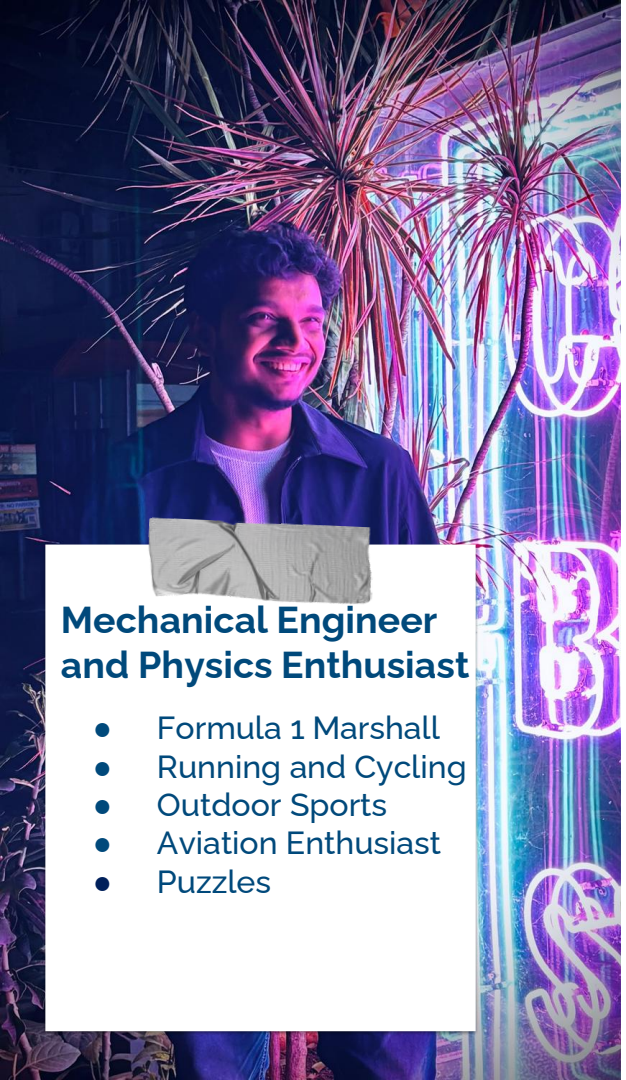

Mechanical Engineer and Physics Enthusiast

- Formula 1 Marshall
- Running and Cycling
- Outdoor Sports
- Aviation Enthusiast
- Puzzles

Meet Sathvik

Structural Design Engineer → Simulations

Software Engineer

- Open Source Enthusiast
- Basketball
- Music
- Trekking

Meet Ankush

Full Stack Developer

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Agenda

Junaid

- **AIRBUS - Who we are**
- THE WHY?
- **THE WHAT?**
- THE HOW?
- **THE IMPACT?**
- THE FUTURE?

AIRBUS

Who we are

Airbus is a global aerospace pioneer, operating in the commercial aircraft, helicopter, defence and space sectors.

AIRBUS

Our purpose

We pioneer sustainable aerospace for a safe and united world

Leading the journey towards clean aerospace

Helping customers defend their values

Connecting and uniting people across the globe

AIRBUS

Our Business

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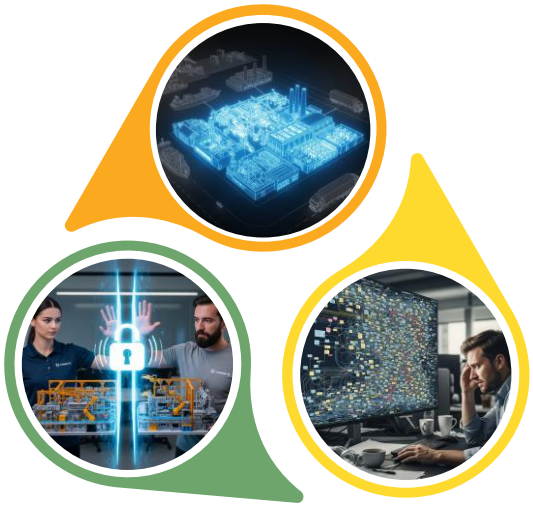
The WHY? — The Limits of Traditional Simulation

Junaid

Interconnected World, Isolated Models



The Collaboration & IP Barrier

Complexity & Scalability Issues

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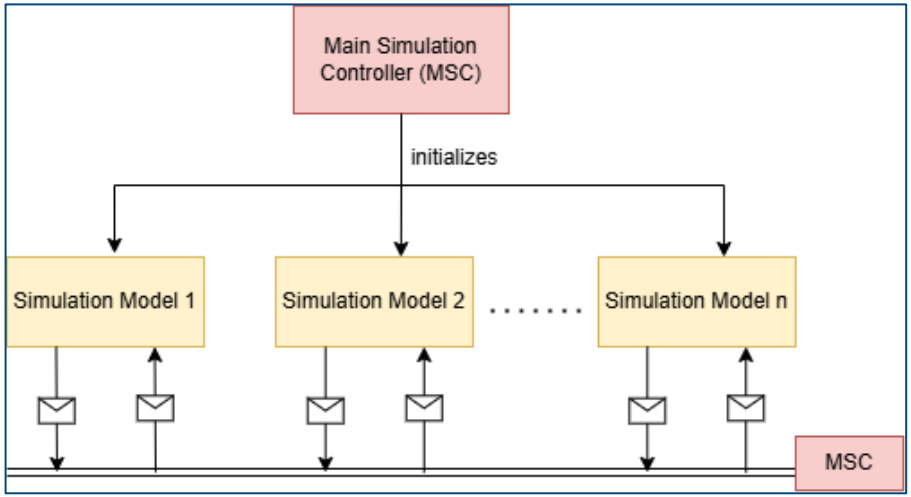
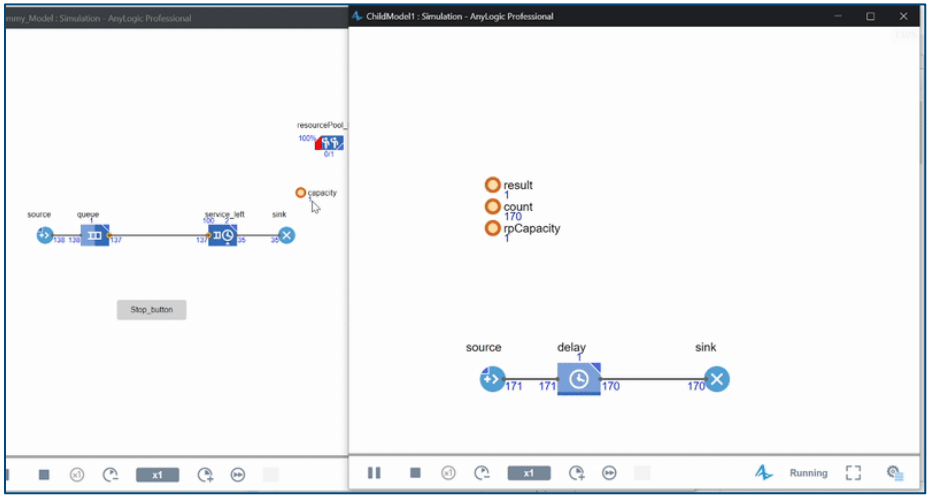
The WHAT? — A "System of Systems" Approach

Junaid

Master-Child Architecture: A methodology that enables multiple, independently developed simulation models to run concurrently, exchanging data in real-time to function as a single, cohesive system.





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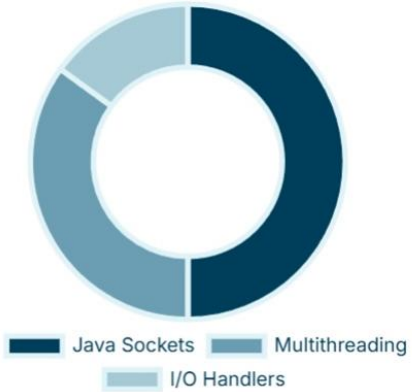
The HOW? — Our Implementation Journey in AnyLogic

Sathvik

Core Capabilities Developed

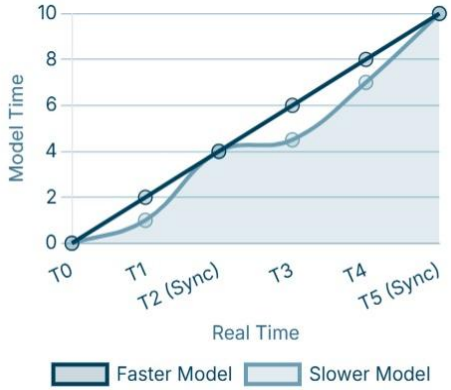
Real-Time Communication

A robust client-server architecture using Java sockets and multithreading enables seamless, two-way data flow between models, forming the backbone of the co-simulation architecture.



Adaptive Time Synchronization

Our Catch-up algorithm ensures all models stay synchronized. Slower models accelerate their step execution to catch up with faster ones, preventing time drift and maintaining simulation integrity.



Secure Black-Box Models

To protect intellectual property, models are encapsulated into runnable files. This "black-box" approach hides internal logic while allowing secure data exchange, fostering cross-organizational collaboration.

Model Encapsulation

Proprietary Logic is Encapsulated and Secured

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The HOW? — Our Implementation Journey in AnyLogic

Sathvik

The Journey: A Milestone-Driven Approach

M1

One-Way Communication

Established initial client-server link via sockets.

M2

Bi-Directional Flow & Thread Fixes

Enabled two-way data exchange and resolved thread/socket management issues.

M3

Time Synchronization

Implemented step-based sync and the adaptive "Catch-Up" algorithm.

M4

Black-Box Implementation

Achieved model encapsulation using runnable JAR files.

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The HOW? — Our Implementation Journey in AnyLogic

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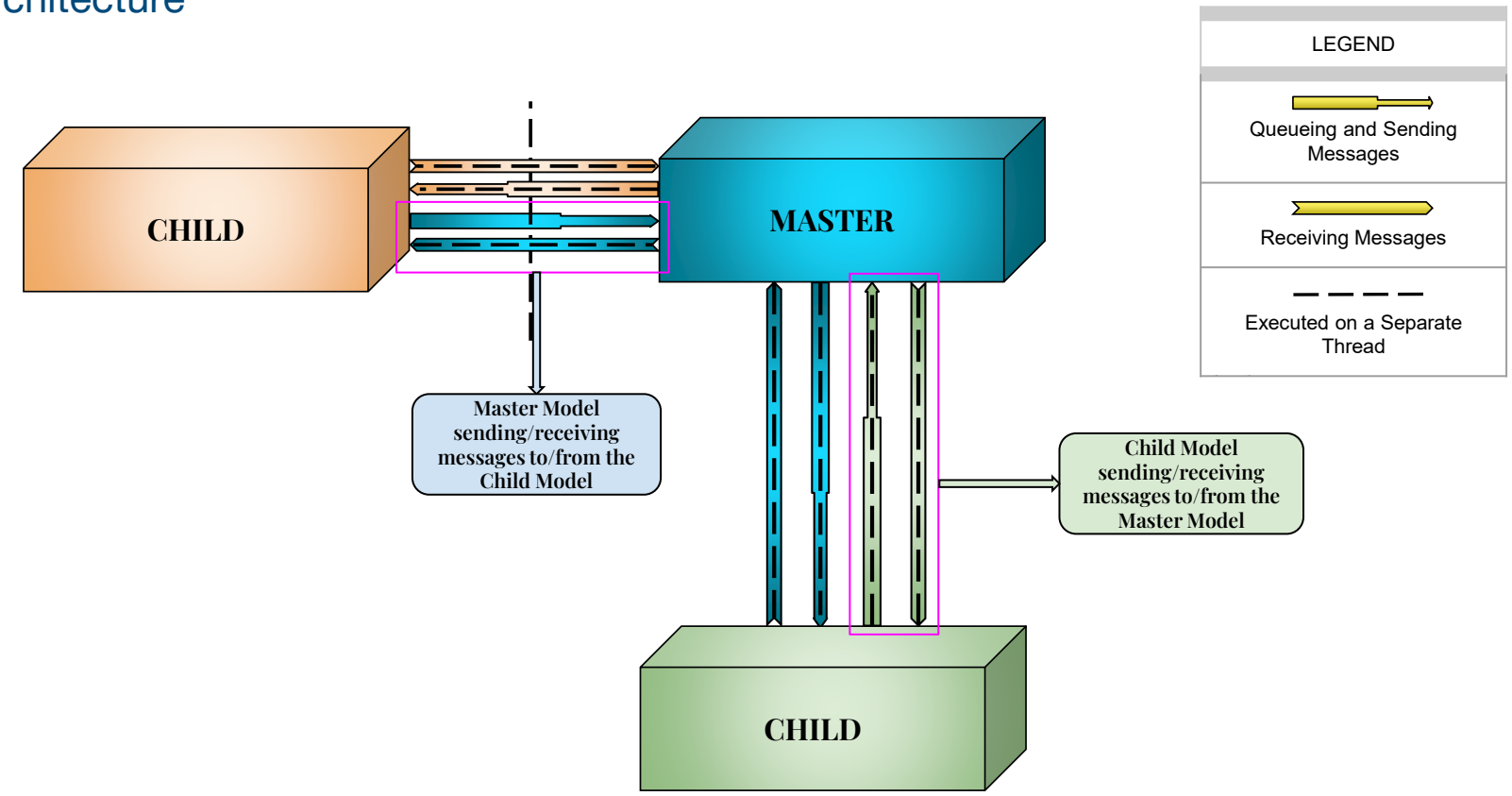
Concept Architecture



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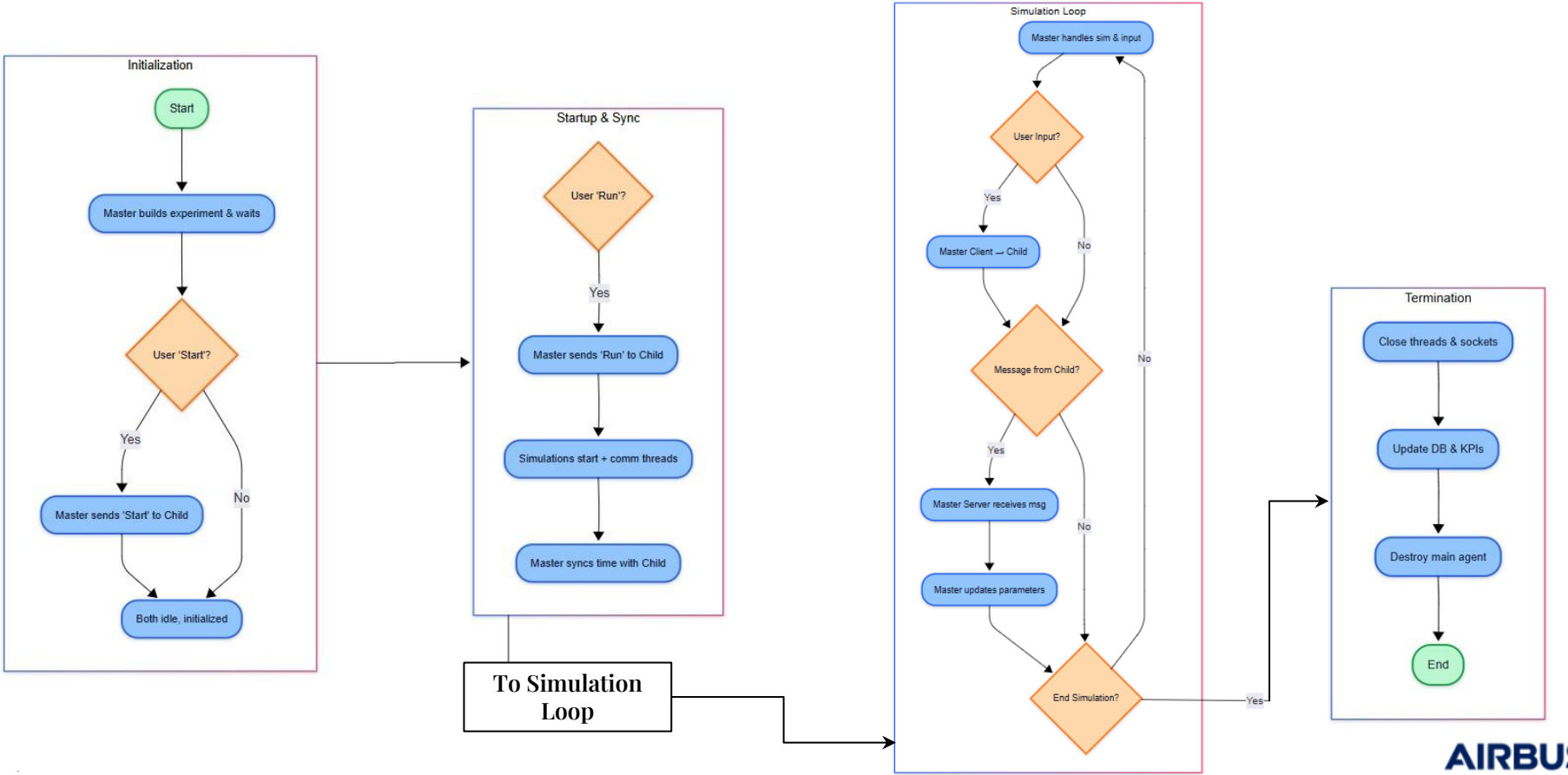
The HOW? — Our Implementation Journey in AnyLogic

Ankush

Concept Architecture



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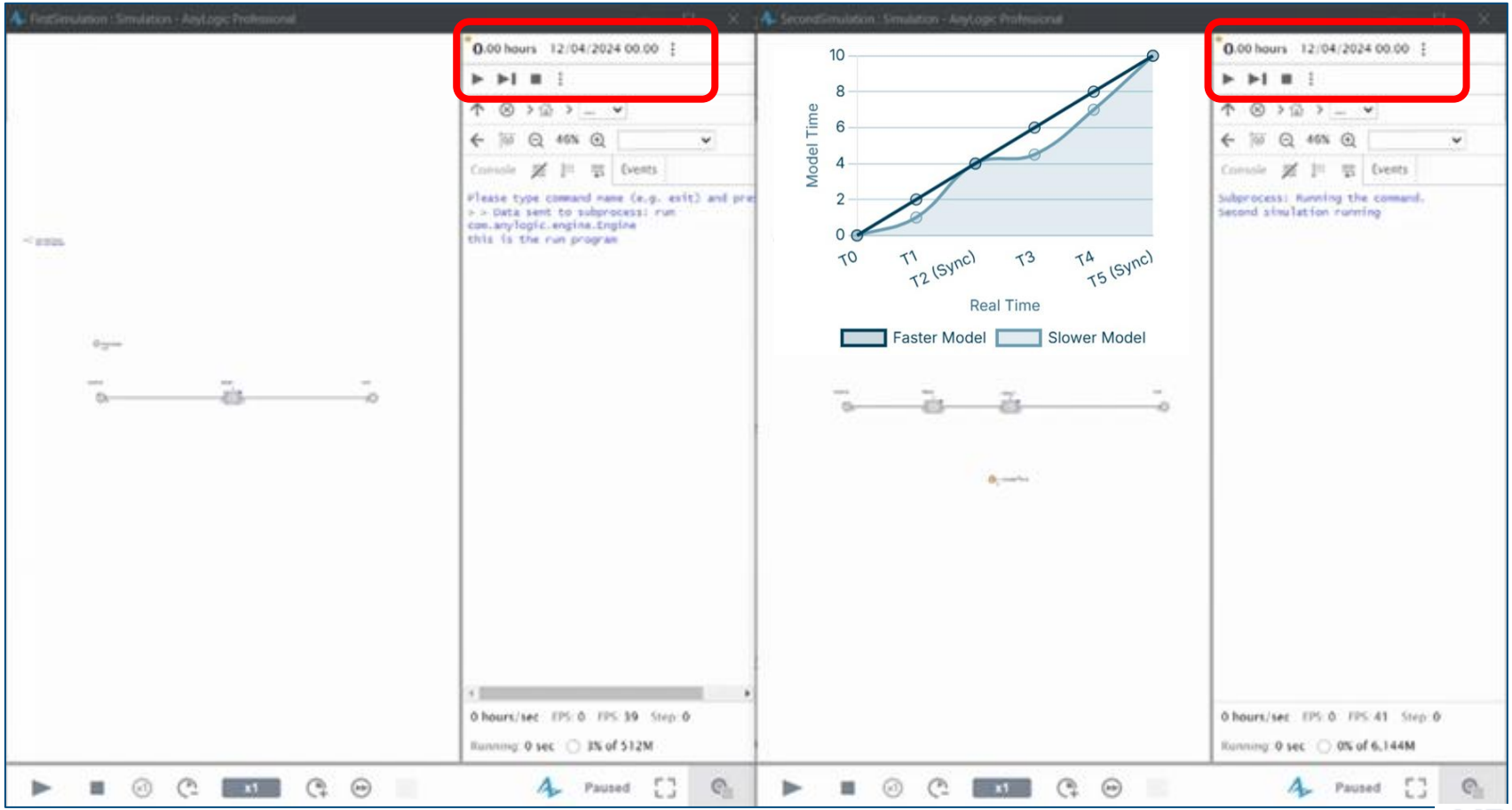
Ankush



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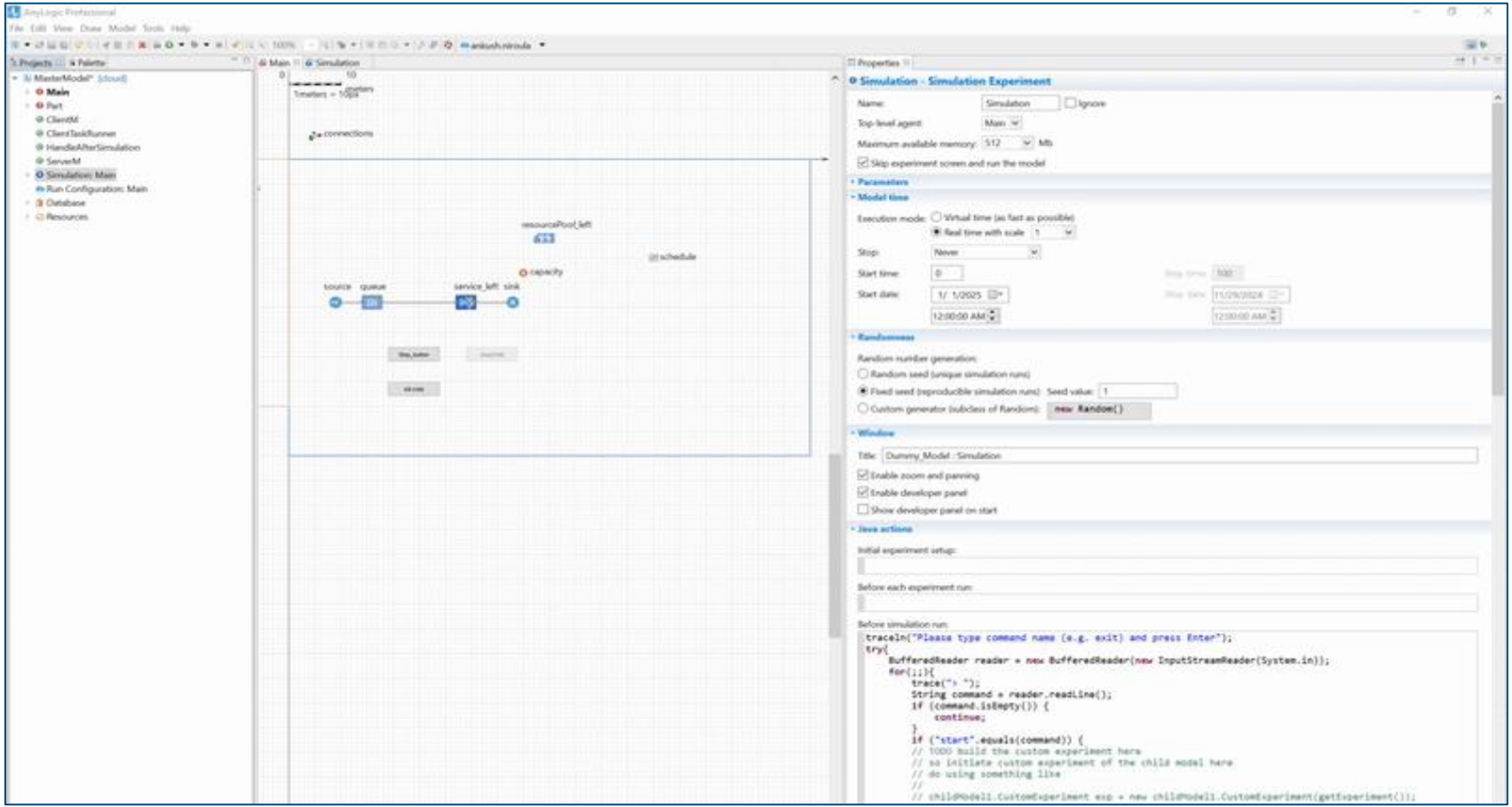
The HOW? — Our Implementation Journey in AnyLogic

Ankush



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The IMPACT — Unlocking Transformative Business Value

Junaid

This capability unlocks critical insights across numerous sectors

Supply Chain

Build resilient, end-to-end digital twins by connecting secure models from suppliers, logistics partners, and distributors to proactively manage and mitigate disruptions across the entire value chain.

Financial Services

Test the entire financial system's response to a crisis, allowing competing banks to contribute to the simulation securely without sharing their private information.

Aerospace & Defense

Validate the mission readiness and interoperability of complex, multi-contractor systems in a secure environment.

Healthcare

Co-simulation connects hospitals into a regional digital twin, simulating real-time capacity to route critical patients to the optimal facility, preventing fatalities from life-threatening delays.

Energy & Utilities

Analyze grid stability by integrating realistic, proprietary models from independent power producers.

Manufacturing

Virtually commission multi-vendor smart factories by integrating protected models of robots, machinery, and control systems, eliminating integration risks and optimizing production flow before physical setup.

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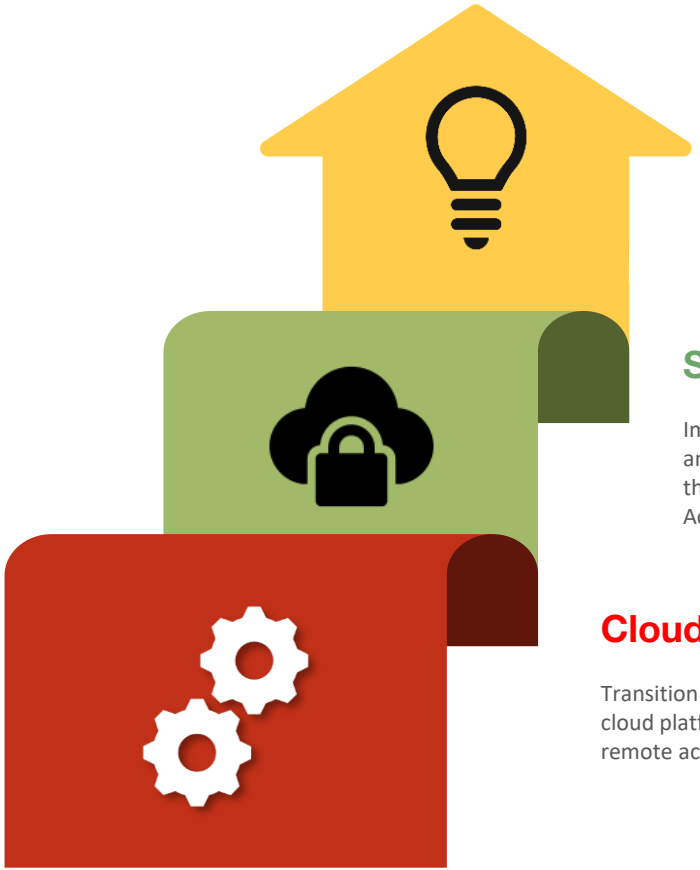
The FUTURE — From a Capability to an Ecosystem

Sathvik

The Vision for Scalable Co-Simulation



Full Digital Twin Integration

Evolve the framework into a real-time Digital Twin, creating a live, virtual replica of the production line for continuous monitoring and predictive maintenance.

Security on the Cloud

Implement a system where the models can be run and perform communications on the cloud without the requirement of local runs of the models. Achieved with secure communication protocols.

Cloud Adaptation

Transition the co-simulation framework to cloud platform for enhanced flexibility on remote access to global teams.

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Thank you

Q & A