

[Case Study](#)

Advanced Autonomous Robotics for Defense R&D

Delivering Mission-Ready Navigation in
GPS-Denied Environments

40%

Field-Testing Reduction

30%

Deployment Acceleration

Client Profile:

Our client is a premier government research organization operating under the Ministry of Defence, Government of India. Based in Bengaluru, this strategic R&D institution specializes in advanced robotics, autonomous systems, and underwater defense technologies. With a highly skilled workforce of 500+ scientists and engineers, it drives cutting-edge innovations for national security applications, including unmanned platforms, AI-enabled systems, and secure communication solutions.

Problem Statement

The client faced critical gaps in deploying autonomous systems for defense applications:



Localization Failure: Inability to maintain accurate positioning indoors/outdoors without GPS signals, risking mission integrity.



Sensor Fusion Complexity: Unreliable real-time integration of LiDAR, IMU, and stereo camera data, causing navigation drift.



Software Capability Gap: Limited in-house expertise to develop scalable ROS2-based autonomy stacks for path planning and 3D mapping.



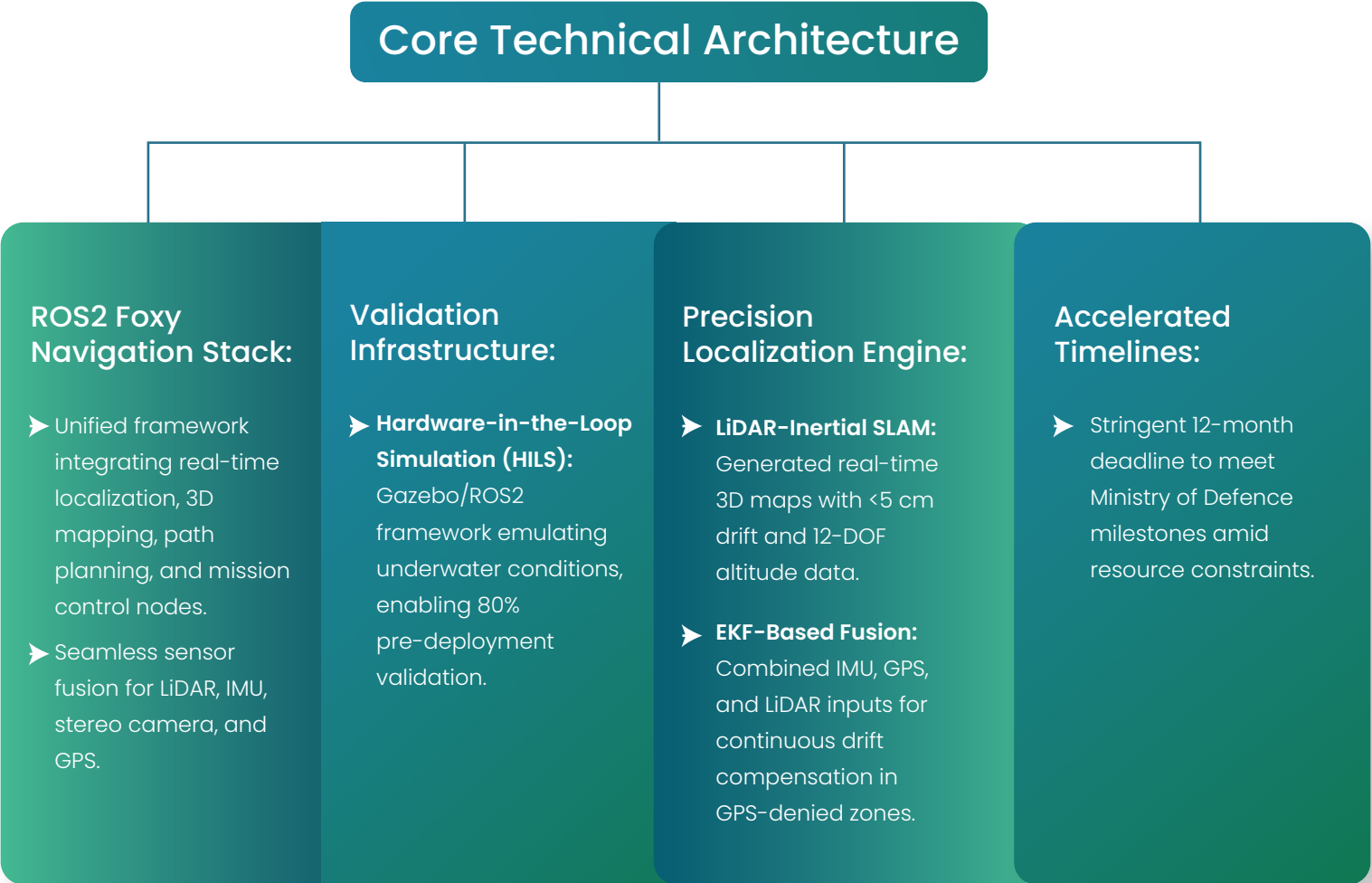
Validation Bottlenecks: Absence of Hardware-in-the-Loop Simulation (HILS) delayed algorithm testing, escalating field deployment risks.



Accelerated Timelines: Stringent 12-month deadline to meet Ministry of Defence milestones amid resource constraints.

Our Solution:

MicroGenesis delivered a modular autonomous navigation stack with end-to-end capabilities:



Development Approach

Phase	Activities	Tools/Outputs
Development	Custom ROS2 nodes for SLAM, EKF, path planning	C++, Python, Nav2 Stack
Testing	HILS validation of obstacle navigation	Gazebo, RViz, Ubuntu 20.04
Deployment	Docker packaging; on-premises integration	Docker, GitLab CI/CD
Knowledge Transfer	SDD/ICD documentation; on-site training	Technical manuals, simulation reports

Business Impact:

The solution delivered mission-ready autonomy within 12 months, achieving quantifiable outcomes:

Performance Metrics

KPI	Result	Operational Impact
 Localization Accuracy	<5 cm drift in GPS-denied environments	Reliable navigation in critical zones
Testing Efficiency	80% validation via HILS pre-deployment	40% reduction in on-site testing time
Deployment Speed	Dockerized configuration	30% faster integration
Project Timeline Compliance	On-time delivery within 12 months	Met MoD defense milestones

Strategic Advantages



Future-Ready Architecture:

Modular design enables AI-based semantic mapping and swarm coordination upgrades.



Client Autonomy:

Comprehensive documentation/training empowered in-house team ownership.



Tactical Demonstration:

Successfully validated autonomous multi-floor transitions with dynamic obstacle avoidance.



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