Team Details

a. **Team name:** AETHER Vision
b. **Team leader name:** Sudarshanam Yessasvini
c. **Problem Statement:** Current mobility systems operate in isolation — vehicles act as independent data nodes without real-time collaboration. This leads to delayed hazard response, inefficient routing, and preventable emissions. There's a need for a collective intelligence framework that transforms fleets into connected ecosystems for safer, cleaner, and more adaptive transportation.

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Brief about the idea

AETHER (Autonomous Edge for Transient Hazard Evasion and Routing) transforms isolated vehicles into a **symbiotic cognitive fleet** using Edge AI and mesh networking. Each vehicle becomes part of a distributed neural network — sensing, predicting, and sharing intelligence in real-time. The system's "Cognitive Firewall" acts as a shield against hazards, inefficiencies, and emissions by merging on-edge analytics, peer-to-peer learning, and cloud-driven evolution.

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Opportunities:

The global mobility ecosystem is moving toward connected, intelligent, and sustainable transport. Yet, most “smart vehicle” solutions today operate in **silos**—each vehicle collects and processes its own data without collaborating with others.

AETHER introduces a new opportunity: turning every vehicle into a **node of a collective intelligence network**. By merging **Edge AI, swarm learning, and predictive analytics**, AETHER unlocks safer roads, cleaner cities, and more efficient fleet operations for governments, OEMs, and logistics providers.

How Different Is It from Existing Ideas?

Current Systems	AETHER's Breakthrough
Vehicles act independently, reacting to hazards after detection	Vehicles **cooperate in real-time**, sharing processed insights via mesh networking
Routing optimized only for time or distance	**Fleet-level optimization** based on aerodynamics, emissions, and micro-climate conditions
Safety features detect fatigue reactively	**Biometric-driven proactive wellness monitoring** and automated "safety corridors"
Smart traffic lights rely on fixed logic	**Swarm intelligence** among vehicles negotiates dynamic intersection priority

In essence: AETHER moves from *vehicle autonomy* → to *collective cognition.*

How will it be able to solve the problem?

- **Predicts and Neutralizes Hazards:** Edge AI classifies potholes, road damage, and evolving risks, alerting nearby vehicles instantly.
- **Enhances Driver Safety:** Monitors biometric and behavioral cues to prevent accidents before they occur.
- **Reduces Emissions:** Dynamic, cooperative routing reduces drag and idle time through fleet-wide optimization.
- **Improves Traffic Flow:** Real-time mesh negotiation at intersections minimizes congestion and fuel waste.
- **Data Privacy by Design:** Only anonymized insights are shared—no personal or raw sensor data leaves the vehicle.

USP of the proposed solution

USP — Unique Selling Proposition

The world's first Cognitive Firewall for Mobility."

- AETHER transforms fleets into **self-organizing, learning organisms** that protect drivers, passengers, and the environment.

  Unlike traditional connected-car solutions, AETHER's **Edge–Mesh–Cloud tri-layer architecture** ensures:
- Real-time collaboration without dependence on external networks
- Predictive adaptability through continuous fleet learning
- Ethical, privacy-preserving intelligence sharing
- In short, **AETHER is not just smart mobility—it's symbiotic mobility.**

List of features offered by the solution

1. 🔹 **Predictive Pothole & Road Damage Neutralization:**

* Detects, classifies, and predicts road surface deterioration using Edge AI.
* Shares insights across nearby vehicles for optimized traversal and real-time reporting to civic authorities.

2. Dynamic Emissions–Aero Routing

* Calculates optimal routes based on micro-climate wind patterns, gradient, and fleet positioning.
* Enables cooperative aerodynamic driving, where vehicles adjust speed and alignment to minimize fuel use and drag.

3. Proactive Driver Wellness & Safety Corridor

* Monitors biometric indicators (heart rate variability, grip pressure, micro-saccades).
* Automatically initiates a **“Safety Corridor”** by coordinating with nearby vehicles to create buffer space and reduce driver stress.

4. Swarm Intelligence for Intersection Priority

* Vehicles negotiate right-of-way dynamically based on type, urgency, energy level (EV battery), and occupancy.
* Eliminates unnecessary idling, improving traffic flow and lowering emissions.

5. Cognitive Mesh Networking

* Establishes a low-latency peer-to-peer network** between vehicles using Wi-Fi HaLow or simulated C-V2X.
* Shares only processed intelligence (not raw data), ensuring privacy and ultra-fast decision exchange.

6. Real-Time Fleet Intelligence Dashboard

* Central dashboard visualizing active meshes, predicted hazards, emission savings, and wellness events.
* Provides fleet managers and city operators with actionable, data-driven insights.

7. Edge–Cloud Learning Loop

* Edge AI continuously learns from live conditions; fleet-level cloud AI retrains models and pushes updates back to all vehicles.
* Enables **continuous self-improvement** of the entire fleet ecosystem.

8. Privacy-First Cognitive Firewall

* Built-in architecture that anonymizes, encrypts, and filters shared data.
* Ensures secure intelligence sharing across all vehicles without personal or identifiable information exposure.

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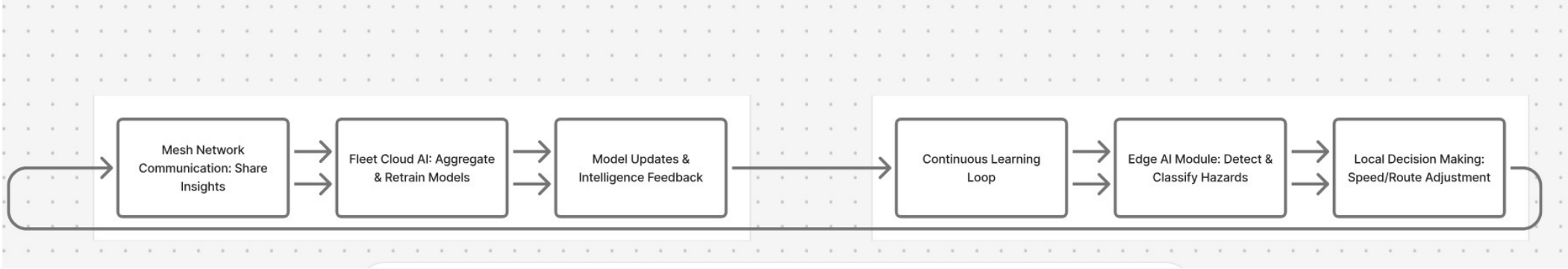
Process flow diagram or Use-case diagram

The **AETHER Process Flow** illustrates how vehicles, edge devices, and the cloud collaborate in real-time to create an intelligent, adaptive fleet network.
Each stage represents how **data becomes intelligence**, shared and evolved continuously across the fleet.



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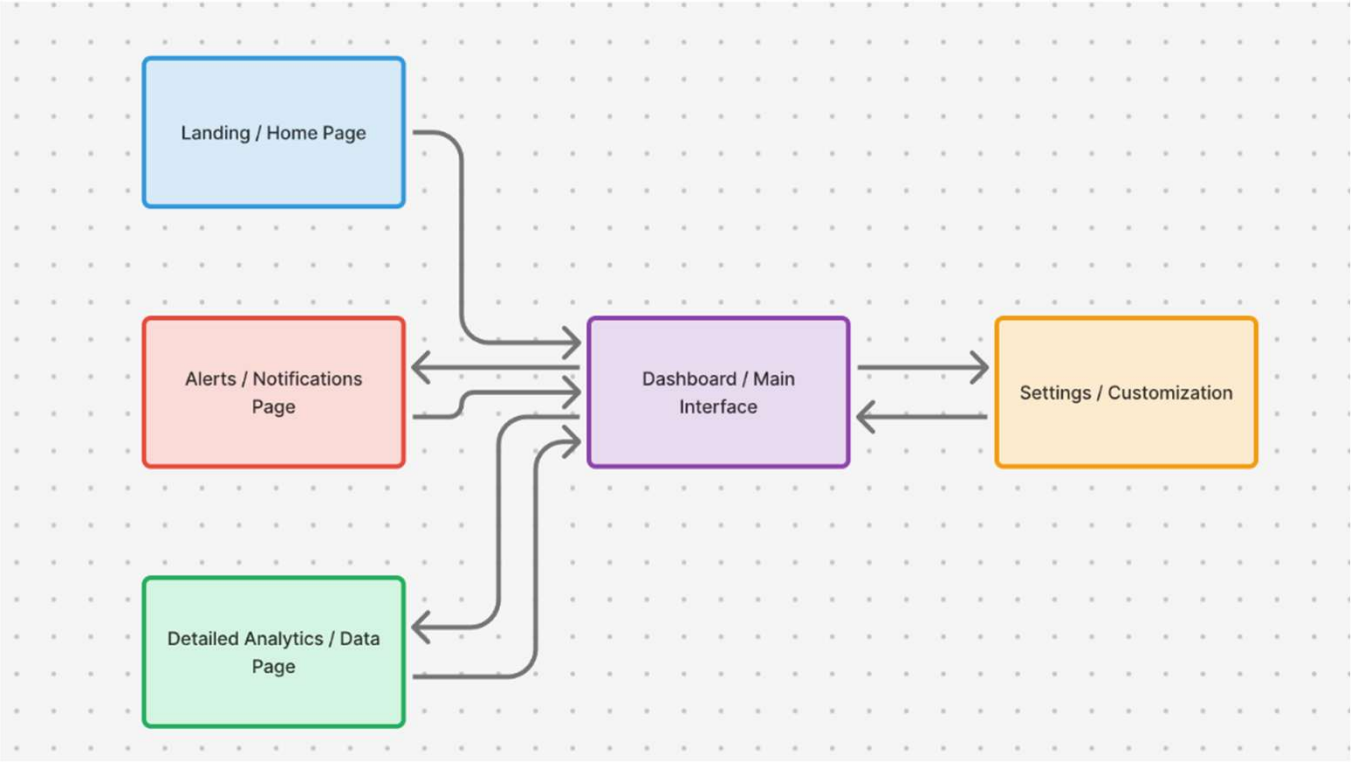
Wireframes/Mock diagrams of the proposed solution (optional)



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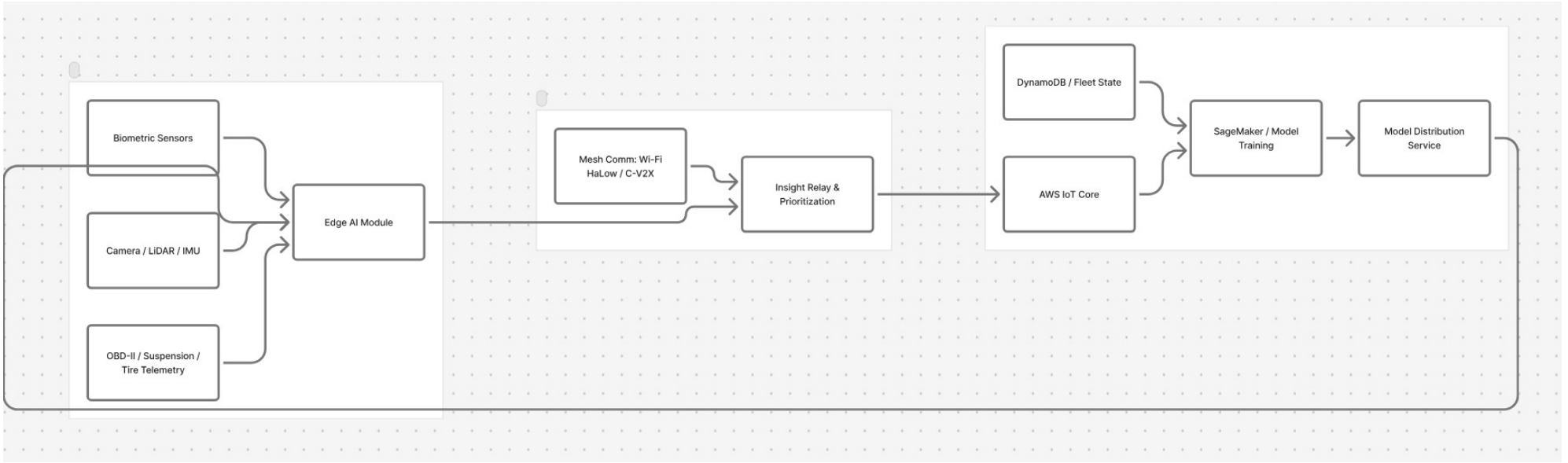
Architecture diagram of the proposed solution



Technologies to be used in the solution

1. Data & Analytics

Big Data Platforms: Apache Hadoop, Apache Spark
Data Warehousing: AWS Redshift, Google BigQuery, Snowflake
Data Visualization: Power BI, Tableau, Grafana

2. Artificial Intelligence & Machine Learning

Machine Learning Frameworks: TensorFlow, PyTorch, Scikit-learn
Computer Vision: OpenCV, YOLO, Mediapipe (for object detection & traffic monitoring)
Natural Language Processing: Hugging Face Transformers, spaCy (for in-vehicle assistants)
Reinforcement Learning: For predictive traffic optimization or autonomous driving scenarios

3. Cloud & Edge Computing

Cloud Platforms: AWS, Microsoft Azure, Google Cloud Platform
Edge Computing: NVIDIA Jetson, AWS IoT Greengrass, Azure IoT Edge
Serverless Architectures: AWS Lambda, Azure Functions

4. Internet of Things (IoT)

IoT Sensors: LIDAR, RADAR, GPS, accelerometers, temperature/humidity sensors
IoT Platforms: AWS IoT Core, Azure IoT Hub, Google Cloud IoT
Vehicle Connectivity Protocols: MQTT, CAN bus, OBD-II interfaces

5. Software & Development

Programming Languages: Python, Java, C++, JavaScript (Node.js / React)
Frameworks: Flask, FastAPI (for APIs), React.js / Next.js (for frontend dashboards)
Databases: PostgreSQL, MongoDB, Firebase, Neo4j (for graph-based traffic networks)

6. Networking & Security

Communication Protocols: 5G, V2X (Vehicle-to-Everything), MQTT, HTTP/REST
Cybersecurity Tools: TLS/SSL encryption, JWT authentication, IDS/IPS solutions

7. AR/VR & Simulation

Simulation Tools: Unity3D, Unreal Engine, CARLA Simulator (for autonomous driving testing)
AR Visualization: ARKit, ARCore (for smart city overlays or vehicle interfaces)

8. DevOps & Monitoring

Containerization: Docker, Kubernetes
CI/CD: GitHub Actions, Jenkins, GitLab CI
Monitoring & Logging: Prometheus, ELK Stack, Grafana

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Estimated implementation cost (optional)

💰 Estimated Implementation Cost (Prototype Phase)

Component	Description	Estimated Cost (INR)
🧠 Edge Hardware Units	NVIDIA Jetson Nano / Xavier modules, sensors (OBD-II, IR, IMU, GPS) for prototype vehicles	₹60,000
🌐 Connectivity & Mesh Simulation	Setup of Wi-Fi HaLow / MQTT mesh network and testing environment using Raspberry Pi nodes	₹25,000
☁️ Cloud Infrastructure	AWS IoT Core, SageMaker training instances, DynamoDB storage, and analytics (for 3 months)	₹15,000
💻 Software Development & Integration	Model development (TensorFlow Lite, OpenCV), dashboard (Streamlit / React), backend APIs	₹10,000
🎛️ Testing & Visualization Tools	Data collection utilities, simulation dashboards, performance visualization	₹5,000
🧩 Miscellaneous & Maintenance	Power supplies, connectors, field testing, transportation, backups	₹5,000
💵 Total Estimated Prototype Cost		₹1.2 Lakhs (INR)

📈 Scalability Outlook

Once validated, the per-vehicle integration cost can drop significantly with:

- Bulk hardware procurement (~30–40% savings)
- Shared cloud inference via federated learning
- Software containerization for modular deployment (Edge + Cloud updates)

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