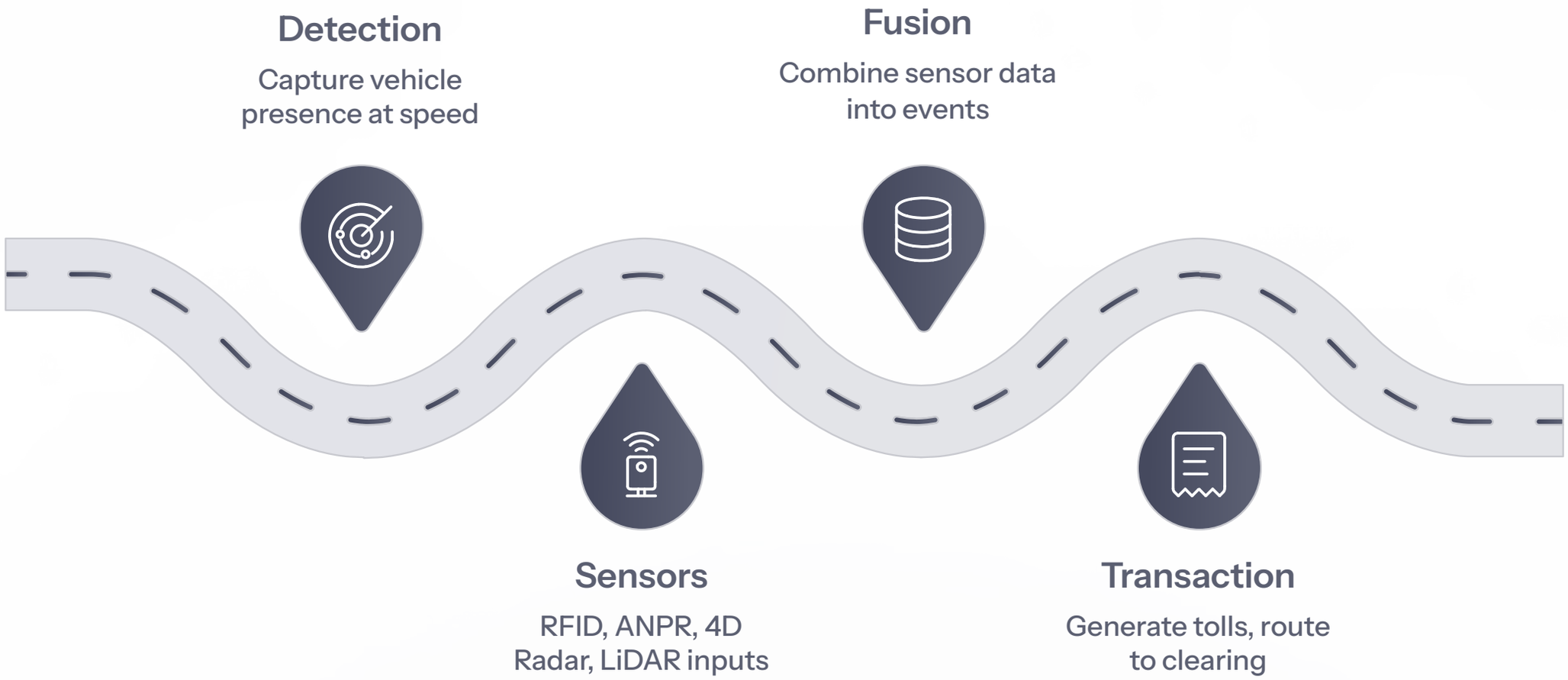
RITAIS Intelligent Transport Architecture

A unified systems overview — from roadside sensors to national command centers. Designed for NHAI, MoRTH, investors, and smart city decision-makers.

EXECUTIVE OVERVIEW

Understand the Solution in 30 Seconds



Every vehicle interaction — from detection to billing — flows through a layered, redundant architecture designed for zero-stop tolling at highway speeds.

Multi-Lane Free Flow: The Core Promise

No Stopping

Vehicles transact at up to 120 km/h

Higher Throughput

3–5× capacity vs. toll plazas

Lower Emissions

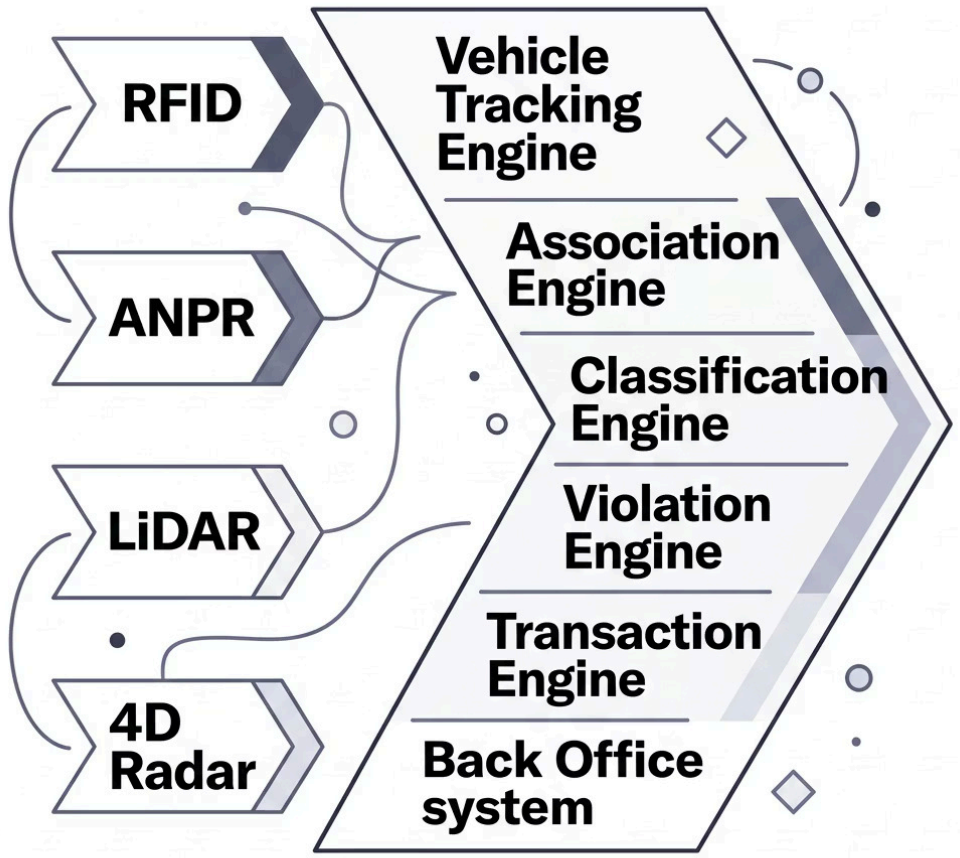
No idling, no deceleration losses

Zero Infrastructure

No barriers, no booths, no queues

ENGINEERING ARCHITECTURE

RITAIS MLFF Sensor Fusion Architecture



Why Fusion Matters

No single sensor is sufficient. RITAIS fuses four independent data streams into a single, legally defensible vehicle record.

RFID

FASTag transponder read

ANPR

License plate recognition

4D Radar

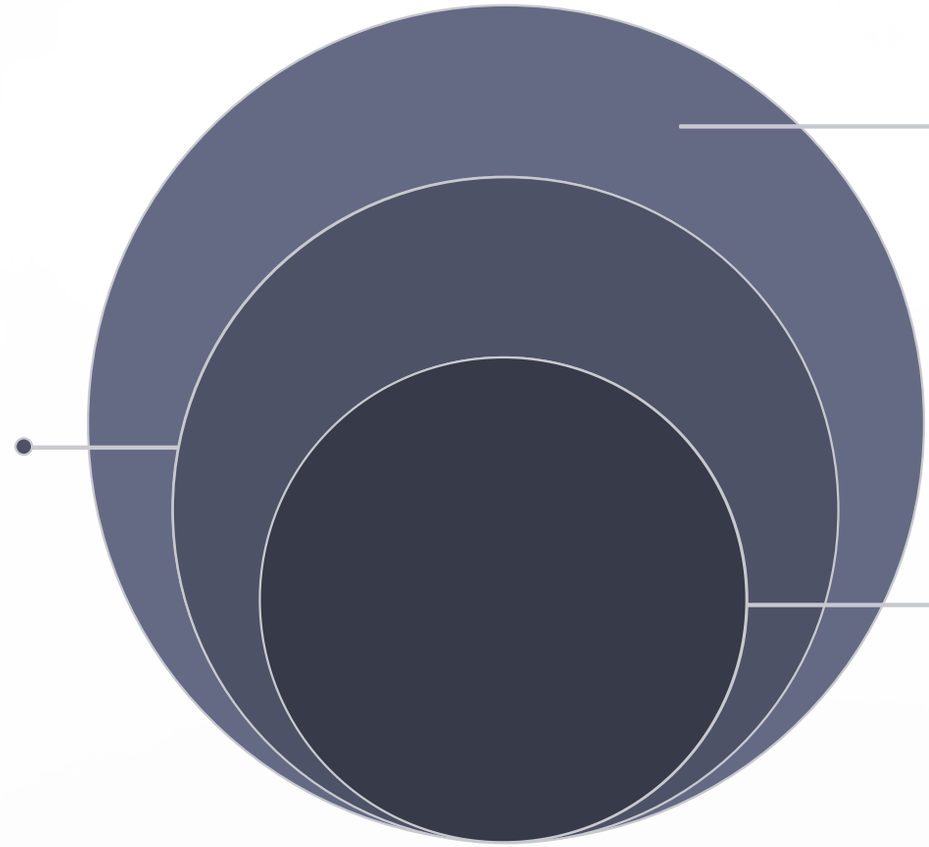
Speed, trajectory, position

LiDAR

Vehicle class, axle count, height

DEPLOYMENT ARCHITECTURE

Physical Deployment: Field to National Center



Outer: Field & Network

Field devices → cabinet → OFC ring redundancy

Layer: Regional Center

Regional monitoring and control

Core: National Center

Central command and coordination

All roadside assets connect via redundant OFC ring topology — ensuring no single point of failure from the gantry to the command center.

USE CASE 1

High-Speed Free Flow Tolling

4D Radar Acquires Vehicle

Vehicle detected at 120 km/h, trajectory locked

RFID + ANPR Read

FASTag and plate captured simultaneously under gantry

LiDAR Classification

Axle count, height, vehicle class confirmed

Transaction Completed

Correct toll deducted — zero driver interaction

USE CASE 2

Lane Change During Tolling

The Problem

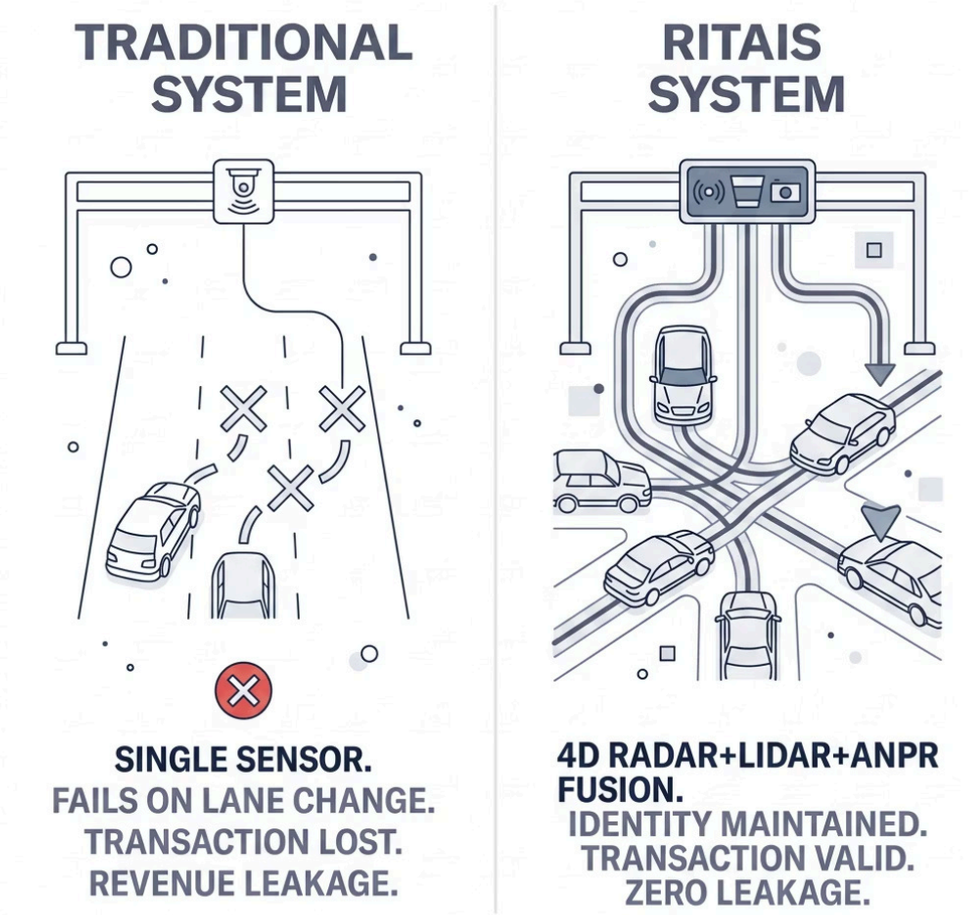
Vehicle enters **Lane 2** but switches to **Lane 3** mid-gantry. Traditional single-sensor systems lose the transaction record — creating revenue leakage and disputes.

⚠ Traditional RFID-only systems fail this scenario entirely.

The RITAIS Solution

4D Radar + LiDAR + ANPR maintain continuous vehicle identity across all lanes simultaneously. Identity is never lost — regardless of lane change timing.

✓ Transaction integrity maintained at all speeds, all lane positions.



USE CASE 3

Truck Occluding a Car

Camera Loses Sight

A truck body fully blocks the trailing car from ANPR and visible-light cameras. Without redundancy, the car's transaction is lost.

Radar Continues Tracking

4D Radar penetrates the truck's mass and independently tracks the car's position, speed, and trajectory throughout the gantry passage.

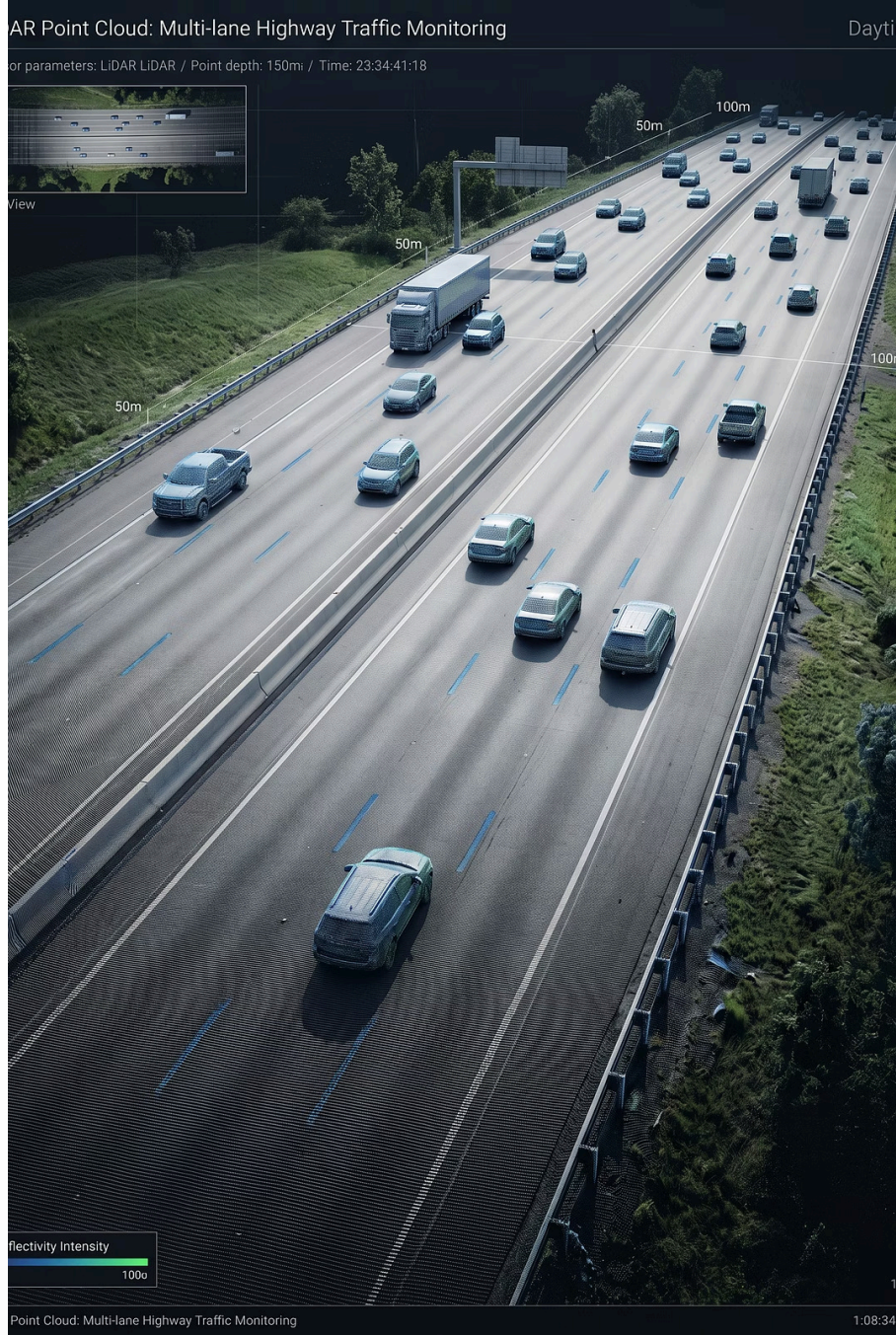
Transaction Remains Valid

Sensor fusion correlates radar track with RFID read — the occluded vehicle is correctly identified and charged. Zero revenue leakage.

DEEP DIVE

LiDAR: The Most Underexplained Sensor in ITS

Most ITS deployments treat LiDAR as a supplementary camera. RITAIS treats it as a primary classification engine — delivering data no camera or radar can provide.



LIDAR ARCHITECTURE

What LiDAR Actually Does in MLFF

Point Cloud Generation

Millions of laser pulses per second produce X, Y, Z, and Intensity data — a precise 3D digital twin of every vehicle passing the gantry.

Vehicle Separation

Distinguishes truck from trailer, car from motorcycle — even when physically adjacent or touching bumper-to-bumper.

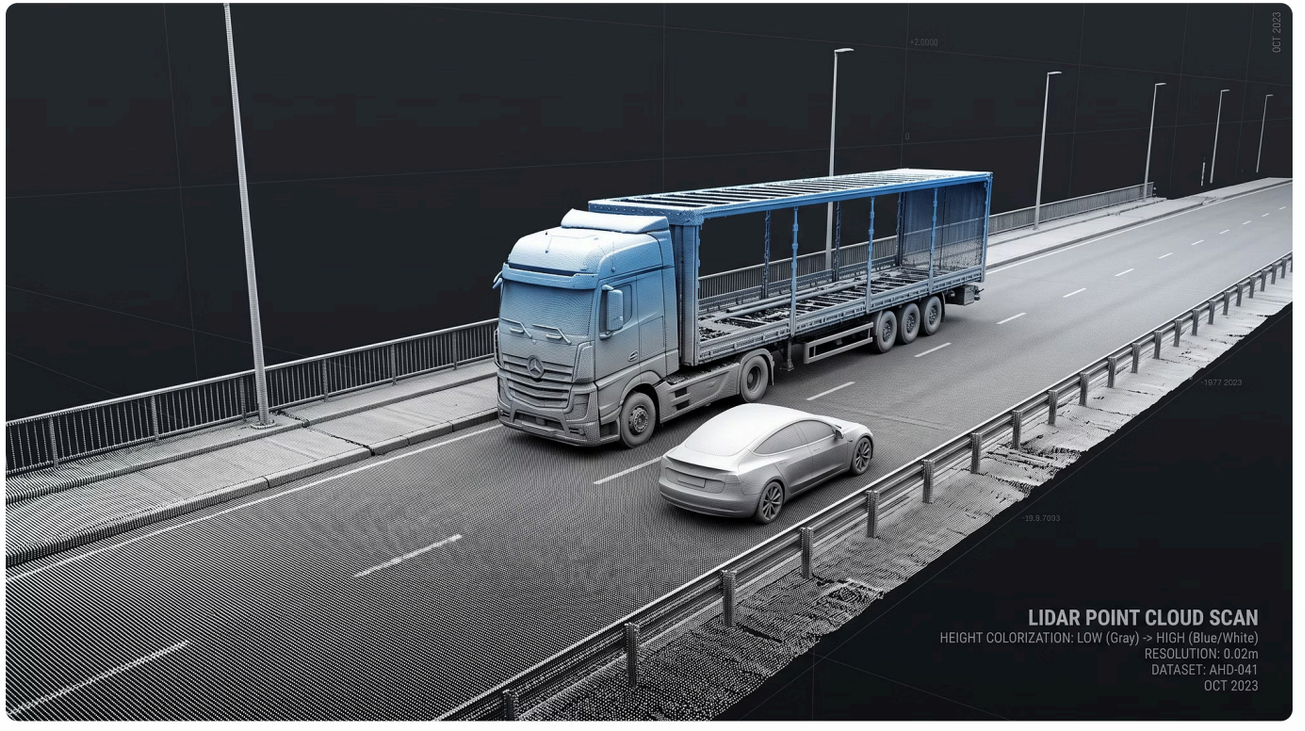
Axle Estimation

Counts axles with high accuracy to support correct toll category assignment — especially for multi-axle commercial vehicles.

Height Measurement

Measures vehicle profile height to cross-validate toll class — catches misclassified or modified vehicles attempting undercharging.

LiDAR Point Cloud: Data Attributes



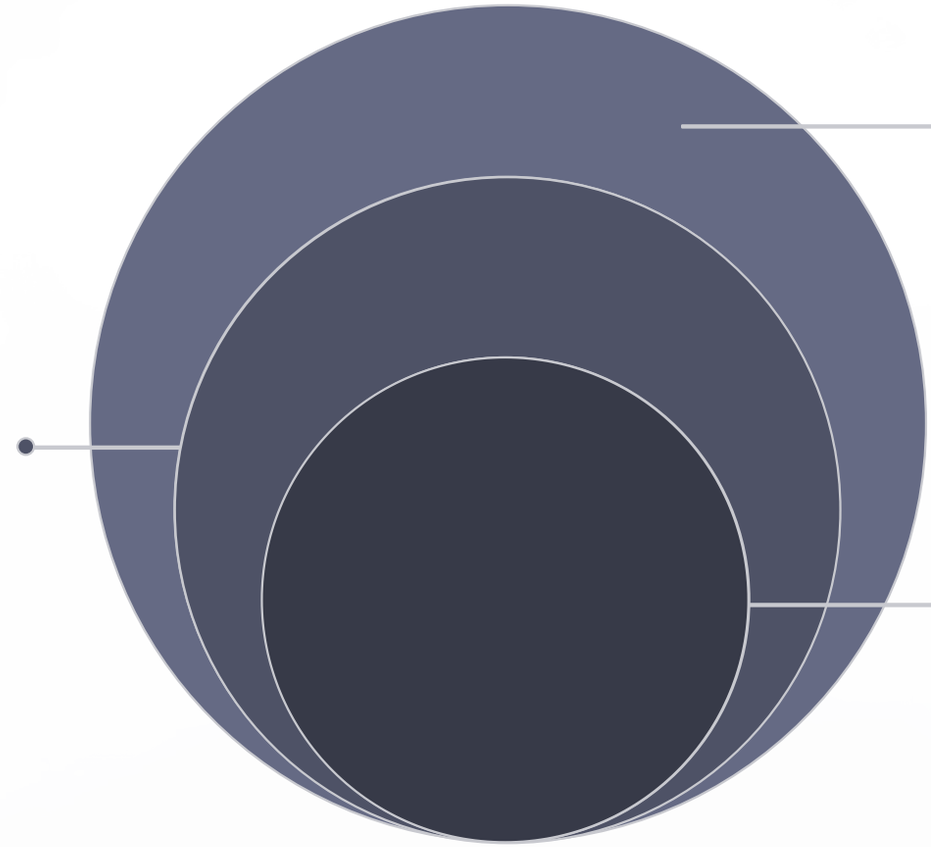
Every Pulse Returns Four Values

Axis	What It Captures
X	Lateral position across lane
Y	Longitudinal position along road
Z	Height above road surface
Intensity	Surface reflectivity / material type

Combined, these four values enable full vehicle classification without any dependence on lighting conditions, weather, or lane markings.

COMMUNICATIONS INFRASTRUCTURE

Smart Highway OFC Backbone



Edge Devices

Field devices via field switches at gantries

Control & Transport

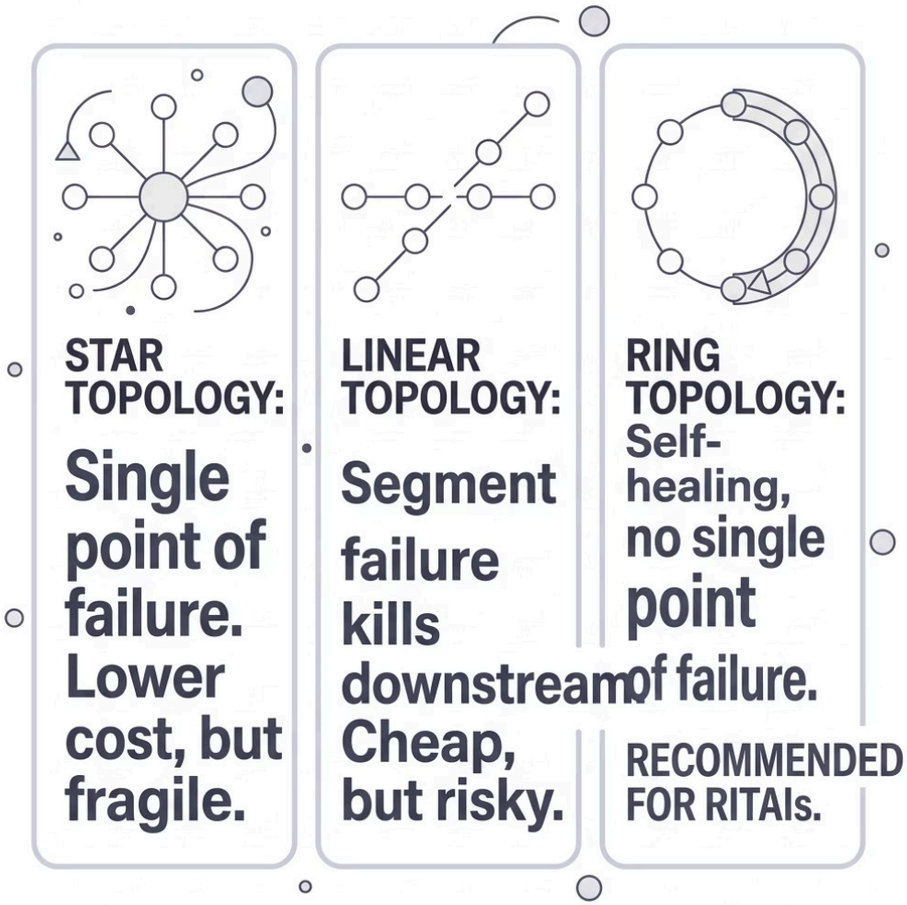
Control Center and redundant OFC ring transport

Core Platform

AI Analytics Platform for centralized insights

All highway assets share a single redundant OFC ring — enabling centralized monitoring, fail-safe redundancy, and future-ready bandwidth for AI workloads.

OFC Ring: Why Ring Topology?



Self-Healing by Design

A ring topology means any single cable cut or node failure causes the network to automatically reroute in the opposite direction — maintaining 100% uptime for tolling and safety systems.

Redundant Path

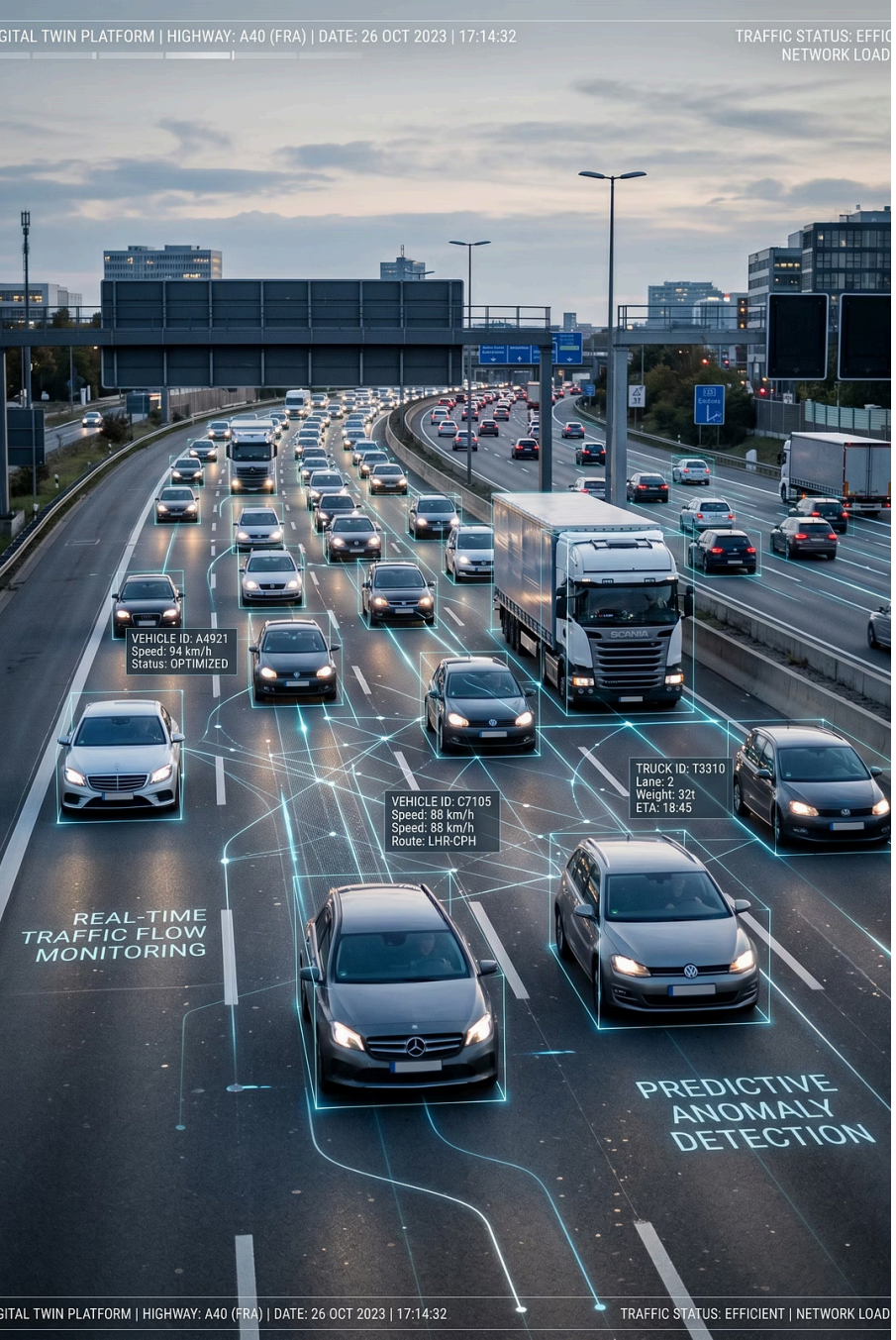
Traffic reroutes in <50ms on fiber cut

Scalable Nodes

New assets added without service disruption

Future-Ready

10G+ bandwidth headroom for AI and video



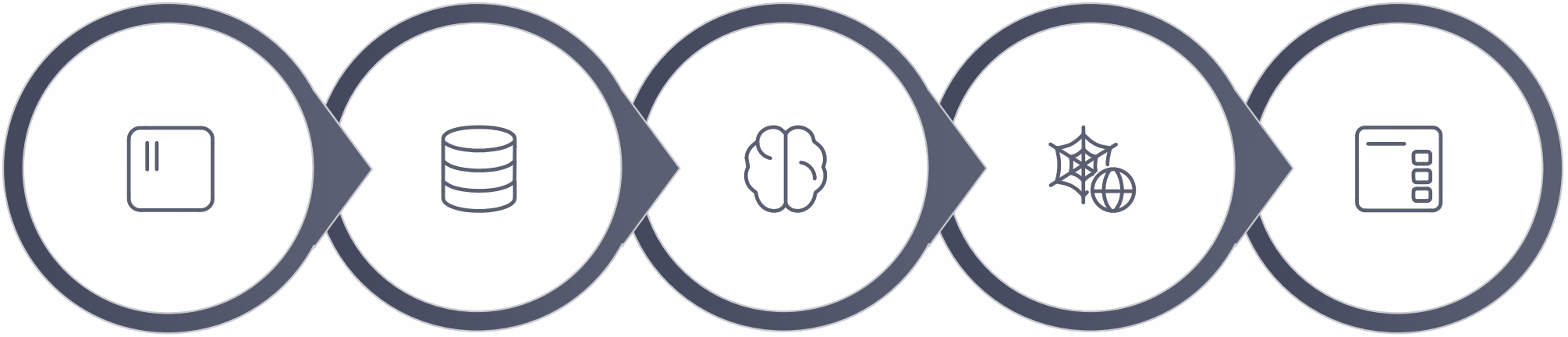
AI PLATFORM

Digital Twin Architecture

Every sensor feed becomes a live input to RITAIS's AI engine — creating a real-time digital replica of the highway for predictive operations.

AI PLATFORM

From Raw Data to Command Intelligence



The digital twin enables operators to respond to incidents before they escalate — shifting highway management from reactive to predictive.

ENVIRONMENTAL MONITORING

Weather & Environmental Intelligence

RITAIS Micro Weather Station

Rainfall Sensor

Intensity and accumulation rate

Wind Sensor

Speed and direction — gusts and crosswinds

Visibility Sensor

Forward visibility in meters, fog alerts

PM2.5 Sensor

Particulate matter for air quality index

Temperature Sensor

Ambient and road surface temperature

CONTROL CENTERS

Regional & National Command Centers

Field Cabinet

Edge processing, local storage, power management at gantry level

Regional Control Center

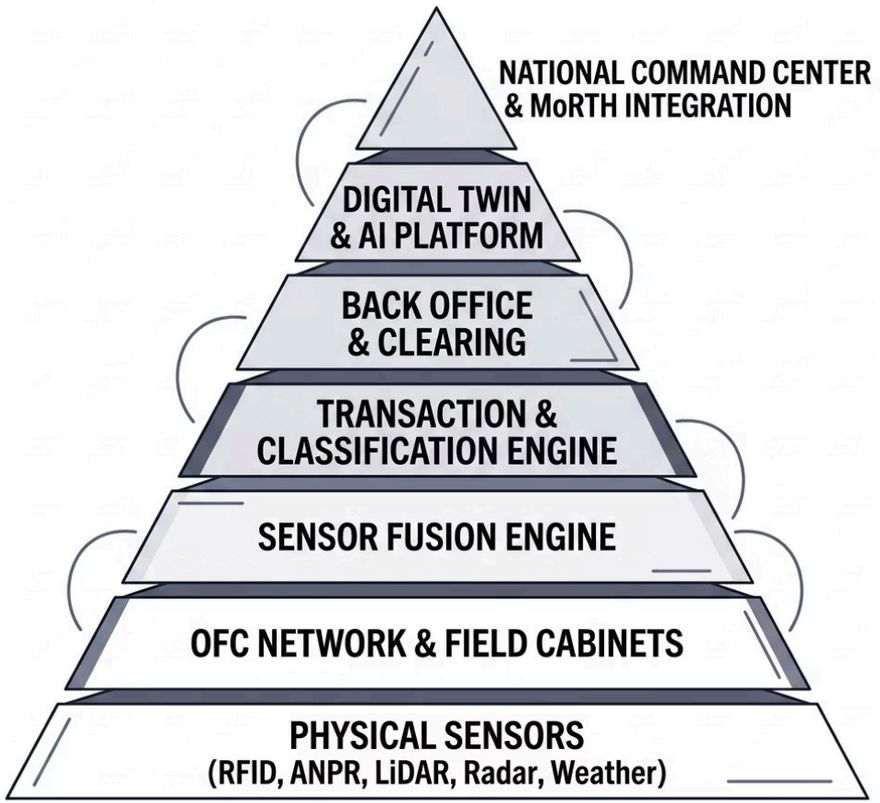
Multi-corridor supervision, incident management, escalation hub

National Control Center

Policy enforcement, revenue reconciliation, MoRTH reporting

SYSTEM SUMMARY

Full RITAIS Stack at a Glance



Designed for India's Scale

From a single gantry to a national highway network — every layer is modular, redundant, and interoperable with NHAI's existing FASTag ecosystem.

Open Standards

ETSI, ISO 17987, IRC-compatible

FASTag Native

Full NETC / NPCI integration

Cloud + Edge

Hybrid architecture for resilience

Why RITAIS Outperforms Competing Approaches

Capability	RFID Only	ANPR Only	RITAIS Fusion
Lane change handling	❌ Fails	⚠️ Partial	✅ Full
Occlusion recovery	❌ No	❌ No	✅ Radar bridges gap
Vehicle classification	⚠️ Tag-declared only	⚠️ Visual only	✅ LiDAR verified
Weather resilience	✅ All weather	❌ Fog / rain degrades	✅ All conditions
Violation detection	❌ None	⚠️ Plate only	✅ Multi-modal proof

Ready to Deploy. Built for Scale.

RITAIS delivers a fully integrated, standards-compliant MLFF ecosystem — sensor to settlement, gantry to national command. Every architecture diagram in this deck reflects a production-ready, deployed system.

Proven Architecture

Engineered for India's highway density and traffic mix

Investor-Grade Transparency

Full audit trail from sensor read to bank debit

MoRTH / NHAI Aligned

Compliant with national tolling policy and FASTag mandate