

Real-world Experience of Leveraging ATMS for Safer, Smarter, and Efficient Highway Operations

Transforming India's national highways through Advanced Traffic Management Systems

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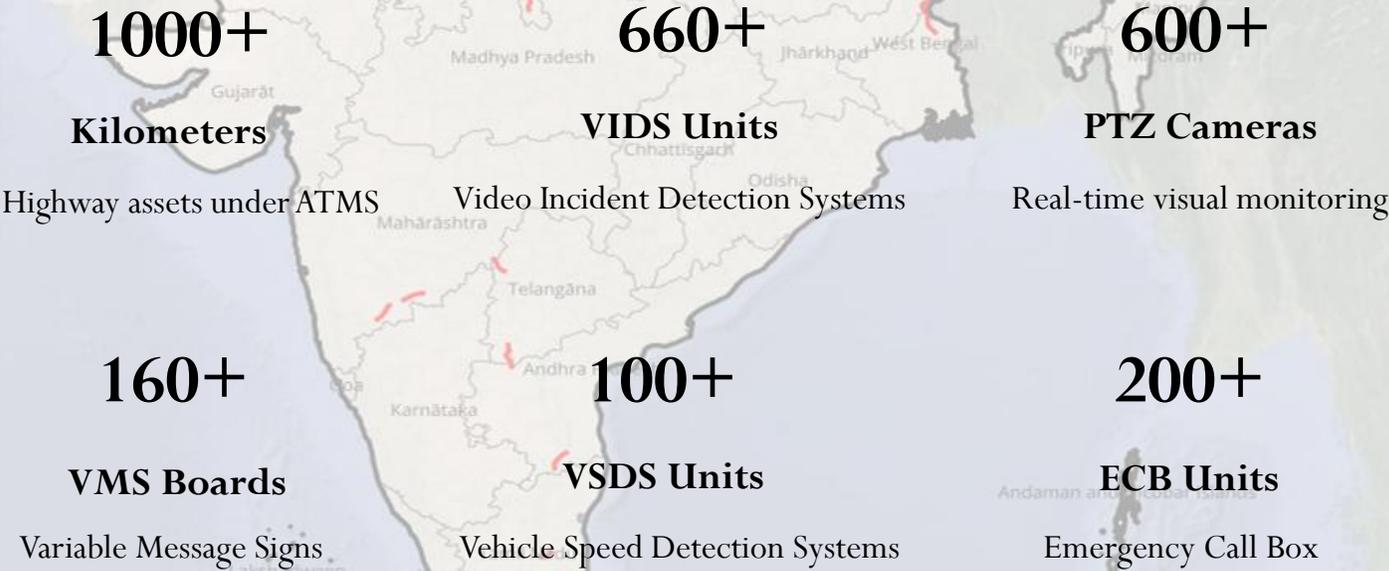
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Introduction

- India's national highways experience high traffic, mixed vehicle flow, and frequent maintenance activities.
- Hundreds of work zones are created daily, making manual supervision impractical and increasing safety risks.
- Advanced Traffic Management Systems (ATMS) enable continuous, data-driven operations through surveillance, video analytics, and centralised command and control.

CUBE Highways manages one of the country's largest ATMS networks, continuously expanding with new corridors. The system integrates intelligent field devices through a central command and control architecture.



Planning & Architecture

Strategic ATMS Deployment Approach

01

Risk-Driven Methodology

Prioritised high-risk locations: interchanges, median openings, service road entry/exit points, and accident-prone stretches using traffic behaviour and historical incident data.

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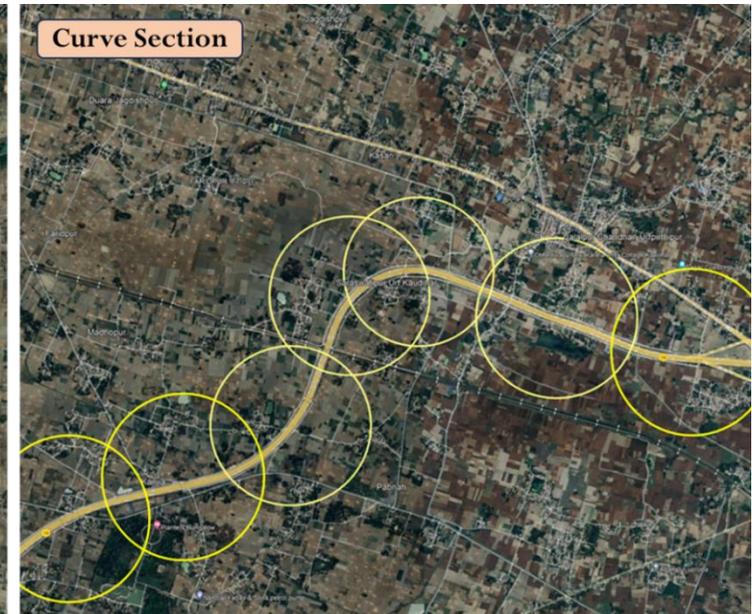
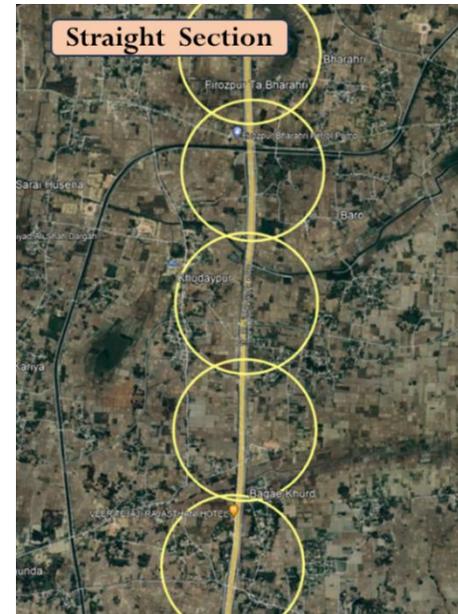
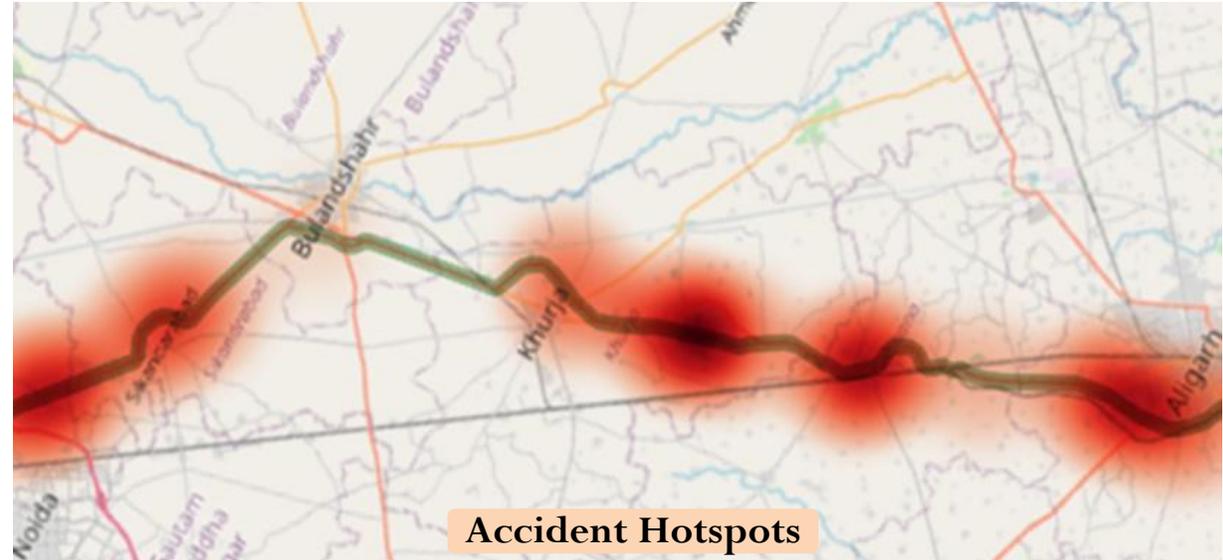
Coverage-Based Planning

PTZ camera locations finalised through GIS mapping, Drone survey to eliminate surveillance blind spots, ensuring uninterrupted visibility across critical movement areas.

03

Modular Architecture

System follows Codal principles with centralised command and control, redundancy in power and communication, and integration with emergency services through 24x7 Command Centre.



ATMS Use Cases

Advanced Traffic Management Systems (ATMS) extend beyond real-time monitoring and incident response by enabling data-driven operational control, safety assessment and behavioural analysis across the highway corridor.

Major Use cases



Behavioural Insights

Understanding speed behaviour, lane usage, merging patterns and unsafe movements using ATMS data



Evidence-Based Analysis & Safety Interventions

Video and system records supporting investigations, safety audits and performance assessment



Incident Management

Real-time detection, verification, response coordination and clearance monitoring.



Operation & Maintenance

Live monitoring of the highway, diversions, traffic flow, safety arrangements and work-zone compliance

Additional Use cases

- Encroachment and RoW activity monitoring
- Law enforcement and investigation support
- Event management (Rallies)
- Safety Awareness campaigns

Challenges

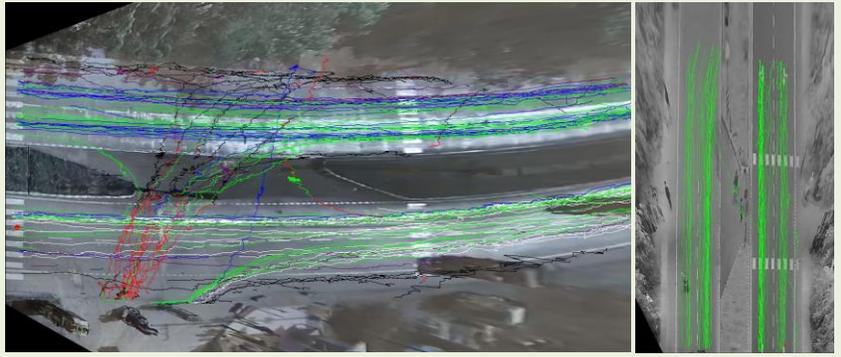
- Theft & vandalism
- Power issues
- Network issues (OFC cut)
- Weather impact (Fog & Rain)

Behavioural Insights

Unlike short-duration field observations, ATMS datasets capture continuous real-world driving behaviour across time, traffic and operating conditions, enabling reliable behavioural assessment for design, operations and enforcement

Trajectory Mapping & Conflict Behaviour

Video analytics reveal lane usage, merging paths and conflict zones at ramps, service-road entries and U-turns, highlighting unsafe manoeuvres and operational design gaps



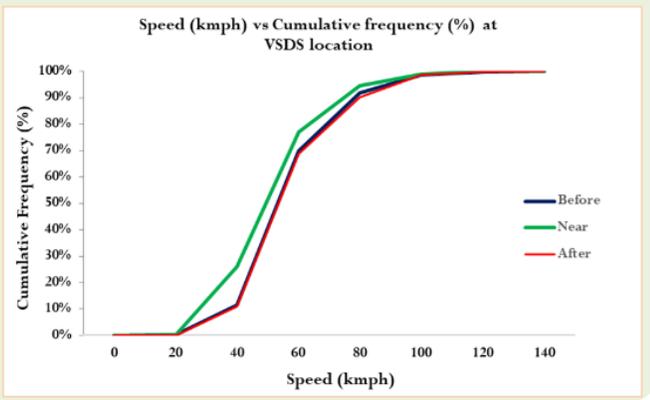
Lane Usage Behaviour

It gives section-wise lane usage patterns and sustained lane preference, supporting corrective measures and pavement design.



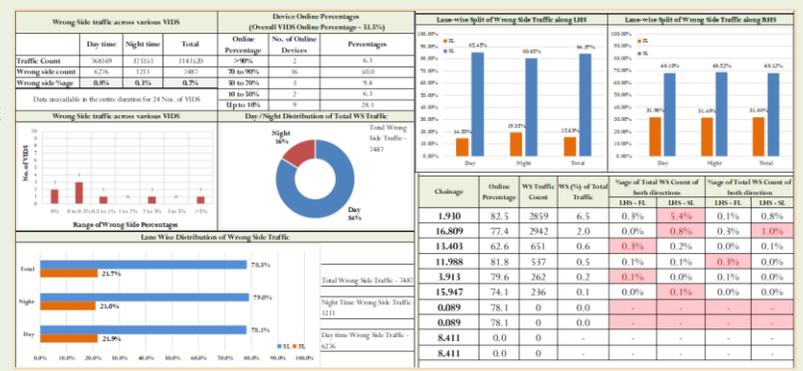
Speed Behaviour and Compliance

VSDS-based speed profiles by vehicle class and time indicate short-term speed reduction only near enforcement locations, demonstrating the need for sectional and staggered speed enforcement



Wrong-side Movement Analysis

ATMS data is used to identify and rank locations with frequent wrong-side movements, enabling targeted enforcement and corrective measures at high-risk locations

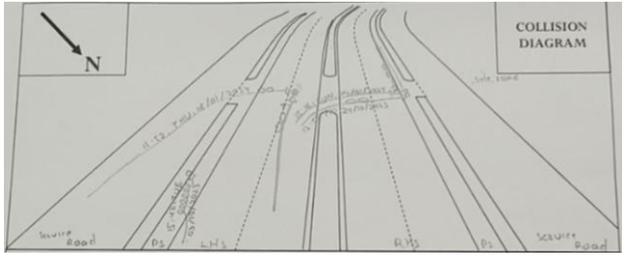


Behavioural insights derived from ATMS data directly support targeted engineering improvements, enforcement planning and proactive safety interventions

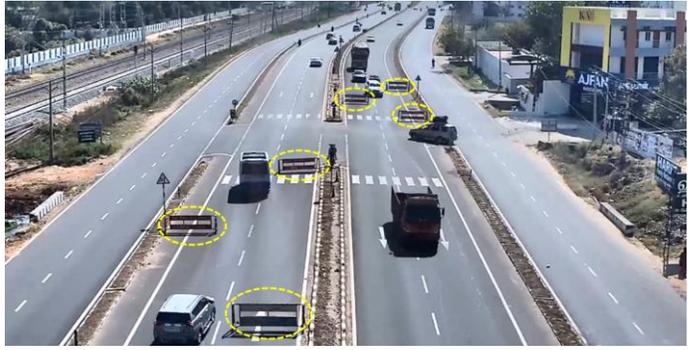
Evidence based Analysis & Safety Intervention

Preparation of Collision Diagram

High-quality footage enables precise mapping of vehicle positions, conflicts and post-crash movements for accurate collision diagrams.



Removal of unsafe barricades forcing abrupt lane shifts



ATMS video analysis revealed that barricades provided with the intention of safety were creating conflict points and increasing near-miss incidents, leading to their removal or safer repositioning in coordination with the concerned agency

Installation of speed breakers at high-speed service road entries

ATMS video analysis identified repeated unsafe and high-speed service road entries at a few locations, leading to the installation of speed breakers at critical points on the service roads to reduce conflicts and improve merging safety.



Enforcement Drives

ATMS data and video evidence were used to identify and prioritise locations with frequent wrong-side movements, enabling focused enforcement drives at high-risk locations.



Furniture Installation

ATMS-based analysis of vehicle movement patterns at a high-risk narrow bridge enabled targeted installation of crash cushions and correction of road markings to improve safety



Incident Management

Video Incident Detection System (VIDS) continuously monitors highways, automatically flagging unusual events like collisions, stalled vehicles, or wrong-way movement.

01 02

Automated Detection

VIDS alerts generated within seconds of incident occurrence

Live Verification

Control room confirms incident through real-time camera feeds

03 04

Immediate Dispatch

RPVs and IMS teams sent with exact coordinates

Traffic Management

VMS boards warn motorists to reduce secondary crash risk



Alert ID	TimeStamp	Priority	Alert Type	Asset Type	Asset Name	Description	Ack	Actions	Status
1244986	03-02-2026 15:18:47	CRITICAL	VIDS-Traffic	VIDS	VIDS_L1_62.593_Median	Stationary vehicle (DWELL) detected on VIDS_L1_62.593_Median (StopTemp-LHS-FL-Z1)	<input checked="" type="checkbox"/>		OPEN
1244983	03-02-2026 15:09:18	CRITICAL	VIDS-Traffic	VIDS	VIDS_L1_88.580_Median	Stationary Vehicle detected on VIDS_L1_88.580_Median (StopTemp-LHS-PS-Z2)	<input checked="" type="checkbox"/>		OPEN
1244978	03-02-2026 15:03:57	CRITICAL	VIDS-Traffic	VIDS	VIDS_L1_96.285_Median	Stationary Vehicle detected on VIDS_L1_96.285_Median (StopTemp-RHS-SL-Z1)	<input checked="" type="checkbox"/>		OPEN
1244966	03-02-2026 12:32:03	CRITICAL	VIDS-Traffic	VIDS	VIDS_L2_60.390_Median	Stationary Vehicle detected on VIDS_L2_60.390_Median (StopTemp-RHS-PS-Z1)	<input checked="" type="checkbox"/>		OPEN
1244965	03-02-2026 12:25:16	CRITICAL	VIDS-Traffic	VIDS	VIDS_L2_92.816_Median	Stationary Vehicle detected on VIDS_L2_92.816_Median (StopTemp-RHS-PS-Z2)	<input checked="" type="checkbox"/>		OPEN
1244963	03-02-2026 12:15:32	CRITICAL	VIDS-Traffic	VIDS	VIDS_L2_86.367_Median	Stationary Vehicle detected on VIDS_L2_86.367_Median (StopTemp-RHS-FL-Z3)	<input checked="" type="checkbox"/>		OPEN

Operations & Maintenance

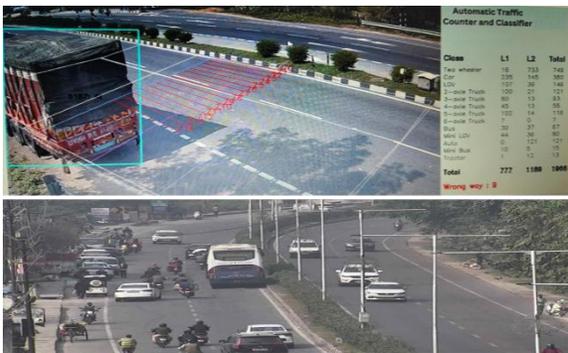
Over 400 work zones created daily across the CUBE network. ATMS provides continuous live camera feeds for round-the-clock oversight, ensuring safe and consistent operations.

- **Setup Verification**
- **PPE Compliance**
- **Movement Control**
- **Diversion Management**
- **Long Duration Work Zone Monitoring**
- **Quality Assurance**

Deviations are communicated to site supervisors in near real time, often within minutes, enabling prompt corrective action without waiting for physical inspections.



Enhanced Monitoring Capabilities



Unauthorized Parking Control

Quick detection of unauthorized parking near ATCC locations and restricted areas enables timely clearance, maintaining traffic flow and data accuracy.



Encroachment Prevention

Continuous monitoring identifies ROW violations, material dumping, and temporary structures early, allowing intervention before issues escalate.



Event Management

Real-time tracking of processions, rallies, and gatherings with VMS coordination ensures smooth traffic flow during disruptions.



Law & Enforcement

Provides real-time and recorded video intelligence to enforcement agencies for incident investigation, vehicle tracking, crowd management and law-and-order support, improving response efficiency and corridor security.

Building Safety Culture

With the ATMS data targeted safety campaigns are conducted at high-risk villages, schools, and locations with frequent traffic violations.

Village Sessions: Real accident videos show clear consequences of unsafe crossings and distracted driving

School Programs: Teaching basic rules and control room visits encourage safe habits early

Onsite Counseling: Focused drives at locations with frequent traffic violations with immediate education



Future Potential



Predictive Analysis

Multi-source ATMS data enables prediction of emerging high-risk locations by analysing near-misses and conflict patterns to support proactive engineering, enforcement and early safety interventions



Collision diagrams

TMS video and trajectory data enable accurate collision mapping and conflict analysis to strengthen safety audits and guide geometric, signage and visibility improvements



Weather-based Monitoring

Real-time MET data and automated alerts support timely VMS warnings and operational preparedness during adverse weather to reduce weather-related crash risk



Smart Encroachment Detection

Image comparison and operator-verified workflows enable early detection and removal of ROW misuse and temporary encroachments before they become permanent risks



Road Furniture Effectiveness

Behavioural and crash-interaction analysis assesses the real-world performance of road furniture and safety barriers to guide redesign, relocation and future policy improvements



Data Archiving & Research

Long-term ATMS datasets support traffic and behavioural research to improve design standards, planning capacity and evidence-based safety programmes and policies

With careful planning, strategic system placement and continued technology upgrades, ATMS has the potential to further strengthen corridor safety, operational efficiency and transparency, and enable the organisation to lead data-driven and technology-enabled highway management in the coming years.



Thank You
