Building a Nation, not just Roads

ATMS in NHAI Projects

10.10 onwards

भारतीय राष्ट्रीय राजमार्ग प्राधिकरण
(सड़क परिवहन और राजमार्ग मंत्रालय)

National Highways Authority of India
(Ministry of Road Transport and Highways)

Earlier Provision

- NHAI Policy Circular No 214/2016 dated 15.09.2016 gives "Standard ATMS Provisions" for implementation of Advanced Traffic Management System on developed NH section.
- While 2016 Circular is very comprehensive, its relevance and adequacy was checked in view of latest technology available in 2023.
- NHAI released a comprehensive new policy on 10th October, 2023 for ATMS projects henceforth (link)
- ATMS Projects are in various stages in: Dwarka Expressway, Delhi-Jaipur and Delhi-Agra and Bengaluru-Mysuru Expressway

Why ATMS?

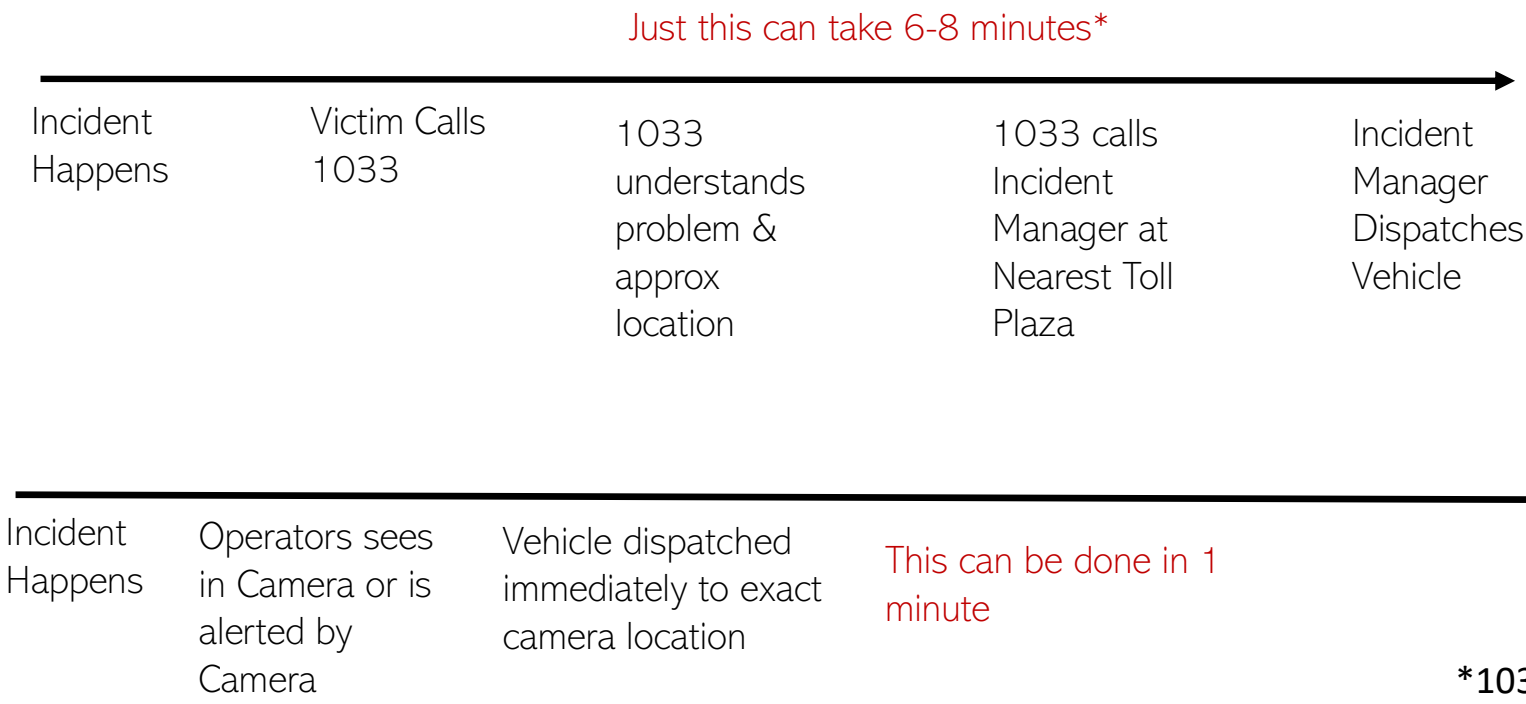
Reducing Incident Response Times

Reducing Incidents

Physical Enforcement (Route Patrol Vehicles)

Digital Enforcement (eChallans)

Reducing incident detection times.



*1033 Nov-Dec Data Analysis

Physical enforcement

CATTLES ARE MOVING ON
EXPRESSWAY AT 29+500 LHS
INFORMED TO SECTION-1

Physical enforcement

TRUCK IS BREAKDOWN AT 64+000 RHS INFORMED TO SECTION-2

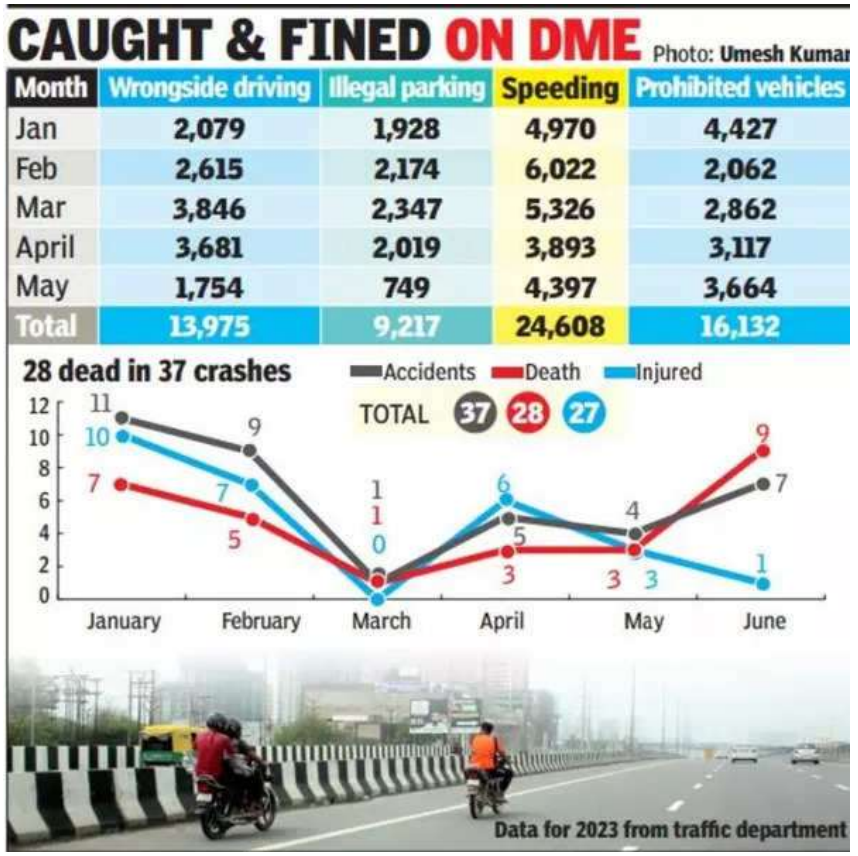
SAFETY PROVIDED - RPV

Digital enforcement

Opened in April 2021, the 60km expressway connects Delhi's Sarai Kale Khan with Meerut. Over 40km of the speedway is in Ghaziabad. Although the National Highways Authority of India (NHAI) has installed cameras on the stretch, they can only detect vehicles if they breach the speed limit.

Ramanand Kushwaha, additional DCP (traffic) in Ghaziabad, said it was not easy to stop vehicles cruising at 100kmph on the DME. "You tell me, is it possible? However, we have a team of around 40 policemen to issue challans to offenders on the expressway."

The traffic department said it was not possible to deploy cops at the entry and exit points because of the high speed of vehicles.



Month	Wrongside driving	Illegal parking	Speeding	Prohibited vehicles
Jan	2,079	1,928	4,970	4,427
Feb	2,615	2,174	6,022	2,062
Mar	3,846	2,347	5,326	2,862
April	3,681	2,019	3,893	3,117
May	1,754	749	4,397	3,664
Total	13,975	9,217	24,608	16,132

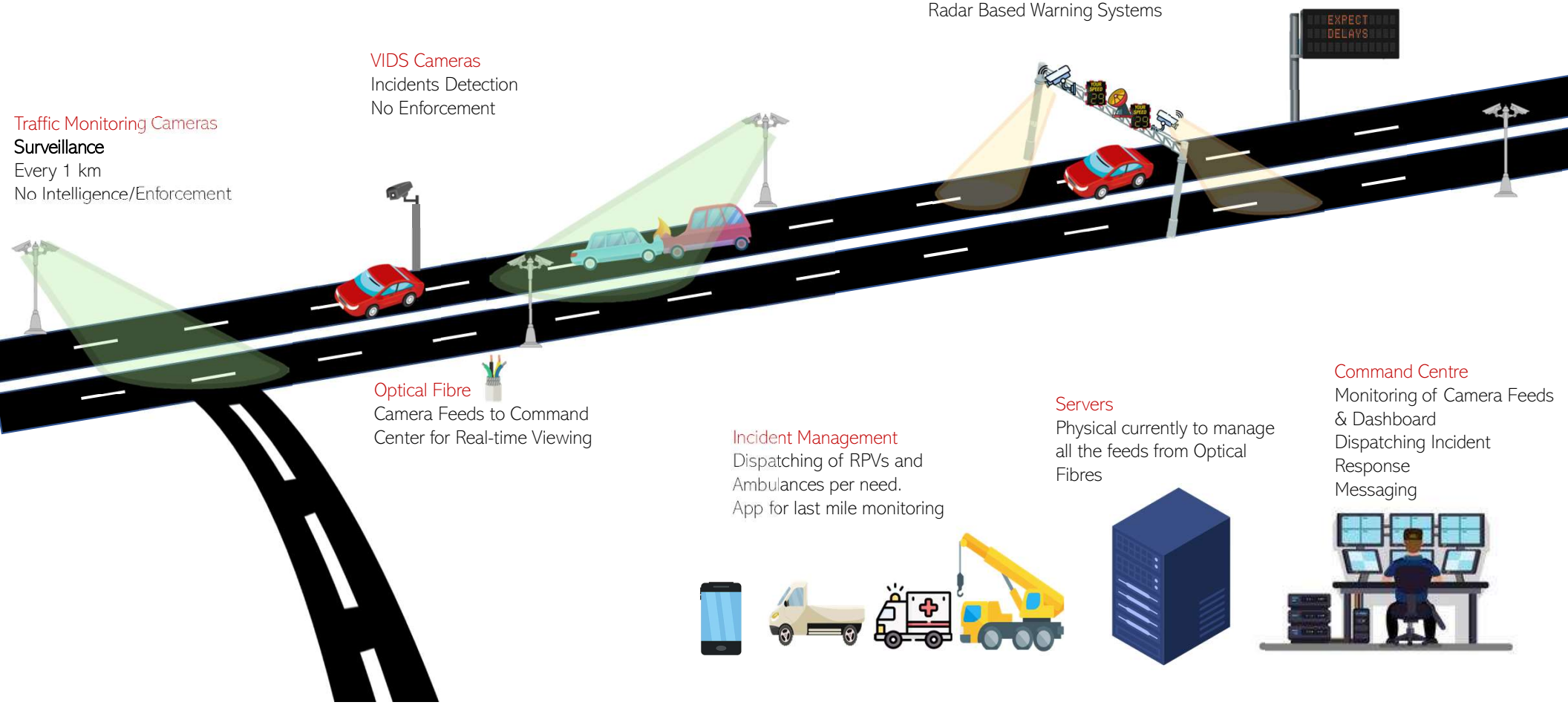
2016 Circular

Traffic Monitoring Cameras
Surveillance
Every 1 km
No Intelligence/Enforcement

VIDS Cameras
Incidents Detection
No Enforcement

VASD + VSDS Cameras
Overspeeding Detection and
Image Capture (No ANPR)
Radar Based Warning Systems

Variable Messaging Signs
Instructional



Optical Fibre
Camera Feeds to Command
Center for Real-time Viewing

Incident Management
Dispatching of RPVs and
Ambulances per need.
App for last mile monitoring

Servers
Physical currently to manage
all the feeds from Optical
Fibres

Command Centre
Monitoring of Camera Feeds
& Dashboard
Dispatching Incident
Response
Messaging

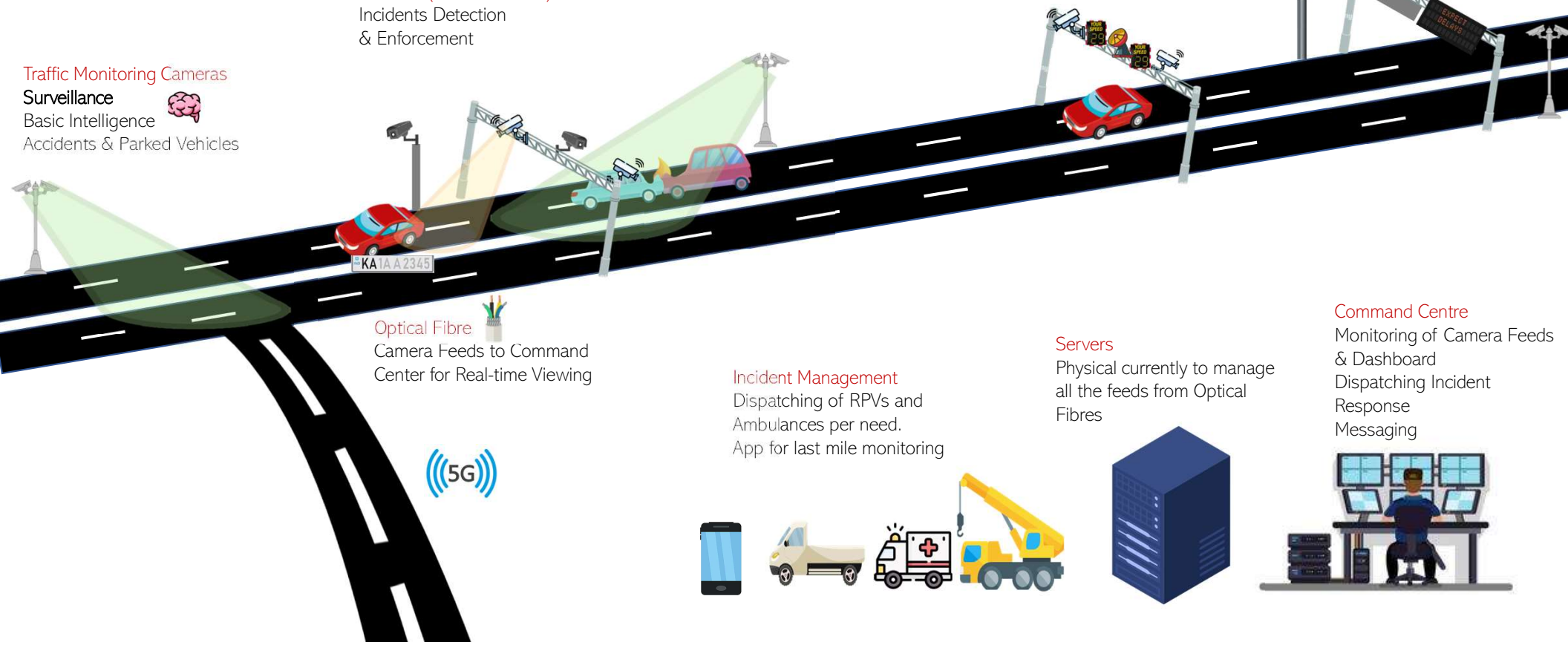
2023 Circular

Variable Messaging Signs
Instructional

VASD ~~+ VSDS Cameras~~
Radar Based Warning Systems

VIDES+ (includes VSDS)
Incidents Detection
& Enforcement

Traffic Monitoring Cameras
Surveillance
Basic Intelligence
Accidents & Parked Vehicles



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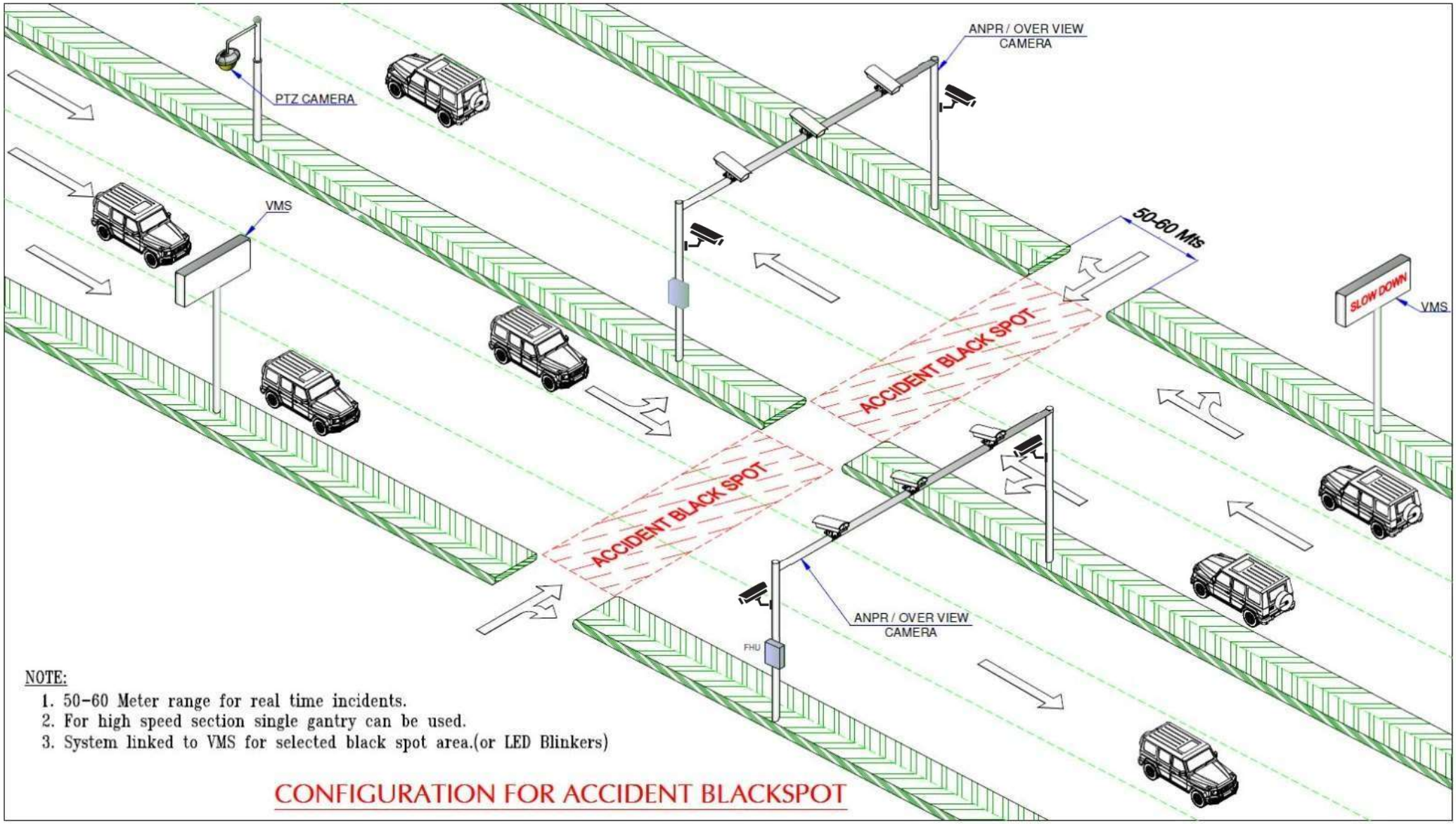
TMCS – Eyes on Highway

- Pan-Tilt-Zoom Cameras
- At least 1 every kilometre
- 100m night range minimum
- Placement should be such that entire highway stretch is visible
- Basic intelligence included (Accident + Stalled Vehicles)
- AI can be centralized or edge-based
- One Traffic Operator manually viewing per 15 Cameras

VIDES – Enforcement Gantries

- System of Camera(s):
  - Overview Camera
  - Side Camera
  - ANPR Camera(s)
  - Radar (if needed)
  - IR and Thermal if needed
- Generally every 10 kilometre in accident prone areas or areas with likely over-speeding or traffic rule violations
- 14 kinds of incidents to be detected using AI
  - 8 of which are eChallan based
- ATCC will be part of it
- VIDES will have dedicated operator(s) and Smart TV in Command Center

Not just spot speeding but also sectional speeding



NOTE:

1. 50-60 Meter range for real time incidents.
2. For high speed section single gantry can be used.
3. System linked to VMS for selected black spot area.(or LED Blinkers)

CONFIGURATION FOR ACCIDENT BLACKSPOT

VIDES Incidents

Incident Type	Actionable
Accident	RPV/Ambulance/VMS/Rajmargyatra
Fog/Smoke	RPV/VMS/Rajmargyatra
Debris	RPV/VMS/Rajmargyatra
Pedestrian Crossing	RPV/VMS/Rajmargyatra
Animals on the carriageway	RPV/VMS/Rajmargyatra
Traffic Flow	Analysis/Messaging/Rajmargyatra
Overspeeding	eChallan

Incident Type	Actionable
Opposite Side Traffic	eChallan
Stalled or Stationary Vehicle	eChallan
Wrong Lane Driving	eChallan
Seatbelt Violation	eChallan
No Helmer in Two Wheeler	eChallan
Triple Ridings in Two Wheeler	eChallan
Two Wheeler or Banned Vehicle on Expressway	eChallan

Sectional Speeding

Car is at VIDES Gantry #1 at 10:00 AM

Car reaches VIDES Gantry #2 at 10:05 AM

Distance between two gantries is 10 km.

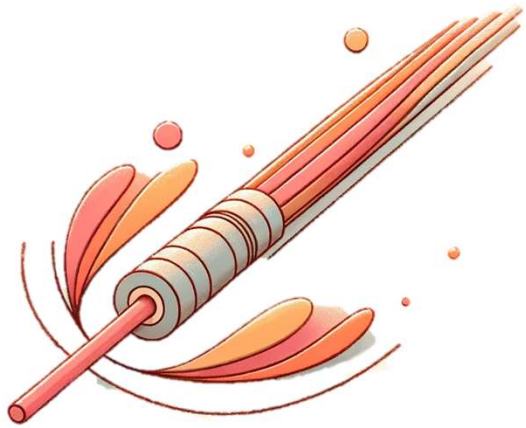
Average Speed is distance/time = 120 kmph

VASD – Speed Calming Measures

- Radar and Lane-wise displays
- No number plate recognition therefore no challan
- Every 20 km and separated from VIDES
- This is inexpensive way to warn before punishing offender through VIDES

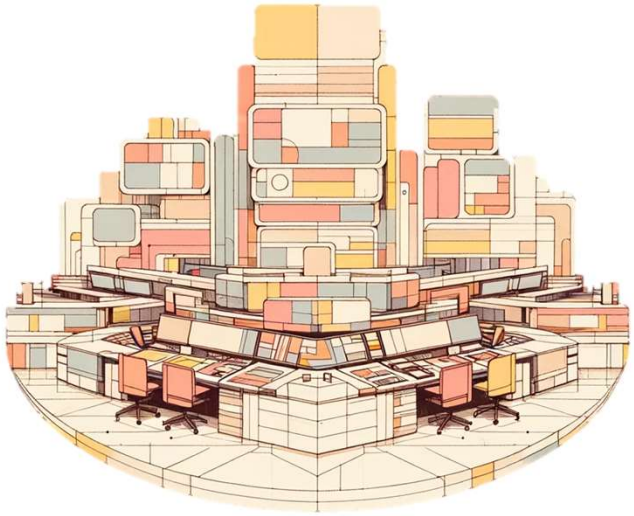
OFC – Nervous System

- Protocol for Laying OFC Cable (9.7)
- Minimum depth is 1.65 m from ground and width greater than 0.3 m meter for OFC Cable
- No trench should be left open overnight
- Backbone is 24 cores
- Backbone to peripheral equipment can be 8/12 cores



Command Centre – The Brain

- Two Video walls (TMCS/General and VIDES)
- Hardware upgraded to modern standards
- Unifying ATMS software that integrates with sub-system software such as VIDES, TMCS etc.
- Software(s) should be STQC certified
- Video recording saved for 180 days
- Aadhaar Based Attendance
- 1 Traffic Operator Per 15 TMCS Cameras
- Highway O&M & Data Analyst added (Appendix C)



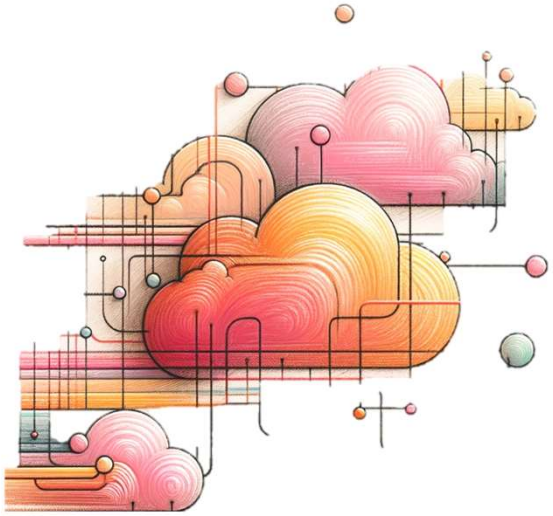
Other Sub-Systems

Sl No	ATMS Sub-Systems covered in 2016 Circular	Comments on relevance and adequacy
1	Variable Message Sign	1. Circular gives all sizes of VMS. 5x1.8m or higher size full gantry proposed for 4/6 Lane NH and Expressways. 2.4x1.5m L Type (cantilever) proposed for 2L+PS Highways and Blackspot Locations. 2. All other specifications as per IRC 67:2022 & IRC SP 85:2023 3. Location- At start and end of Project, Blackspot Locations and Junctions with NH & Expressways.
2	Emergency Call Box	1. Specifications as-is. 2. Mandatorily proposed for Greenfield Expressways and Hill Roads 3. PDs/ROs may see their relevance in other NHs or else may be de-scoped.
3	Mobile Radio Communication System	1. Specifications as-is. 2. Circular provides RPV, Ambulance, Crane to have vehicle mounted Units and staff to have handheld units 3. Mandatorily proposed for Expressways and Hill Roads 4. PDs/ROs may see their relevance in other NHs or else may be de-scoped.

Sl No	ATMS Sub-Systems covered in 2016 Circular	Comments on relevance and adequacy
4	Portable WIMs	Not relevant after installation of WIMs in all Toll Plazas (Descope)
5	Automatic Traffic Counter and Classifier	Not relevant as it will be done with VIDS ANPR cameras (Integrated with ANPR from VIDS)
6	Travel Time Estimation System	Not relevant as it will be done with VIDS ANPR cameras. (Descope)
7	Meteorological System (MET)	Not relevant in general in view of Meghdoot and other Apps. (Descope)
8	Communication & Networking	Adequately covered Made future-ready with 5G and cloud provisions
9	Power Supply	Adequately covered

Integrations

- DataLake for daily reporting and camera access **[API]**
- IP based video access with NHAI HQ for ICCC and Traffic Police Command Centers
- Integration with Rajmargyatra for broadcasting incidents **[API]**
- Provision to integrate with centralized computer aided dispatch system **[API]**
- Dedicated Work station for Traffic Enforcement Agency to sit in ATMS Control Room to improve coordination **[Physical]**
- Re-use of VIDES Gantry as Enforcement Gantry for GNSS Based Tolling



Provision for Dedicated 100 Mbps internet connectivity with Command Center for sharing of feeds/data over internet.

Suggestive Location of ATMS Equipment

Equipment	Locations
Video Surveillance System (PTZ Camera)	Min. 1 camera per km, alternating on both sides or on median. Additional cameras to be put up depending on non-linear structure, clovers, interchanges etc such effective surveillance of the entire highway stretch is achieved.
Video Incident Detection and Enforcement System (Overview Camera, ANPR Camera, Radar etc)	Min. 1 VIDES at every 10 km covering each side of Highway. Exact location of the VIDS should be such that it is placed facing accident and incident prone areas (blackspots, potential accident spot locations, clovers, interchanges, busy junctions etc, between two flyovers, IRAD data based etc). Additional VIDES can be put up depending on number of such locations as per audit by NHAI or Road Safety Experts or Recommendation of Local Traffic Police.
Variable Message Sign	At entry and exit of Project stretch, Blackspot locations, Major Junctions with NH/Expressways. Minimum 2 Portable VMS per Project Package
Vehicle Actuated Speed Display	Gantry Mounted System to be located after every 20km with minimum 2 in each package. Over speeding prone areas should also be considered.

Suggestive Location of ATMS Equipment (contd…)

Equipment	Locations
Emergency Road Side Telephone	Only for Zones experiencing telecom blackspots along highway need to be provided by ERT. On long highway stretches (> 2 km) suffering from telecom blackspots, ERT to be located at every 2 Km on both sides of the highway stretch.
Mobile Communication System	Mobile wireless towers (towers for the main base station and repeater stations) to be appropriately designed and quantities arrived at depending mainly on the highway terrain. Handsets with relevant members of the Dispatch & O&M team along with Portable/Mobile wireless sets on O&M vehicles
ATMS Command and Control Center	Typically at 1 location per 100 km for a highway or depending on the scheme/structure of the project

SLAs - Monitoring the Monitor

Instance Based Deductions

Quarterly Point Based Deductions

SLAs – Instance Based Deductions

Data Sharing Spot-checks	₹ 5000 per inst.
Remote Video Check	₹ 5000 per cam/day
Non-Availability of Video Recording of Incidents/Accidents	₹ 25000 per inst.
Non-compliance of Safety Standards	Max ₹ 100,000
Staff Mobilization/Absenteism	₹ 5000 per day/staff
Data Manipulation, Fudging and other Fraud	₹ 10,00,000
Data Breach or Data Mis-use	Per DPDP Act

SLAs – Point Based Deductions

1. Similar to EPC Deductions for Routine Maintenance during DLP
2. Quarterly Calculation and Deduction on Fixed Lumpsum
3. 100 Point System
   A. 0 to 50 (No Payment)
   B. 50 to 100 (Pro-rated Payment)
4. In case less than 50 for two straight quarters, termination can be invoked
5. There are total 14 SLA categories

Example

KPI	Scoring	Measurement Mechanism
"All calls from 1033 or Emergency Telephones are to be answered in less than 30 seconds of calling"	5 Points if all Emergency calls are picked in less than 30 seconds in first attempt. 0 Points if 1 or more calls have been missed.	Daily shift-wise logs; Authority may take report from 1033 call center or under-take mock calls.

Performance Area	Scoring	Measurement Mechanism
Emergency Calls All calls from 1033 or Emergency Telephones are to be answered in less than 30 seconds of calling.	5 points if all emergency calls are picked in less than 30 seconds in first attempt 0 points if 1 or more calls have been missed.	Daily shift-wise logs accounting for handling of ALL calls and action taken, time to resolve etc. Authority may take report from 1033 Call Center for actual or mock calls to assess whether SLA has been agreed upon. The same can be used for calculation of penalties.
VIDES Automatic detection of all incidents (categorized as real- time in 4.3.2) in areas under camera surveillance	10 points for 0-5 missed incidents 5 points if >5-10 missed incidents 0 points if more than 10 missed incidents	Manual detection of select incident categories on the stretch which is not logged by the Command Centre software automatically through VIDES or TMCS software. NHAI may randomly audit videos collected under VIDS cameras to check this SLA.
VIDES Incident Detection Precision below acceptable limits	10 points if all Incident Types meet their required Precision Criteria 5 points if only 2 or less incident types are not meeting required Precision Criteria 0 points if more than 2 Incident Types are not meeting Required Precision Criteria	By randomly assessing automatically detected incidents and manually assessing through video whether they were correctly flagged or not (*Eg. VIDES says wrong-lane driving but on manually checking video it is correct lane*).
VIDES Uptime Hours All cameras in a VIDS unit have to be functioning for the VIDS unit to be considered up. (irrespective issues with power, network etc)	10 points if >= 95% 5 points if >-90% and <95% 0 points for <90%	Network Management System with real-time access provided to NHAI or nominated representative.

Performance Area	Scoring	Measurement Mechanism
TMCS Uptime Hours cumulatively i.e. total number of hours each TMCS camera has been up/(number of cameras x total hours in billing period)	10 points if >= 95% 5 points if >-90% and <95% 0 points for <90%	Network Management System with real-time access provided to NHAI or Nominated Representative.
TMCS Automated or Manual Detection of all accidents and stalled vehicles in areas under camera surveillance in less than 90 seconds of occurance of event	10 points if 0 accidents or incidents missed in detected in less than 90 seconds 5 points if >1 and <=5 accidents/incidents missed in detection in less than 90 seconds 0 points if >5 accidents/incidents missed in detection in less than 90 seconds	By manually assessing recorded videos of TMCS and comparing with the ticketing system where each and every accident/incident is logged. If accident/incident is not logged, it will be considered a violation.
ANPR Accuracy of ANPR cameras	10 points if >=95% 5 points if 90-95% 0 points if <90%	SI will auto-generate reports on number of number plates that were wrongly read and/or missed completely from reading. Further, NHAI or nominated representative can conduct random audits on the recorded footages from any ANPR cameras
eChallan Validating and Uploading evidence on Government's eChallaan software for processing in less than 24 hours of Violation Occurring	5 points if zero offences have been missed in uploading 2.5 points if >0 and =<5 offences have been missed in uploading 0 points if more than 5 offences have been missed in uploading	By auditing the incident generation time on the VIDS software with the eChallaan upload receipts/time.

Performance Area	Scoring	Measurement Mechanism
Video Wall 99% uptime in the billing period	5 points if >= 99% 2.5 points if >=95% and <99% 0 points for <95%	Network Management System with real-time access provided to NHAI or Nominated Representative.
ATMS Command Centre Overall application availability at Command Centre	5 points if >= 99% 2.5 points if >=95% and <99% 0 points for <95%	Network Management System with real-time access provided to NHAI or Nominated Representative.
Variable Messaging System Uptime Target Uptime = Number of VMS x Number of Hours in Billing Period	5 points if >= 95% 2.5 points if >-90% and <95% 0 points for <90%	Network Management System with real-time access provided to NHAI or Nominated Representative.
Variable Messaging System Usage Whether VMS was updated with relevant information when relevant incident was detected in proximity of VMS (Chapter 4 VIDS).	5 points if 0 instances where incident was detected by VIDS but not updated on nearby VMS. 2.5 points if >0 and <=5 instances where incident was detected by VIDS but not updated on nearby VMS 0 points if more than 5 missed instances	By auditing system generated VIDS and VMS logs.
Vehicle Actuated Speed Display Target Uptime = Number of VASD x Number of Hours in Billing Period)	5 points if >= 95% 0.5 points if >-90% and <95% 0 points for <90%	
Incident Response Dispatch of Ambulance/RPV in less than 90 seconds of occurrence of accident/incident	5 points if zero instances of dispatches took more than 90 seconds. 2.5 points if 1-3 instances of dispatches took more than 90 seconds minute 0 points if >3 instance of dispatches took more than 90 seconds	By auditing the incident generation time on the VIDS software the time in which the RPV/Ambulance was notified about the incident through call/radio any other accepted mechanism as logged. NHAI may conduct mock-drills as well to check this SLA

What is Precision and Recall in SLAs?

Let's take a random two day period to be audited:

VIDES Software says there were 10 Accidents in those two days

You check the 10 "supposed" accident videos and find one of them is not an accident; Precision is 9 out 10 or 90%.

But as per ground reports there were 12 "real" accidents in those two days;

VIDES captured only 9 of those; hence Recall is 9 out of 12 or 75%

Each Incident Type has been given acceptable limits for Precision & Recall in Policy and 20 marks in SLAs are linked to these. ATMS Software will have ready provisions for scan videos at any point of time and show list of incidents etc for auditing.

New Specifications at a Glance

Chapter	Details
Chapter 1	Introduction
Chapter 2	General Provisions for ATMS. It includes design requirement, Quality Assurance, Testing, Civil Work requirement, Power & UPS, Information Security, Security of Field/Command Center Equipment, Defect Liability etc
Chapter 3	Video Surveillance System/TMCS
Chapter 4	Video Incident Detection and Enforcement System. Includes Speed Detection and ATCC
Chapter 5	Vehicle Actuated Speed Display
Chapter 6	Emergency Call Box
Chapter 7	Variable Message Sign System. Fixed and Portable

New Specifications at a Glance (contd…)

Chapter	Details
Chapter 8	Mobile Radio Communication System
Chapter 9	Network Infrastructure for Data Communication
Chapter 10	ATMS Command & Control Center
Chapter 11	Relevant Codes & Standards
Chapter 12	Use of ATMS in Disaster Management
Appendix- A	Suggestive locations of Field Equipment
Appendix-B	Service Level Agreement and Penal Provisions (from payments during O&M period)
Appendix-C	ATMS Control Center Organization & Staffing
Appendix-D	Reporting Requirement and Integration with Datalake
Appendix-E	Typical Strip Chart of ATMS

Important Points/Checklists

Important Points/Checklists (Across Policies)

1. Enough time is spent on design of the system and is vetted thoroughly before work begins
2. OFC backbone should be used only for ATMS work and minimum 24 cores
3. Minimum depth is 1.65 m from ground and width greater than 0.3 m meter for OFC Cable
4. No trench should be left open overnight
5. TMCS cameras should ensure surveillance of entire highway stretch – please put adequate care in selecting locations
6. VIDS/VIDES is placed in *high-incident/accident* zones and action is linked to results. In many ATMS, VIDS/VIDES is constantly buzzing but no action is linked
7. Data generated from VIDS and other systems to be analysed monthly for trends of accidents, traffic etc and reported to PD for any action.

8. VASD to be placed in *high-speeding zones or zones* where you want people to slow down
9. All cameras should have remote access by NHAI i.e. NHAI should be able to click IP/URL and see live footage without intervention by AE or SI
10. Inventory (registration, IP etc) of all ATMS equipment to be kept with AE/IE and PD office. To be registered on DataLake ATMS module to be released shortly.
11. Command Centre operations to be monitored (by camera, by attendance reports, by remote access and random visits)
12. Manpower should be adequate to oversee all cameras and take actions effectively (2016 and 2023 spell out exact requirements)
13. ATMS staff should be adequately trained in managing traffic operations and incidents.

14. Encroachments and O&M defects etc as identified from cameras should also be reported to NHAI
15. Opensource software should be promoted as per MEITY policy. Each software used to be STQC certified.
16. Data confidentiality should be maintained and breaches to be handled as per Government’s DPDP Act.
17. Adequate external internet connectivity for remtote access and feed sharing. (8 Mbps in 2016, 100 Mbps in 2023)

Thank You