



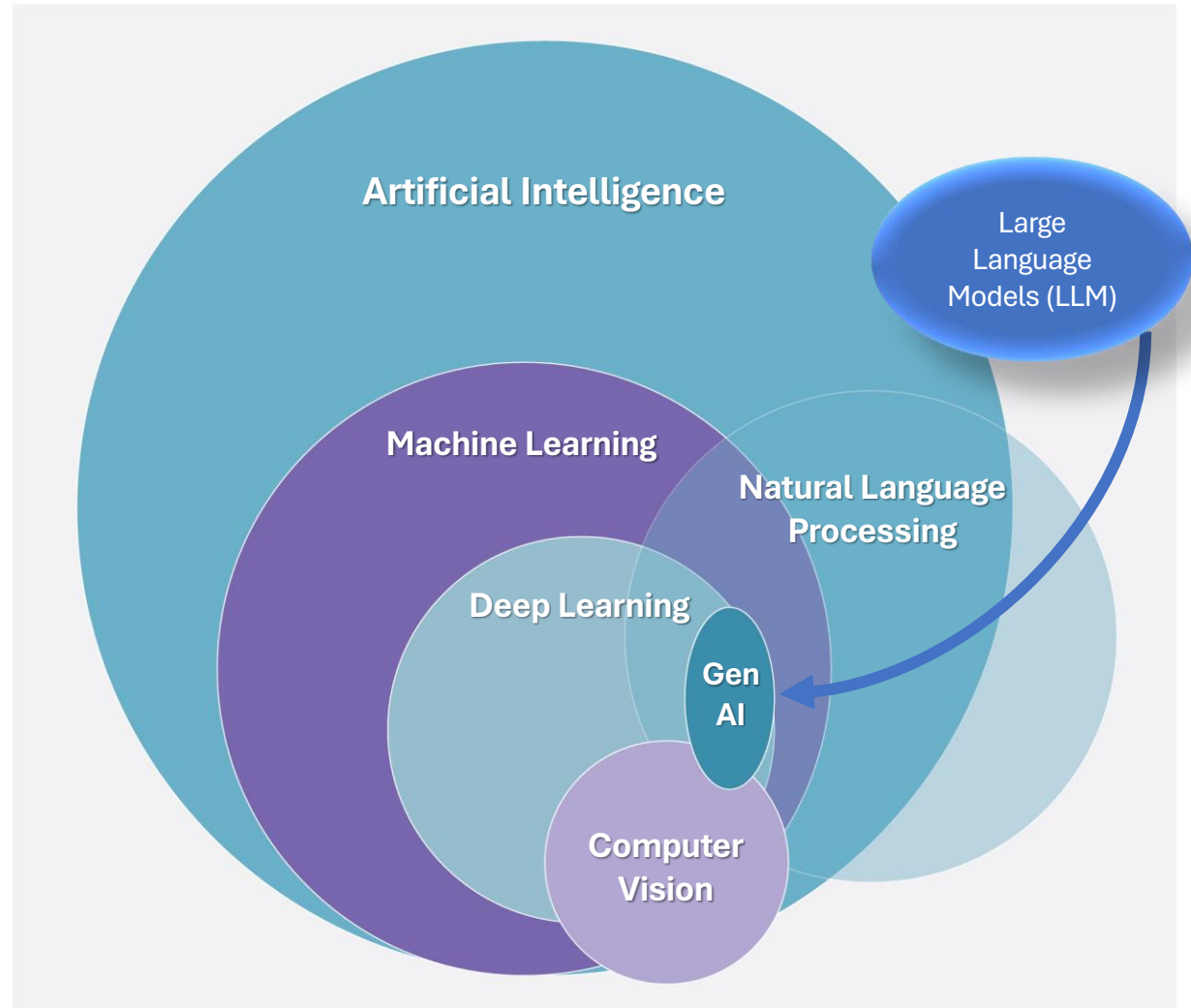
Responsible AI in Transportation

Balancing Innovation, Safety, and Security

What Is Artificial Intelligence (AI)?

Machines that mimic human intelligence by:

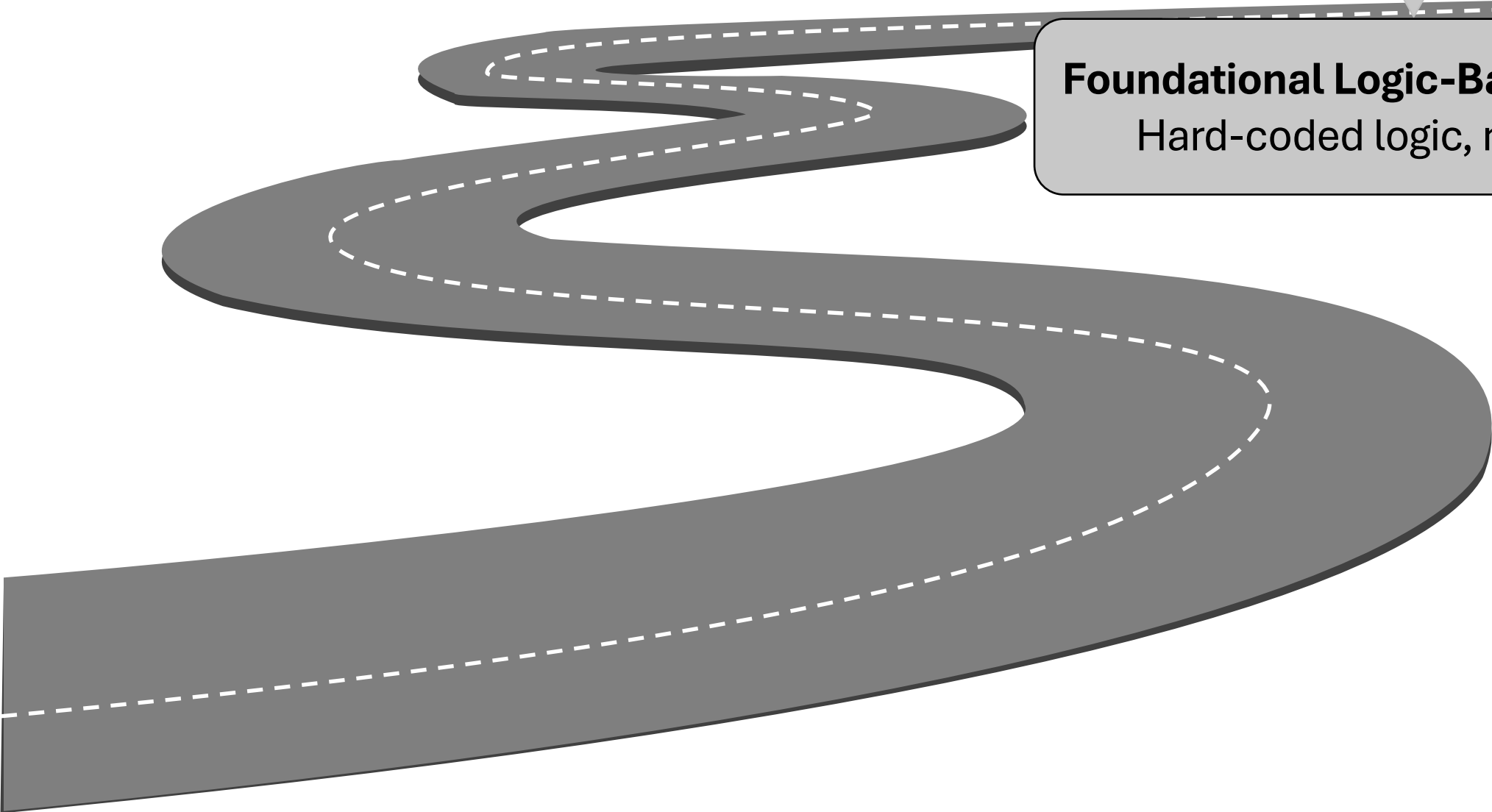
- ***learning*** from data
- ***identifying*** patterns
- ***making*** decisions or predictions



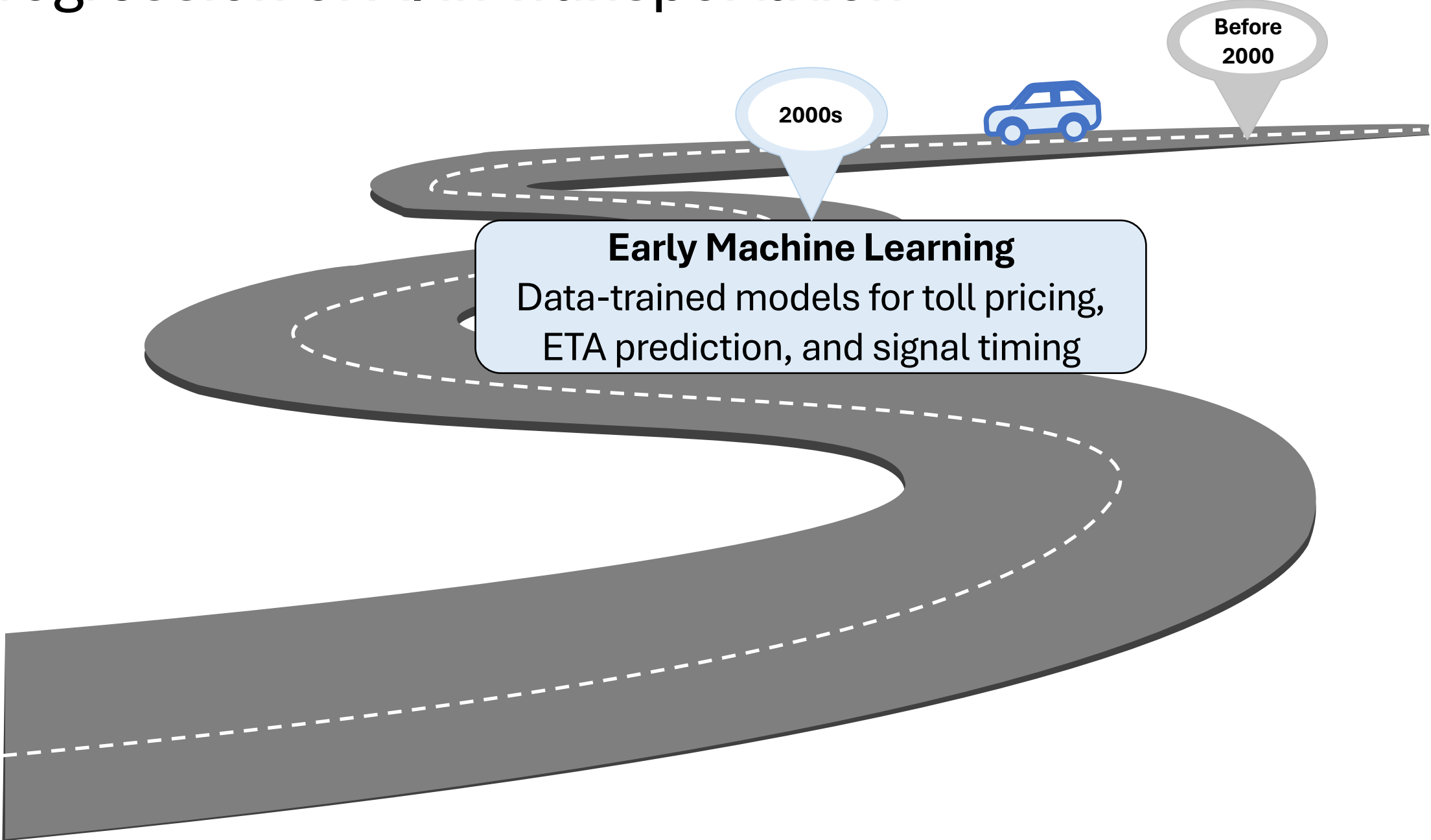
Progression of AI in Transportation

Before
2000

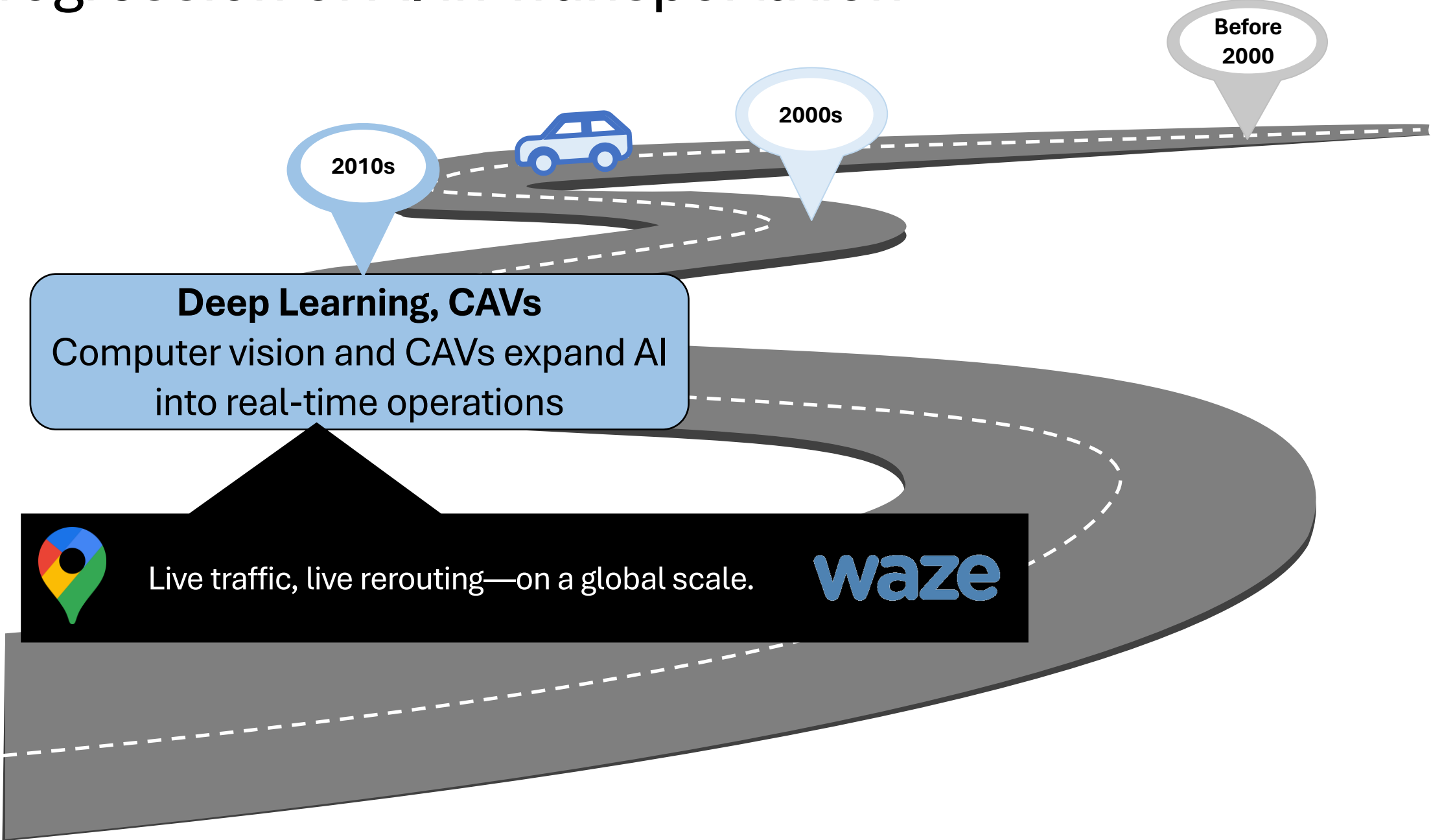
Foundational Logic-Based Systems
Hard-coded logic, no learning



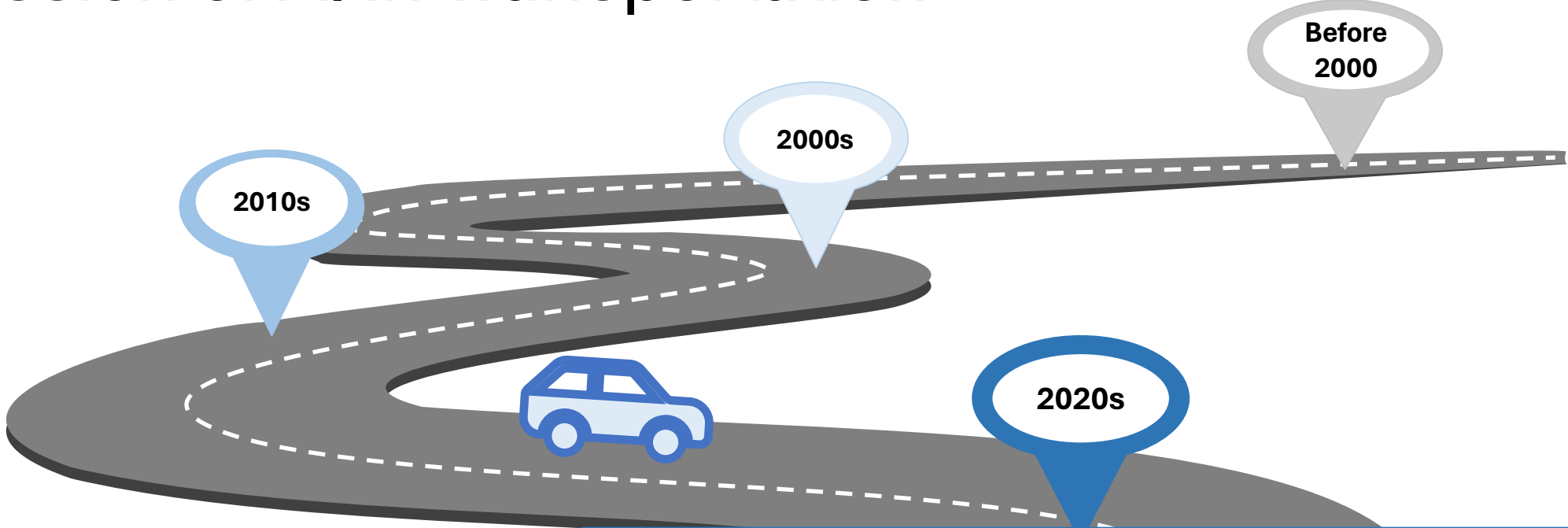
Progression of AI in Transportation



Progression of AI in Transportation



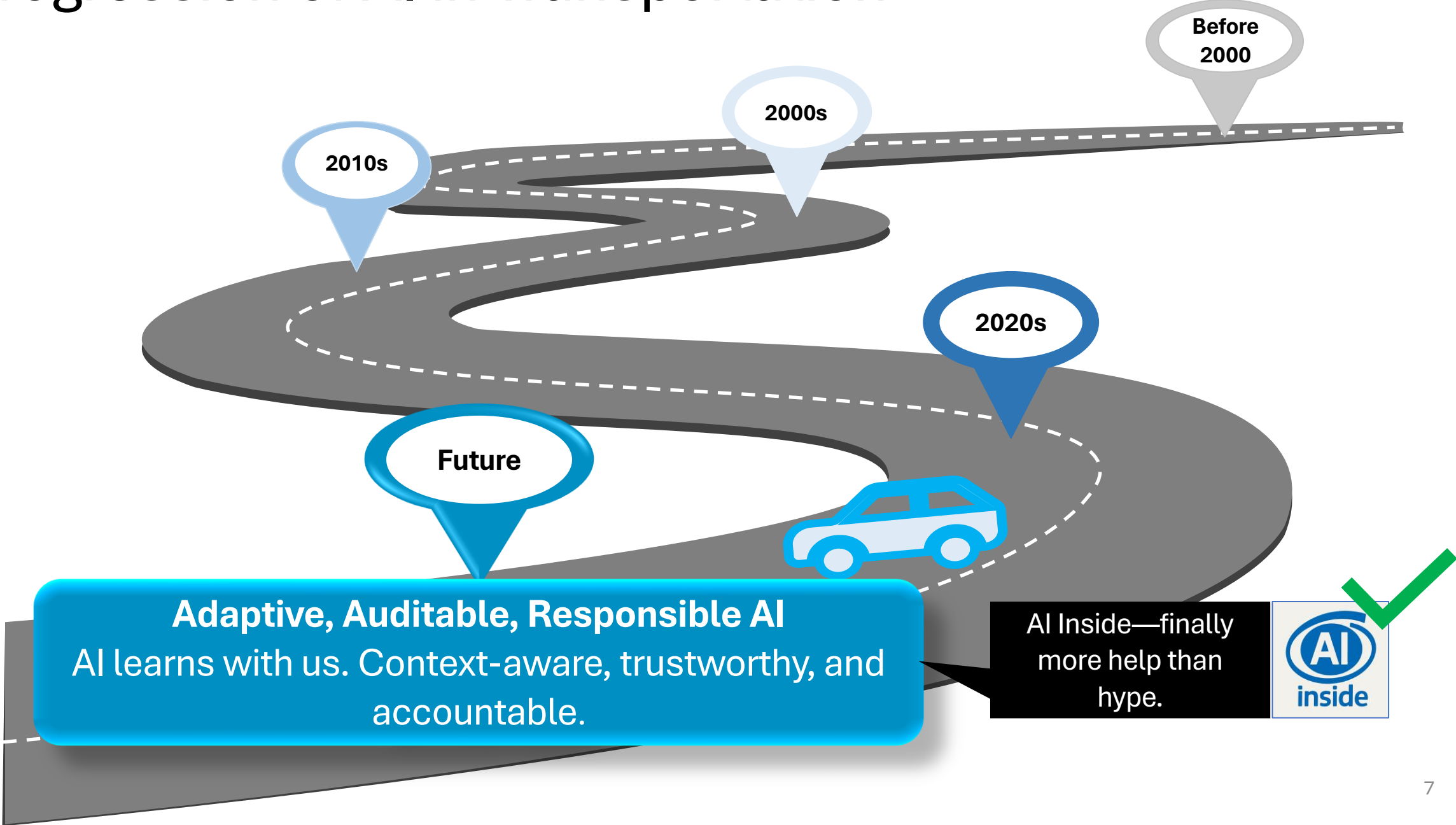
Progression of AI in Transportation



AI inside—real or hype!?!
A black speech bubble with a white border, containing the text 'AI inside—real or hype!?!' in white, sans-serif font.

LLMs and Collaborative AI
Chatbots, Edge AI, and AI-driven decision systems
A blue rounded rectangular box containing the text 'LLMs and Collaborative AI' in bold white font, and 'Chatbots, Edge AI, and AI-driven decision systems' in white font below it.

Progression of AI in Transportation



Applications of AI in Transportation



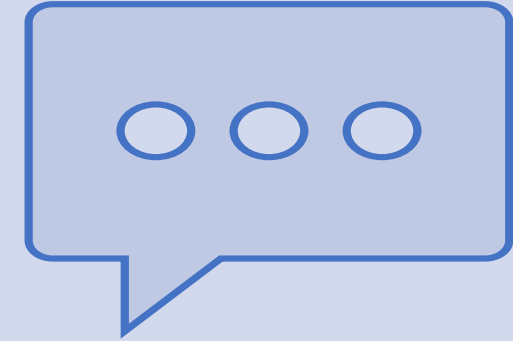
Active-Vision Video Analytics

- Anomaly Detection
- Centralized or “at the edge”



TDOT Decision Support

- Variable speed limits
- Detour routing



Chat-Based Interfaces

- Natural language interface to ATMS
- Ask questions about your documents

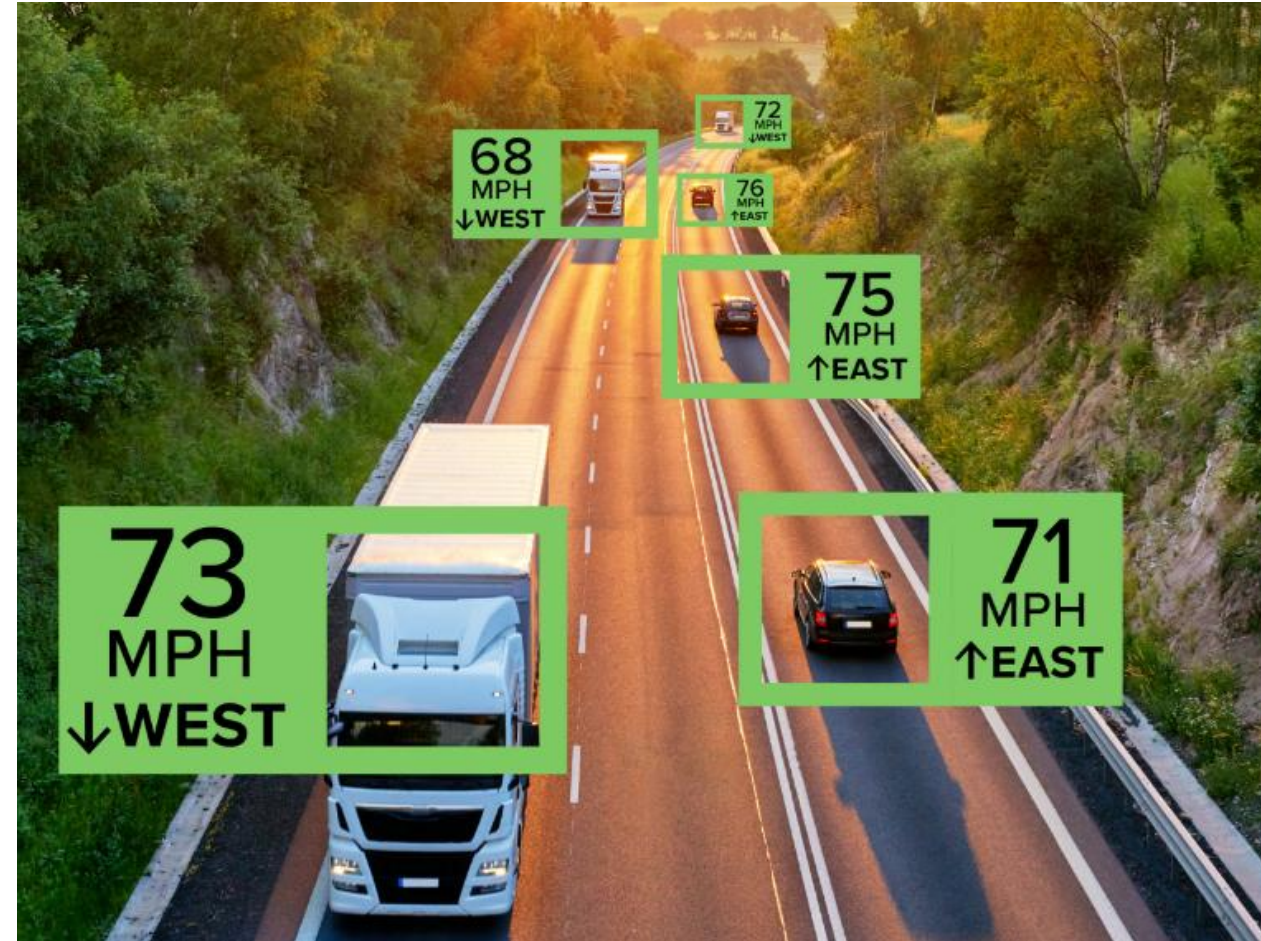


Computer Vision

AI Anomaly Detection

Active-Vision: AI-Powered Video Analytics

- Detects and interprets video feeds using deep learning
 - Classifies objects, including vehicles and people
 - Tracks vehicles and estimates speeds
 - Analyzes traffic flow patterns
- Multiple use cases for the technology
 - Wrong way driver detection
 - Pedestrian alerts
 - Anomaly detection

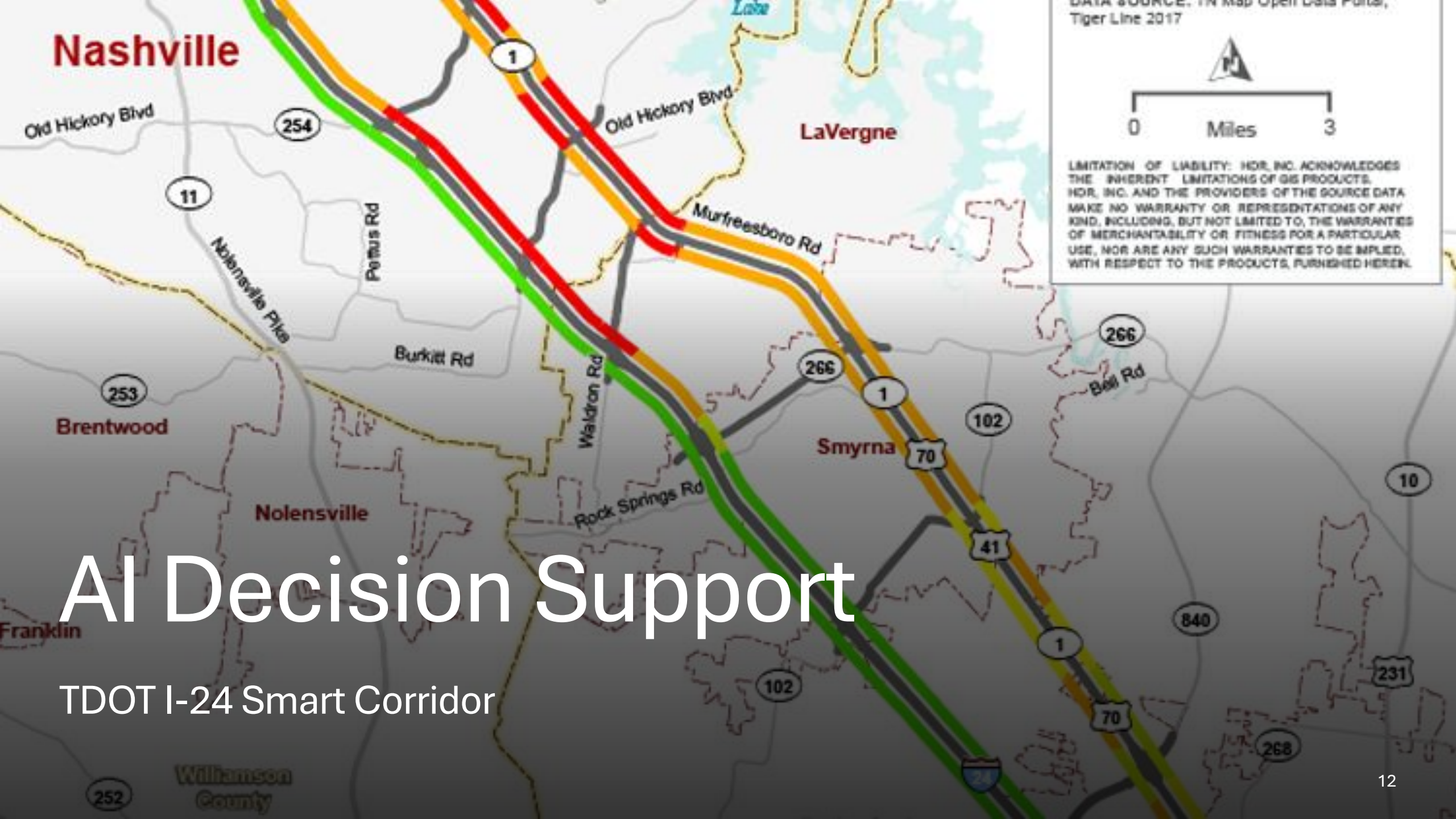


Active-Vision: Wrong Way Driver Detection



Learns the correct direction of traffic flow and detects wrong way vehicles

Nashville



DATA SOURCE: TN Map Open Data Portal, Tiger Line 2017

0 Miles 3

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AI Decision Support

TDOT I-24 Smart Corridor

TDOT Traffic Control: AI-Powered Speed Limit Decisions



- Each gantry
 - Uses nearby traffic data to suggest safe speed limits
 - Consistent logic at every location keeps operations scalable
- Adapts in real time to changing traffic and conditions
- Follows TDOT's rules to avoid sudden speed drops

Since deployment on Feb 26, 2024:

- The AI-enabled VSL has made 50 million decisions
- 40 million trips on the corridor with the algorithm running



Operator Validation in ATMS

Desktop Video Wall 1 *

New Options Layouts Tours

Cameras: Local C2C

RCA

Search

Name

- (026) R3A-00140-209.3E (026)
- (027) R3A-00140-208.8E (027)
- (028) R3A-00140-208.2E (028)
- (029) R3A-01440-000.0E (029)
- (030) R3A-00140-207.0W (030)
- (031) R3A-00140-207.7W (031)
- (032) R3A-00165-085.2S (032)
- (033) R3A-00165-086.0S (033)
- (034) R3A-005R6-011.2S (034)
- (035) R3A-005R6-012.0N (035)
- (036) R3A-005R6-012.6S (036)
- (037) R3A-005R6-013.0N (037)
- (038) R3A-005R6-014.2N (038)
- (039) R3A-005R6-014.9S (039)
- (040) R3A-005R6-015.6N (040)
- (041) R3A-00124-044.0E (041)
- (042) R3A-00124-043.4E (042)
- (043) R3A-SR155-017.3 (043)
- (044) R3A-SR155-016.9W (044)
- (045) R3A-00124-049.0W (045)
- (046) R3A-00165-085.7S (046)
- (047) R3A-00165-081.5N (047)
- (048) R3A-00124-042.3E (048)
- (049) R3A-SR386-002.3W (049)
- (050) R3A-00165-097.6S (050)
- (051) R3A-00140-203.9W (051)
- (052) R3A-00140-201.6W (052)
- (053) R3A-00165-080.0S (053)
- (054) R3A-00165-077.9N (054)
- (055) R3A-00124-055.3W (055)
- (056) R3A-00124-052.6E (056)
- (057) R3A-00140-213.5E (057)
- (058) R3A-00140-213.2 (058)
- (059) R3A-00140-218.1W (059)
- (060) R3A-SR155-016.0E (060)
- (061) R3A-SR155-015.5W (061)
- (062) R3A-00140-215.0W (062)
- (063) R3A-01440-005.0W (063)
- (064) R3A-01440-001.2E (064)

Corridor Status: I-24 Westbound

Selected Corridor: I-24 Westbound

Settings

I-24 W/O Harding Pl MM.55.3

I-24 E/O Briley Pkwy MM 54.6

MILE MARKER 54.4

MILE MARKER 54.6

MILE MARKER 54.8

MILE MARKER 55

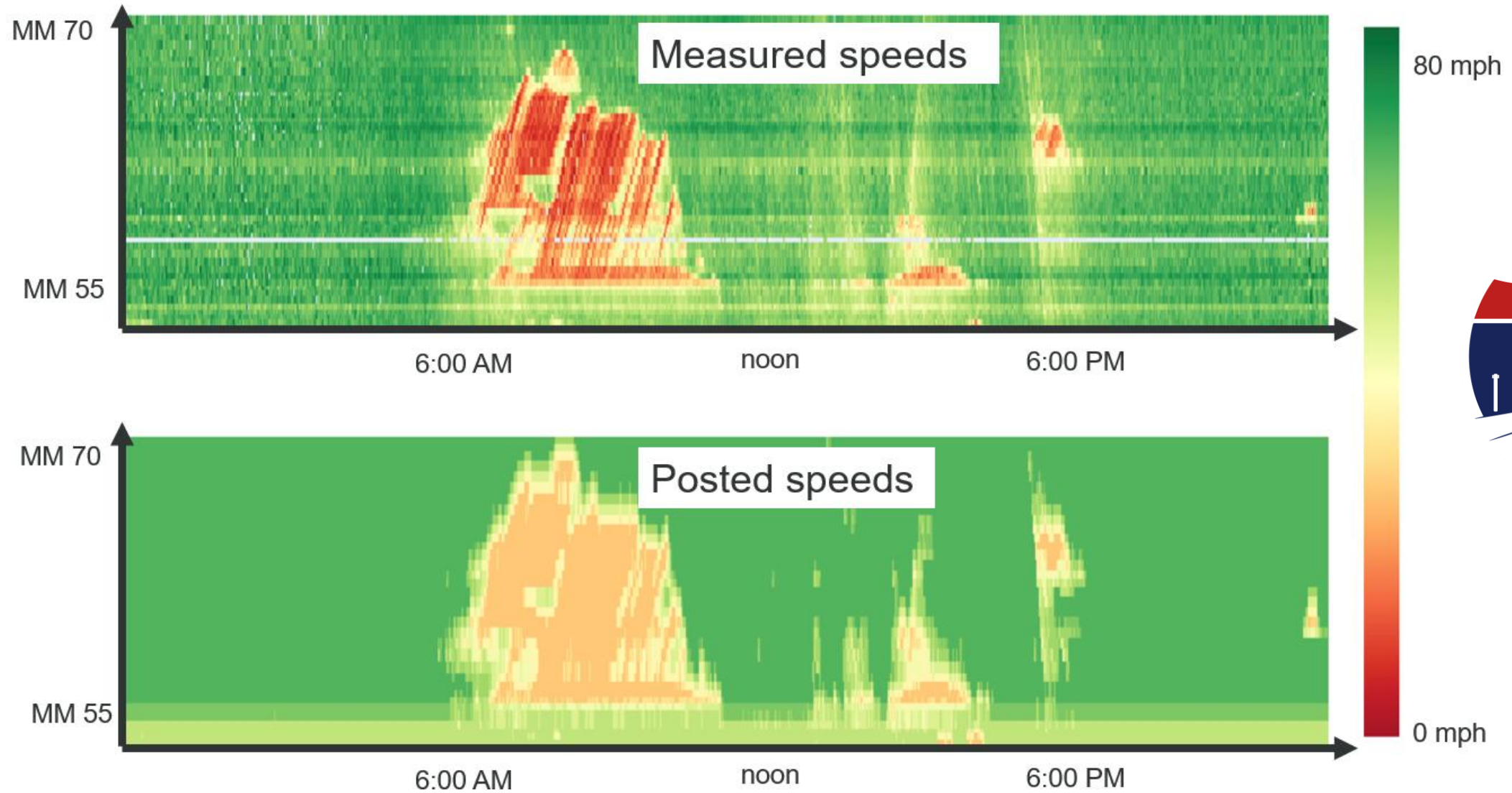
MILE MARKER 55.2

MILE MARKER 55.4

MILE MARKER 55.6

Name	Status	Suggested Speed	Message Displayed	Speed
I-40 Westbound	Normal	SPEED LIMIT 70		
I40-222.8W	Normal	SPEED LIMIT 70	Currently displayed	
R3G-00140-196.4W (461)				70
I40-223.2W	Triggered	SPEED LIMIT 30		30
I40-223.2W			Currently displayed	
R3G-00140-198.2W (286)				30
I40-223.6W	Triggered	SPEED LIMIT 40		
I40-223.6W			Currently displayed	
R3G-00140-198.9W (289)				70
I40-224.0W	Triggered	SPEED LIMIT 50		
I40-224.0W			Currently displayed	
R3G-00140-199.5W (290)				70
I40-224.2W	Triggered	SPEED LIMIT 60		
I40-224.2W			Currently displayed	
R3G-00140-199.9W (293)				70
I40-224.4W	Normal	SPEED LIMIT 70		
I40-224.4W			Currently displayed	
R3G-00140-200.2W (294)				70

Algorithm Validation With Data Comparisons





Chat-Based Interfaces

Large Language Models for Transportation

Chat With Your ATMS



Operator:
Show CCTV feeds near active alarms.

ATMS Helper:
There are currently **4 active alarms**. Would you like to view cameras near each?

Operator:
Yes. Show the closest camera to each alarm.

ATMS Helper:
Opening video on desktop for the 4 nearest cameras:

- **Camera 006-FLIR-ITSPole** (Alarm: NB 281 @ Evans)
- **Camera 007-FLIR-ITSPole** (Alarm: SB 1604 @ Culebra)
- **Camera 005-Vicon-Impath-C** (Alarm: TMC Equipment Room)
- **Camera 008-Hik-Signal-Mast** (Alarm: WB I-10 @ UTSA)

Launching in 2x2 split view...

Use normal language to perform complex operations

Chat With Your SOPs

 **Operator**

What's our SOP if we get a stalled vehicle in the left lane near MM 142 during peak hours?

 **TMC SOP Helper**

According to [**SOP 5.3.2**], for a stalled vehicle in a travel lane during peak hours:

- Notify Highway Patrol immediately
- Dispatch a tow within 6 minutes if shoulder access is blocked
- Activate upstream DMS: “LEFT LANE BLOCKED – USE CAUTION”
- Update the incident log every 10 minutes until cleared

Chat With Your SOPs

 **Operator**

Do we notify media or just update the traveler info system?

 **TMC SOP Helper**

Traveler info update is required within 5 minutes.

Media alerts are optional unless the blockage lasts more than 30 minutes ([SOP 7.1.4]).

 **Operator**

Can you show me the ramp meter adjustment steps if congestion builds behind this?

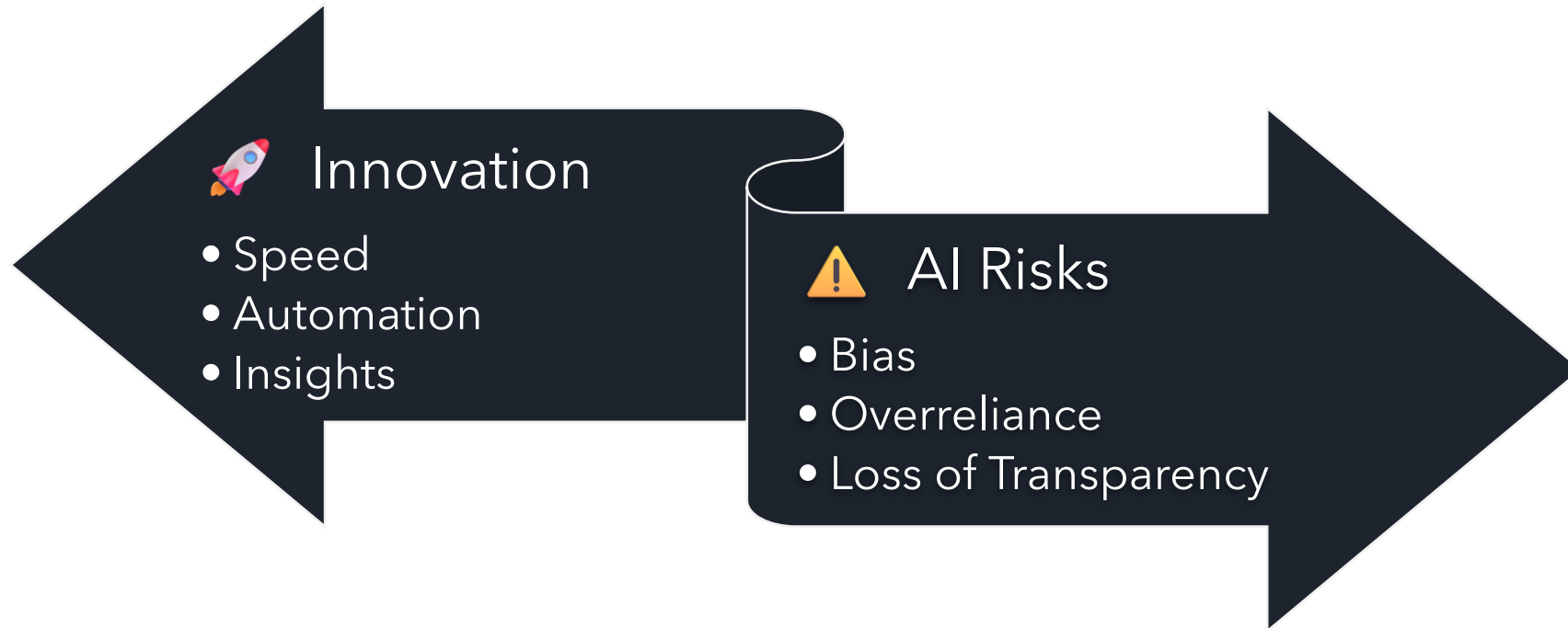
 **TMC SOP Helper**

Per [SOP 4.2.6]:

- Switch affected meters to **manual override**
- Increase green time by **5 seconds** for ramps feeding the queue
- Notify adjacent TMC if queues exceed **1,000 ft**





Balancing Innovation and AI Risks

“With great power comes great responsibility.”
- *Spider-Man*



Innovation provides power—responsibility makes it purposeful

What Does Responsible AI Really Mean?

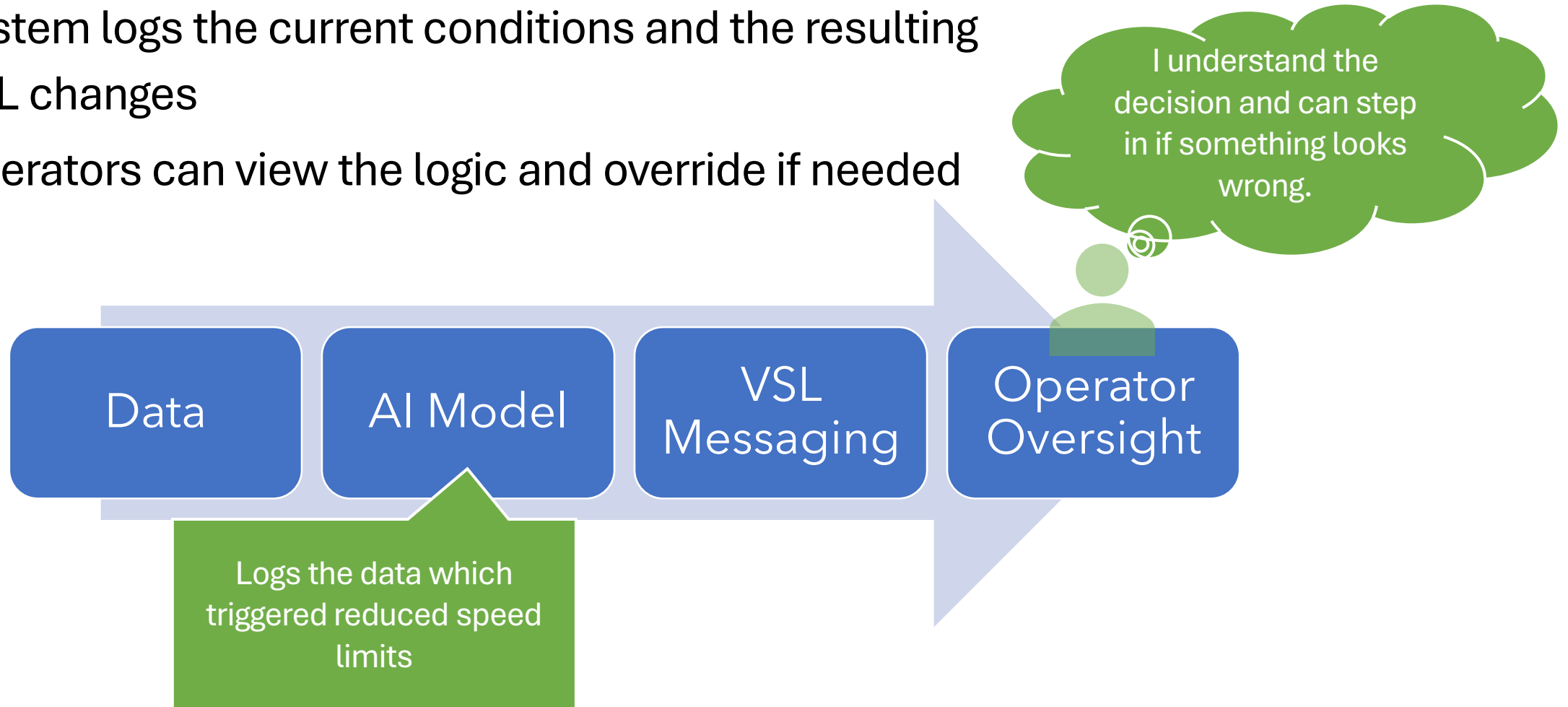
	Principle	What It Means	In Transportation Context
	Transparency	AI decisions can be explained and understood	Operators know why a VSL changed, or detour was suggested
	Fairness	AI treats users and communities equitably	Service quality is consistent across regions and demographics
	Security & Privacy	AI protects data and resists misuse	Documents stay secure; edge AI keeps personal info local
	Accountability	AI supports and does not replace human decision-making	Staff can verify, override, and act without the AI if needed

Responsible AI: Transparency in Practice

Why Did the System Do That?

VSL changes in ATMS

- System logs the current conditions and the resulting VSL changes
- Operators can view the logic and override if needed

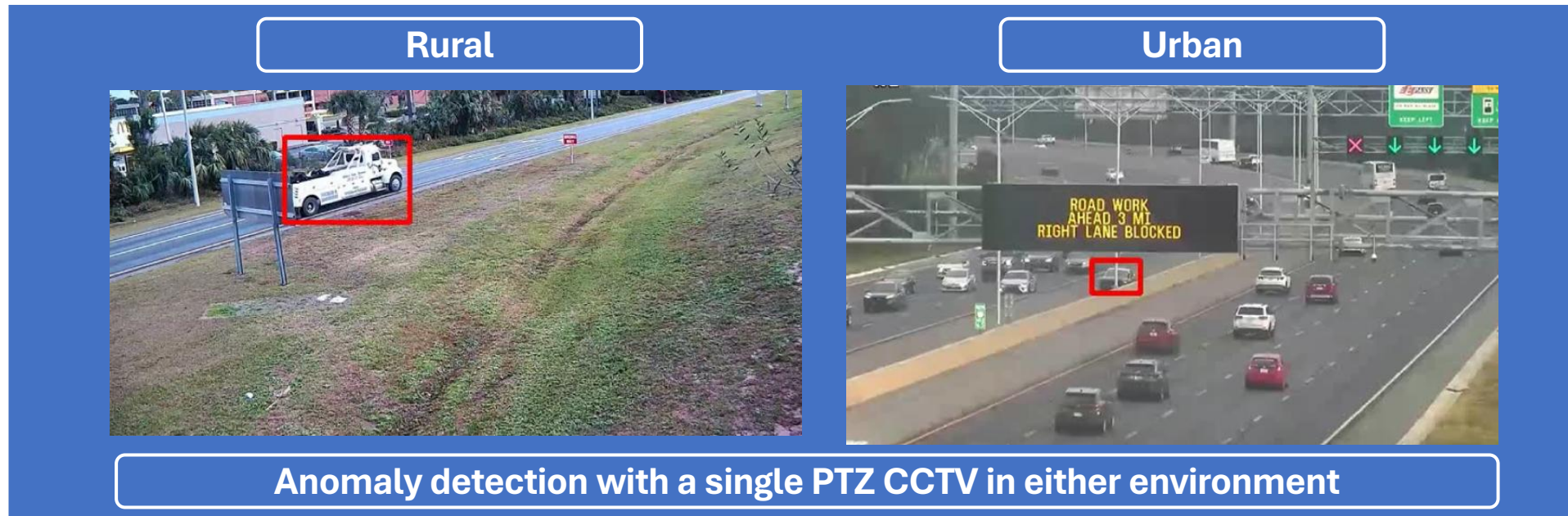


Responsible AI: Fairness in Practice

Equity by Design

Active-Vision: anomaly detection using computer vision

- Consistent detection with varying traffic volumes
- Should not rely upon CCTV density



Responsible AI: Security & Privacy in Practice

Keeping Data Safe By Design

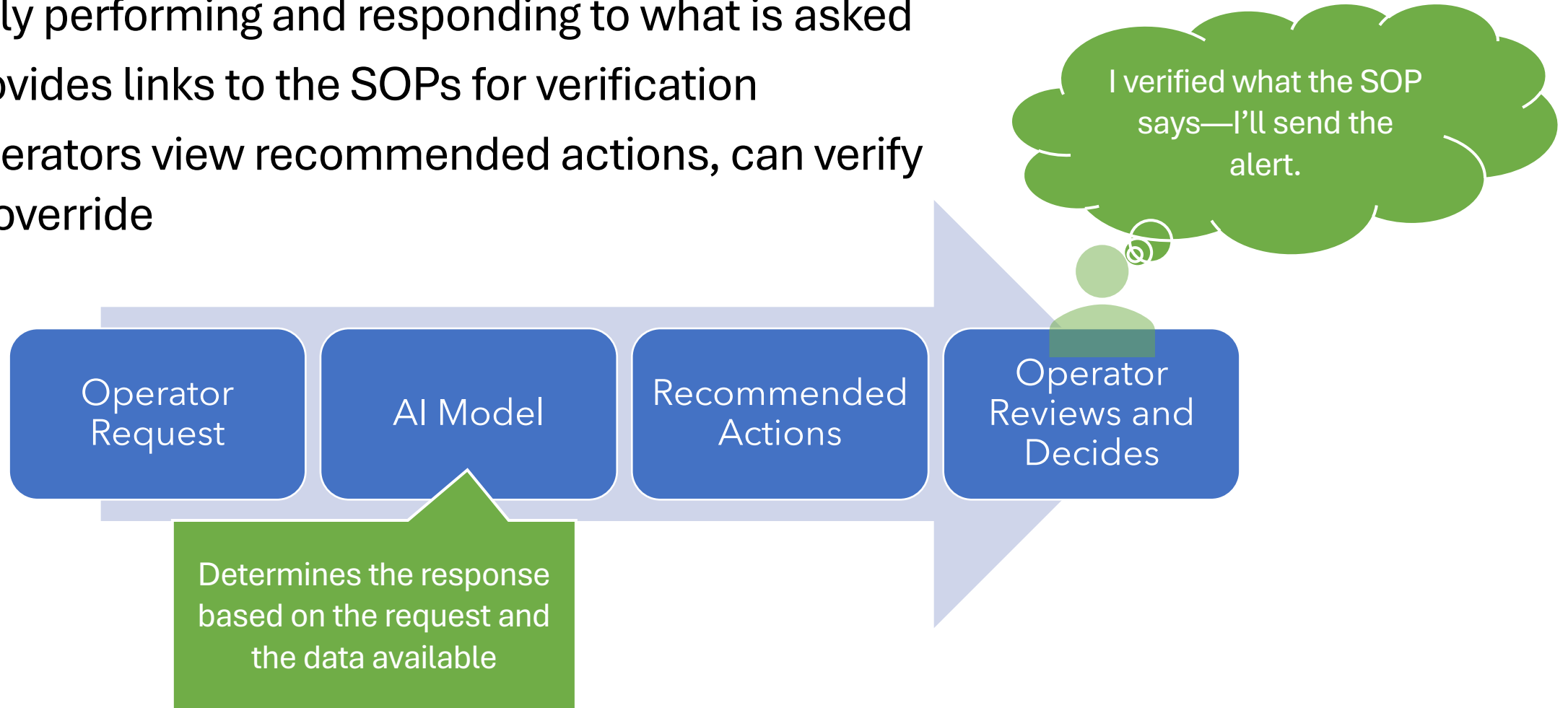
- Systems are architected to minimize attack surfaces
 - Limit external access
 - Isolate model environments
- Sensitive data is removed before AI processing
 - PII
 - HIPAA-protected info
 - IP addresses
 - User information in logs
- AI components follow least-privilege access principles
 - Only the data needed for the task is visible to the model

Responsible AI: Accountability in Practice

AI Supports, Humans Decide

LLM Chatbots

- Only performing and responding to what is asked
- Provides links to the SOPs for verification
- Operators view recommended actions, can verify or override



Responsible AI in Action



This isn't about slowing innovation.



It's about building systems we can trust—today and tomorrow.



Powerful AI needs smart guardrails.

Questions?



Brent Becker

Lead Analyst

brent.becker@swri.org

Lynne Randolph

Institute Engineer

lynne.randolph@swri.org



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