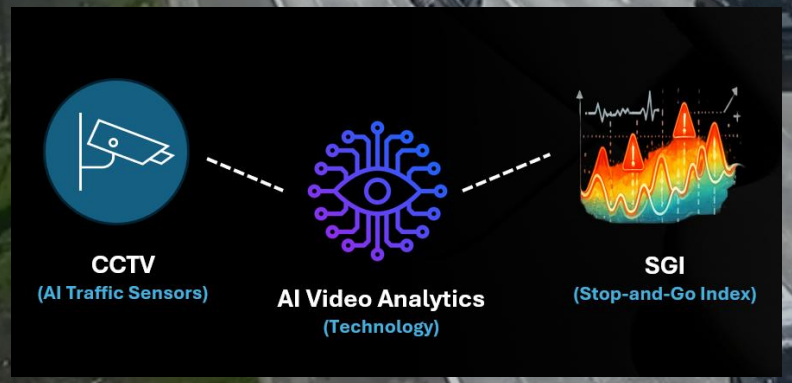
# AI-Powered Video Analytics for TSMO

*Transforming Existing CCTV into Continuous Lane-Level Traffic Sensors and Mobility Intelligence*

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# WSB's AI-Powered Video Analytics (AIVA) Framework

***Generating high-resolution, lane-level vehicle trajectories from existing footage***

- Existing CCTV (RTSP/IP)
- Portable camera
- Drone footage


I-94 WB at Chicago Avenue – Minneapolis, MN
Video Quality: SD, 640x480, 30 fps

- ✓ Automated detection & classification (8 classes)
- ✓ Continuous lane-level trajectory tracking
- ✓ High-resolution data extraction using virtual detectors

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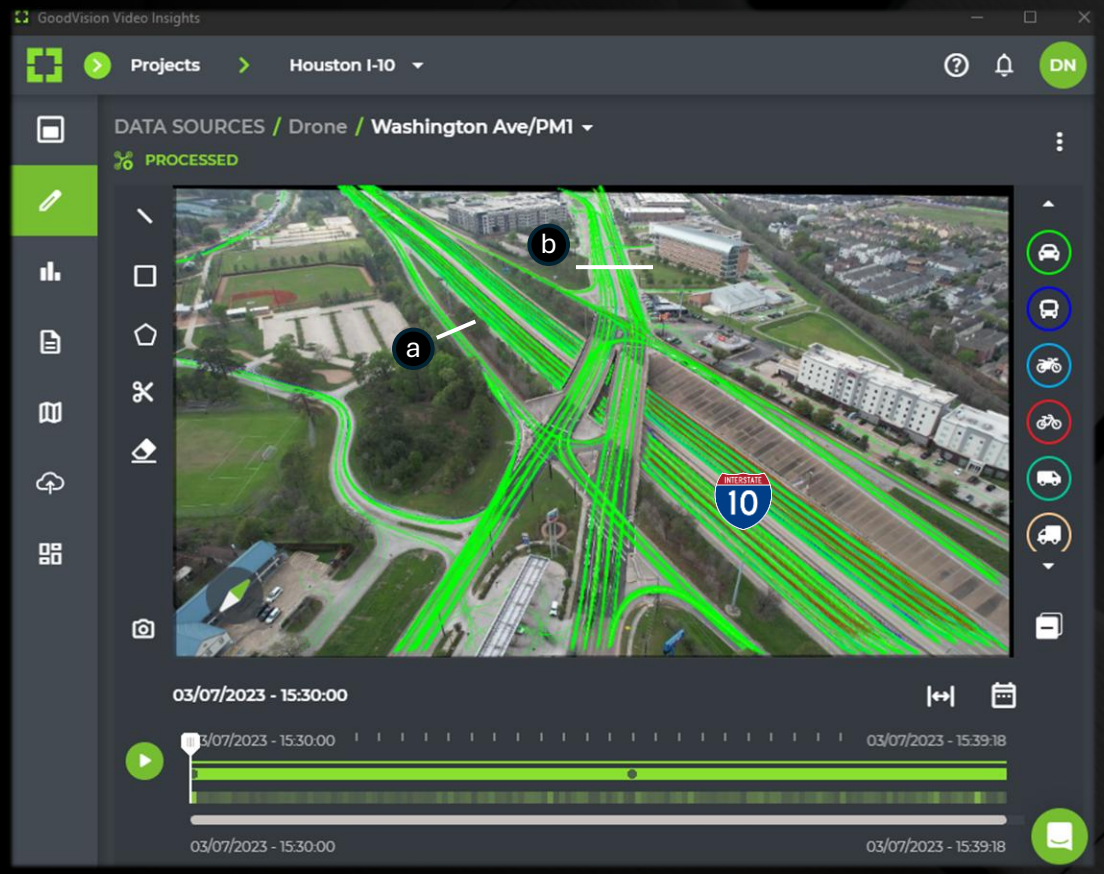
# AI-Powered High-Resolution Data Extraction Platform

***Flexible virtual detection across any lane, link, and time scale in real time or offline***

- Existing CCTV (RTSP/IP)
- Portable camera
- Drone footage




I-10 at Washington Avenue – Houston, TX

- ✓ Continuous lane-level vehicle trajectories
- ✓ Virtual detectors anywhere in the network
- ✓ Lane-by-lane movement and behavior insights

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# I-694 Corridor Detector Health Assessment (Jan 2026 – Mar 2027)

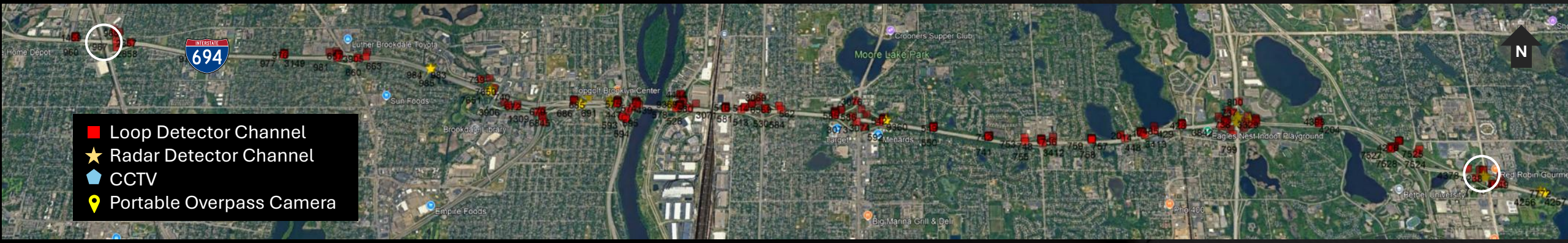
- ***Lane-level detector health assessment using AIVA***
- ***Turning existing CCTV into continuous lane-level traffic sensors with AIVA***

**Project Corridor:**

- I-694 : CR 81 to Lexington Ave (~11 miles)
- ~125 lane-level detectors (loop + radar)
- ~20 MnDOT CCTV (PTZ)

**Project Progress:**

- Hundreds of hours of video evaluated
- 750,000 vehicle trajectories analyzed
- Independent manual counts by a 3rd party



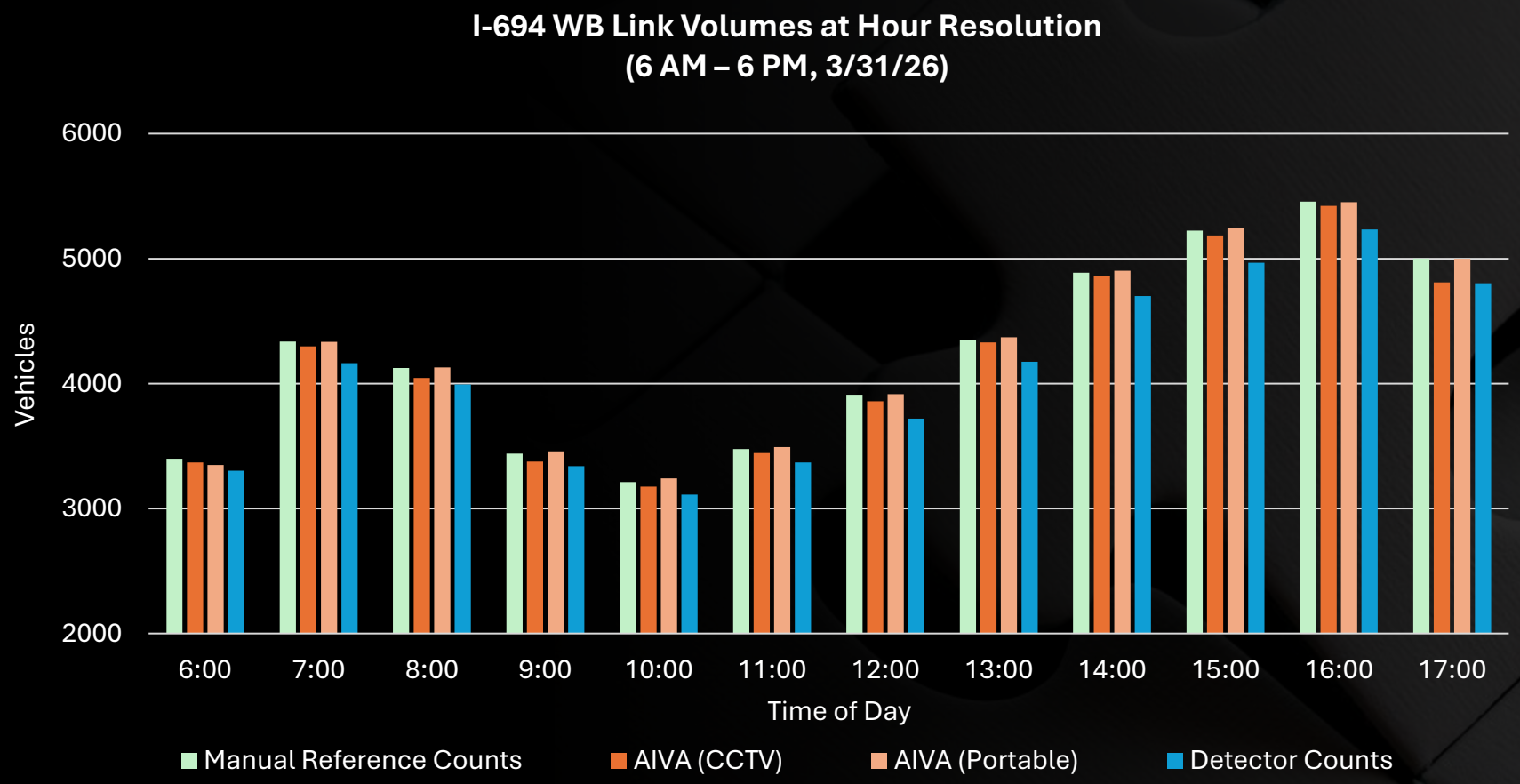
# Example Evaluation Location – I-694 at Xerxes Avenue

***Dual-camera deployment using MnDOT PTZ CCTV and portable cameras***


- Radar detector station
- MnDOT PTZ CCTV coverage
- Portable overpass camera coverage


# Detector Performance Assessment – Link Volume Validation

***Detector and AIVA link volumes show excellent agreement with manual counts (MAPD < 4%)***

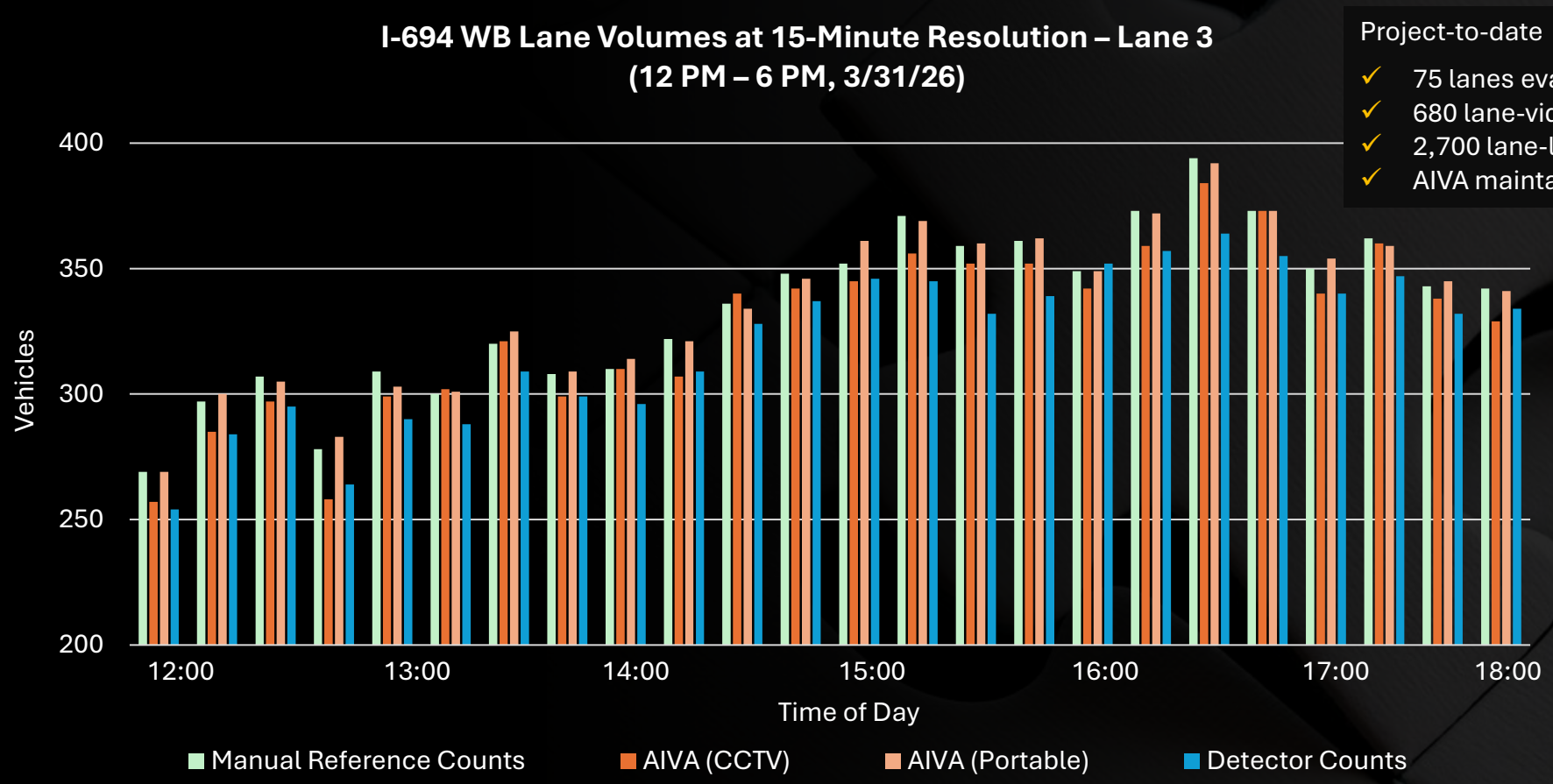



Hourly Error (MAPD)

- Detector: **3.7%**
- AIVA (CCTV): **1.3%**
- AIVA (Portable): **0.4%**

# Detector Performance Assessment – Lane Volume Validation

***Lane-level detector performance varies, while AIVA remains consistent***




Project-to-date

- ✓ 75 lanes evaluated
- ✓ 680 lane-video hours analyzed
- ✓ 2,700 lane-level 15-minute observations
- ✓ AIVA maintains 97% average accuracy

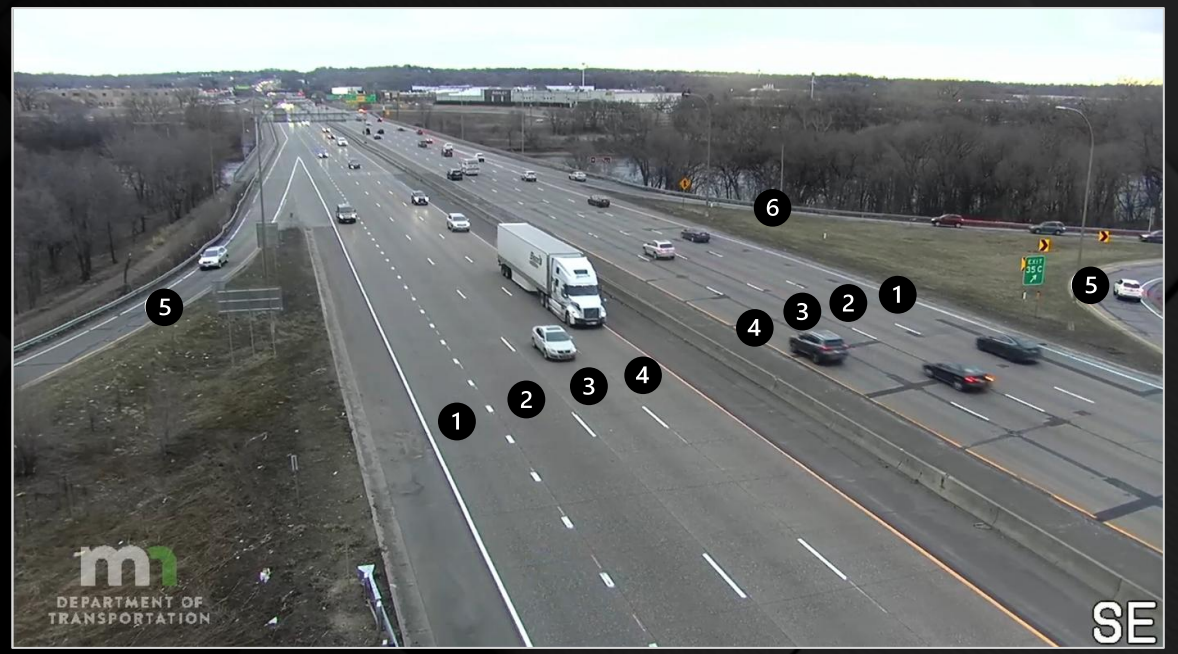
15-Min Error (MAPD)

- Detector: **4.2%**
- AIVA (CCTV): **2.5%**
- AIVA (Portable): **0.7%**

# Single CCTV Monitoring Multiple Detector Stations

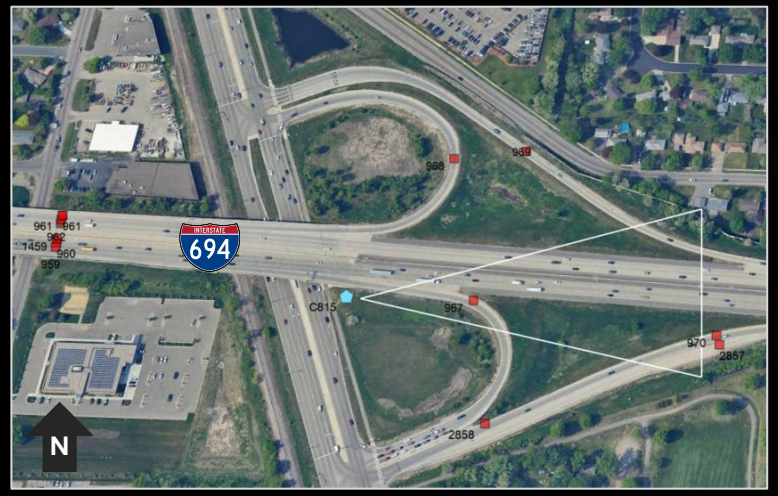
***AIVA analyzes multiple detector stations simultaneously from a single CCTV***


CCTV C7011 Coverage Area

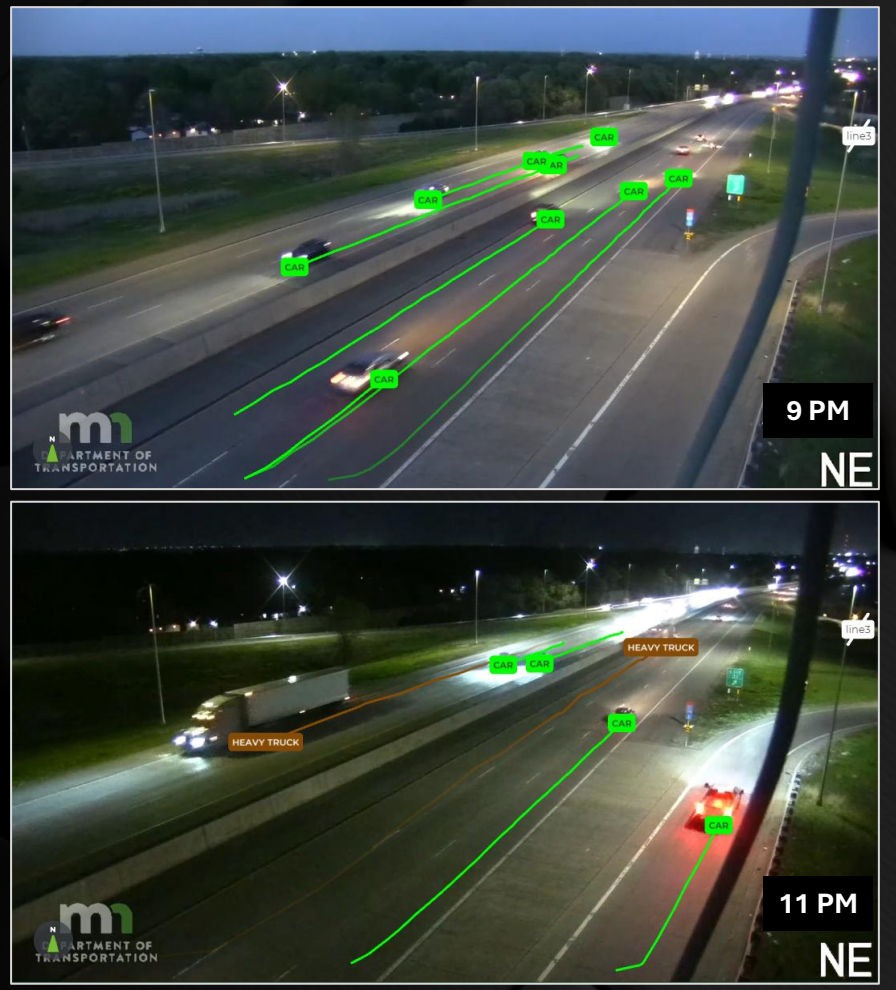


# Robust Nighttime Performance by CCTV

***AIVA maintains reliable vehicle detection and trajectory extraction during nighttime conditions***




CCTV C815 Coverage Area



# Analyzing Flow Instability with AIVA

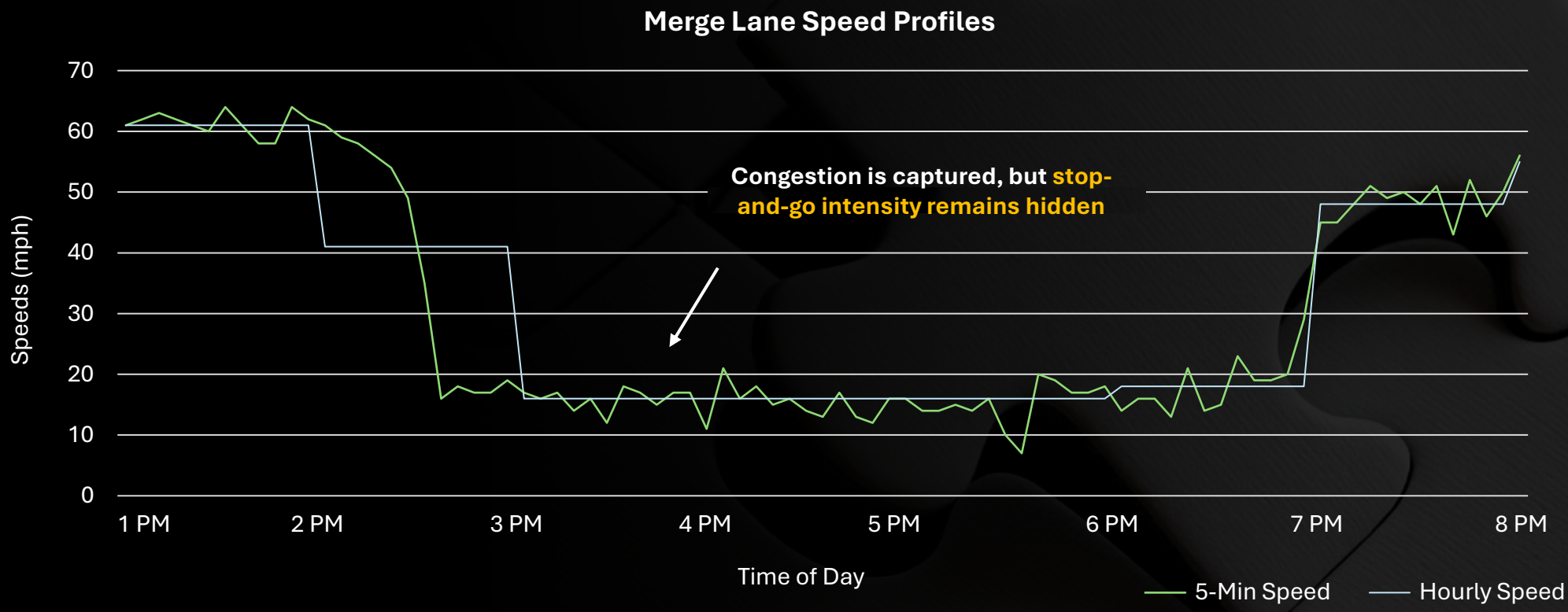
***High merge demand into congested through lanes results in continuous acceleration and deceleration***


I-94 WB at Chicago Avenue Minneapolis, MN

- ✓ High on-ramp demand upstream
- ✓ Exit only lane to 11th Street
- ✓ Downstream bottleneck (Lowry Hill Tunnel)
- ✓ Recurring PM peak congestion

# Speed Captures Congestion, but Provides Limited Insight

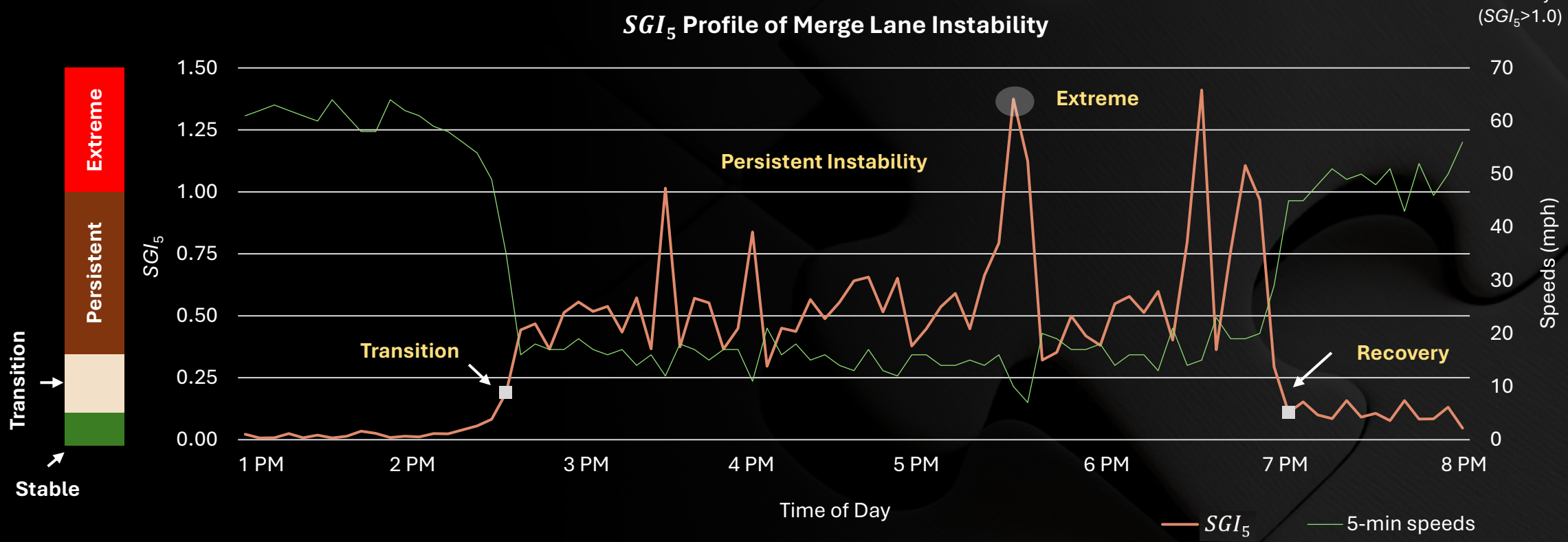
***Speed is widely used – but fails to reveal traffic instability and its impacts***



# Measuring Lane Instability with SGI

***SGI captures the full instability cycle missed by speed***

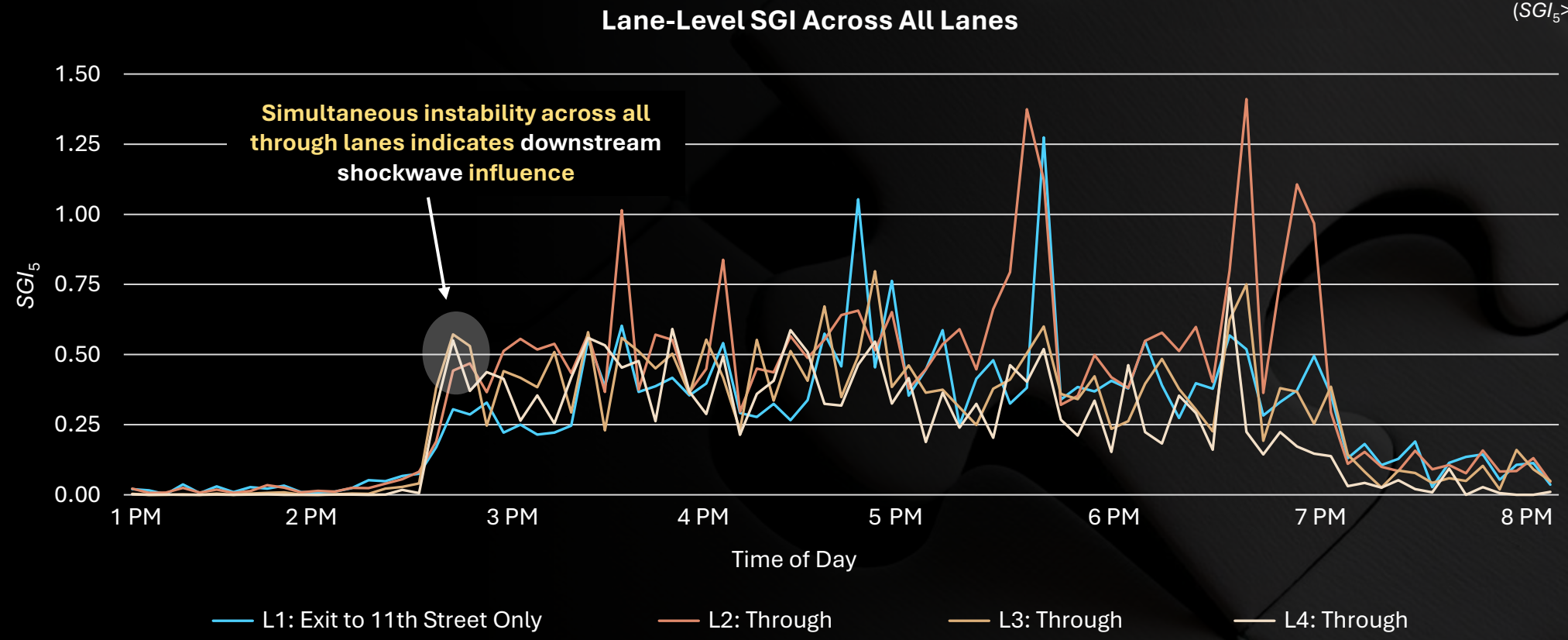

Extreme Instability at 5:25 PM
($SGI_5$>1.0)



# Diagnosing Link Instability using SGI

***2:30 PM - Instability emerges simultaneously across all through lanes***

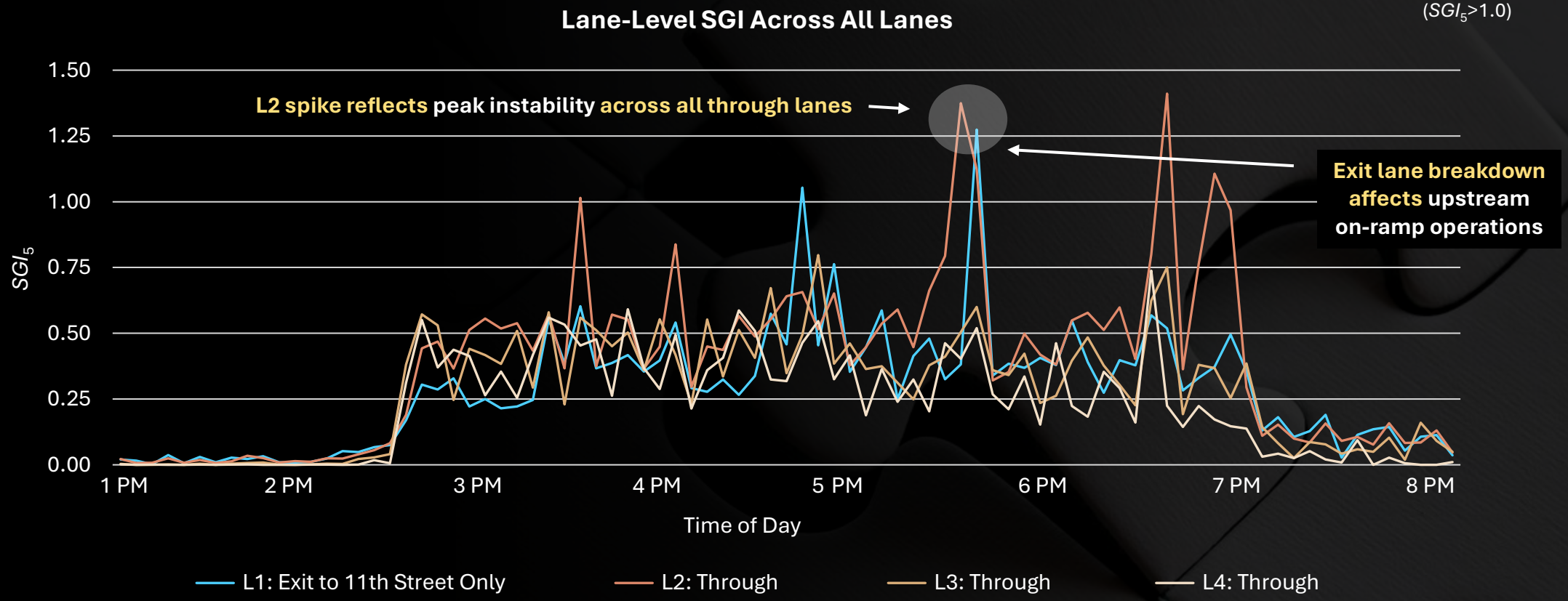

Congested through lanes at 2:30 PM ($SGI_5$>0.25)



# Diagnosing Link Instability using SGI

***5:30 PM - Peak through-lane instability disrupts merge operations***


Exit lane instability at 5:30 PM
($SGI_5$>1.0)



# I-694 Corridor Mobility Analysis using AIVA and SGI

***Add-on Demonstration Project***

## Major Tasks

- ✓ AIVA analytics using existing CCTV and supplemental portable overpass cameras across a 4-mile study area
- ✓ Lane-level instability diagnosis within each corridor segment
- ✓ Tracking instability propagation across the corridor


Study Area and Analysis Segments

# Turning CCTV into Continuous Lane-Level Traffic Sensors

## Questions?



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