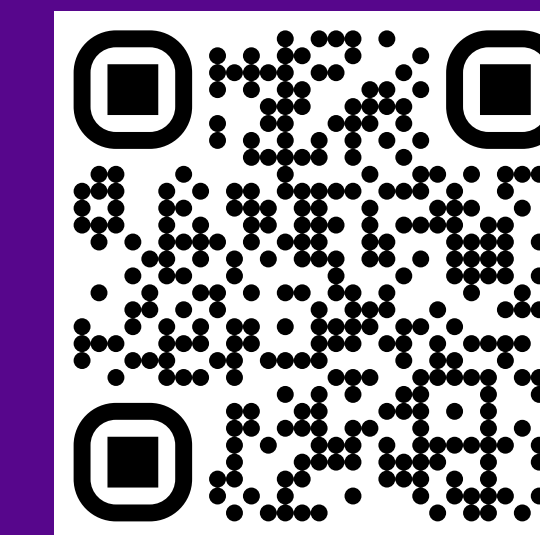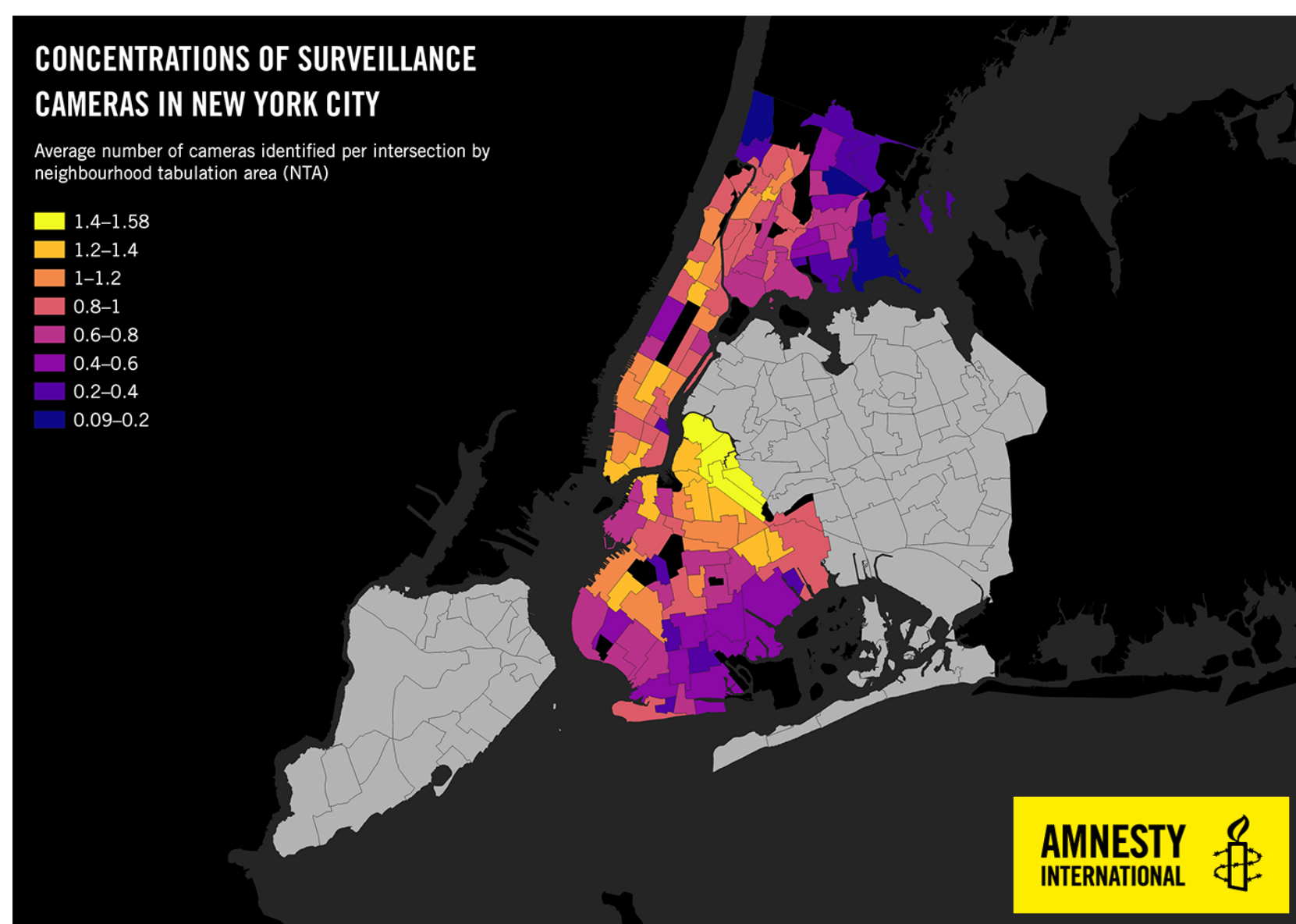# Multi-level Traffic-responsive Tilt Camera Surveillance via Predictive Correlated Online Learning (PiCOL)

Tao Li, Zilin Bian, Haozhe Lei, Fan Zuo, Ya-Ting Yang, Quanyan Zhu, Zhenning Li, Kaan Ozbay

Motivation: Underutilization of Pan-tilt Cameras(PTC)

- Holistic situational awareness (SA) enables agile and proactive urban traffic management.
- PTCs are the eyes of the city: NYC has more than 15,000 surveillance cameras.
- Real-time SA calls for **automated traffic-responsive tilting control**.

TTC-X Conceptualization

Traffic-responsive Tilt Camera (TTC) Surveillance System for Everything (X)
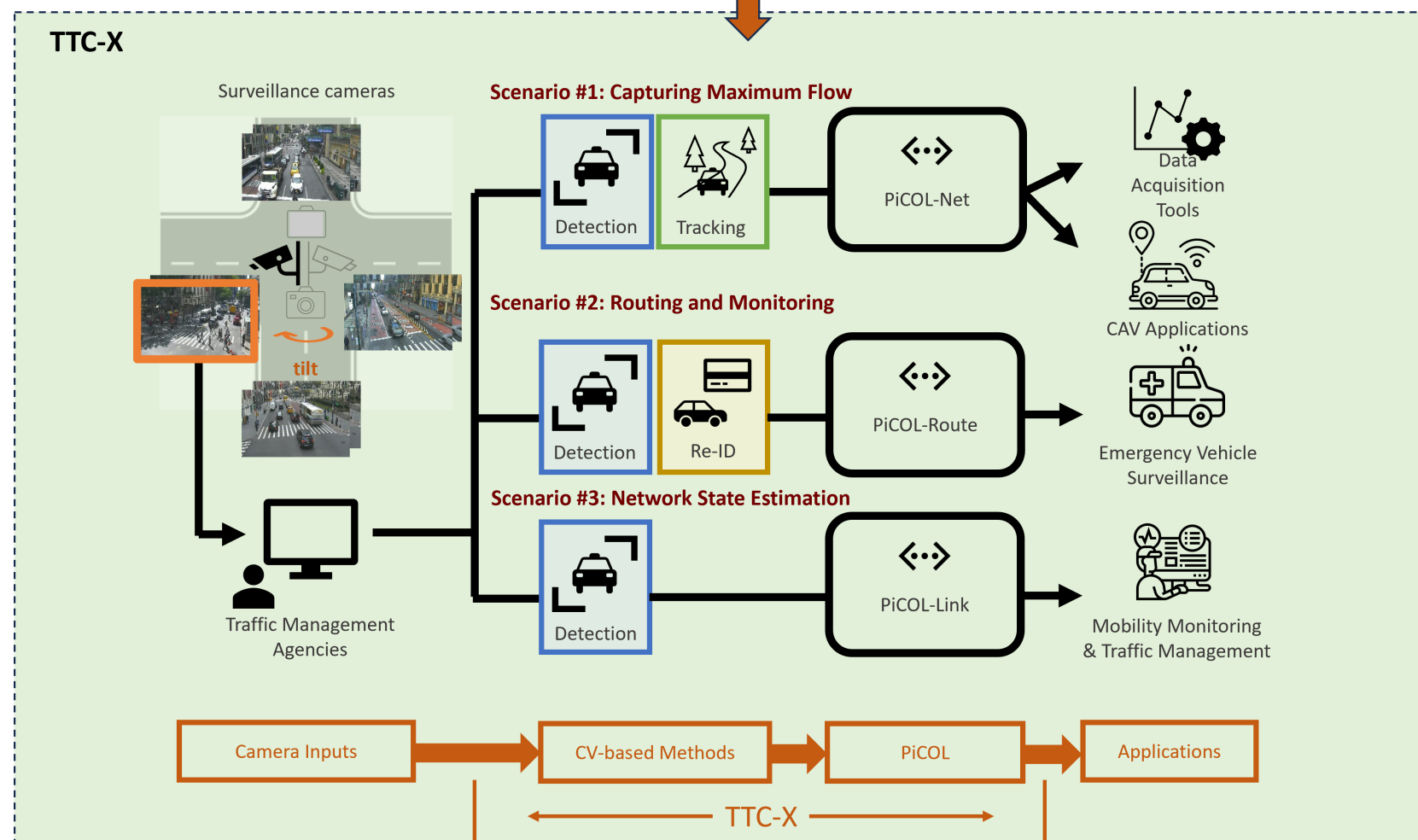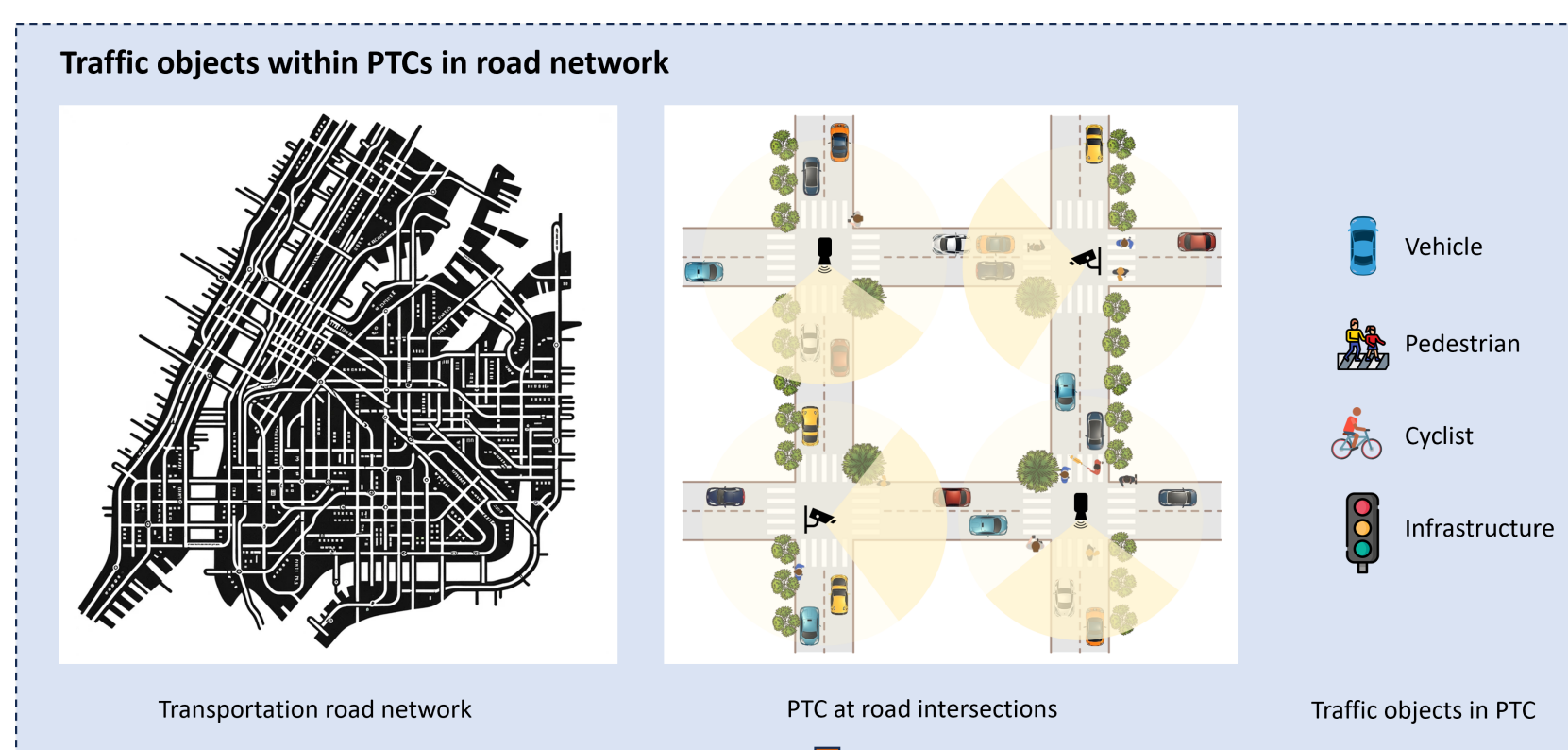

Challenges in TTC-X

1. Spatially temporally coupled traffic dynamics: Transformer-based Graph Predictor (STGP) Traffic states of road segments within the network are spatially and temporally interconnected, which is instrumental when estimating the global state.
2. Cooperative surveillance in large-scale networks: Correlated Online Learning (COL) Distributed camera control calls for intra-camera cooperation and coordination, leading to a multi-agent learning problem.
3. Real-time automated response to traffic situations: STGP+COL=PiCOL Predictor forecasts traffic states and prepares PTC controller for recurrent and non-recurrent incidents.

Predictive Correlated Online Learning

Counterfactual Regret Minimization
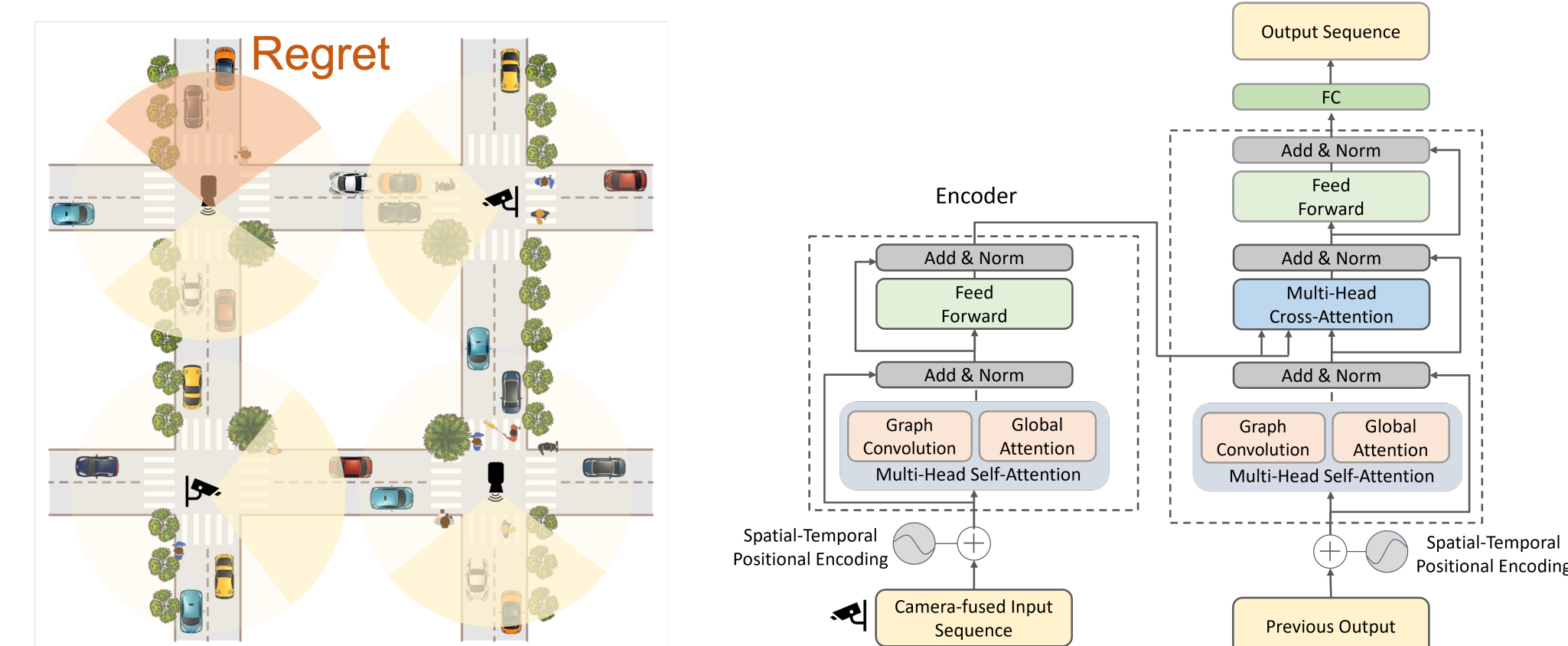
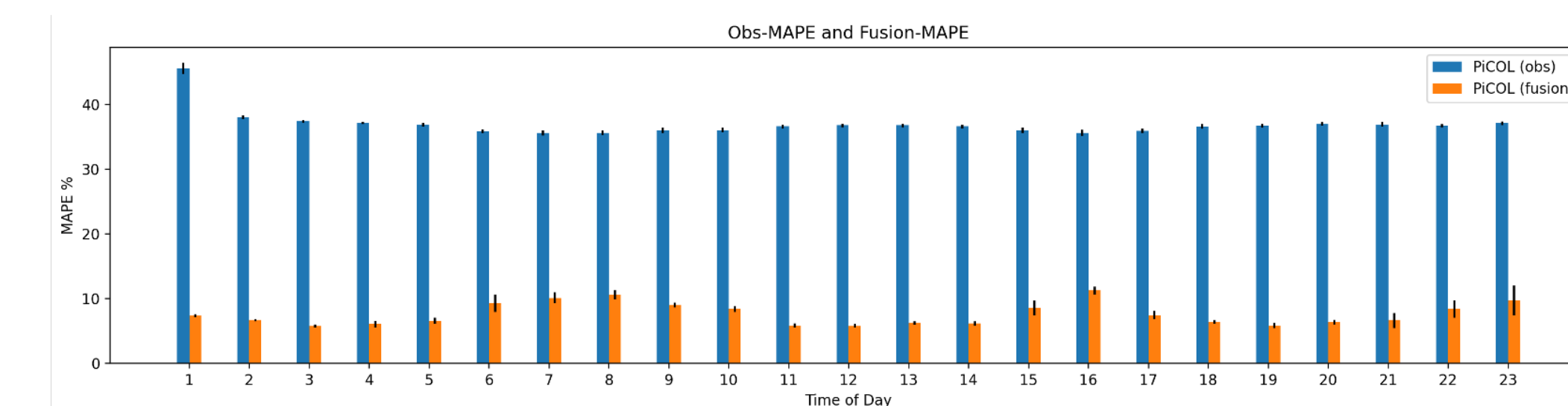
TTC-X Workflow Summary
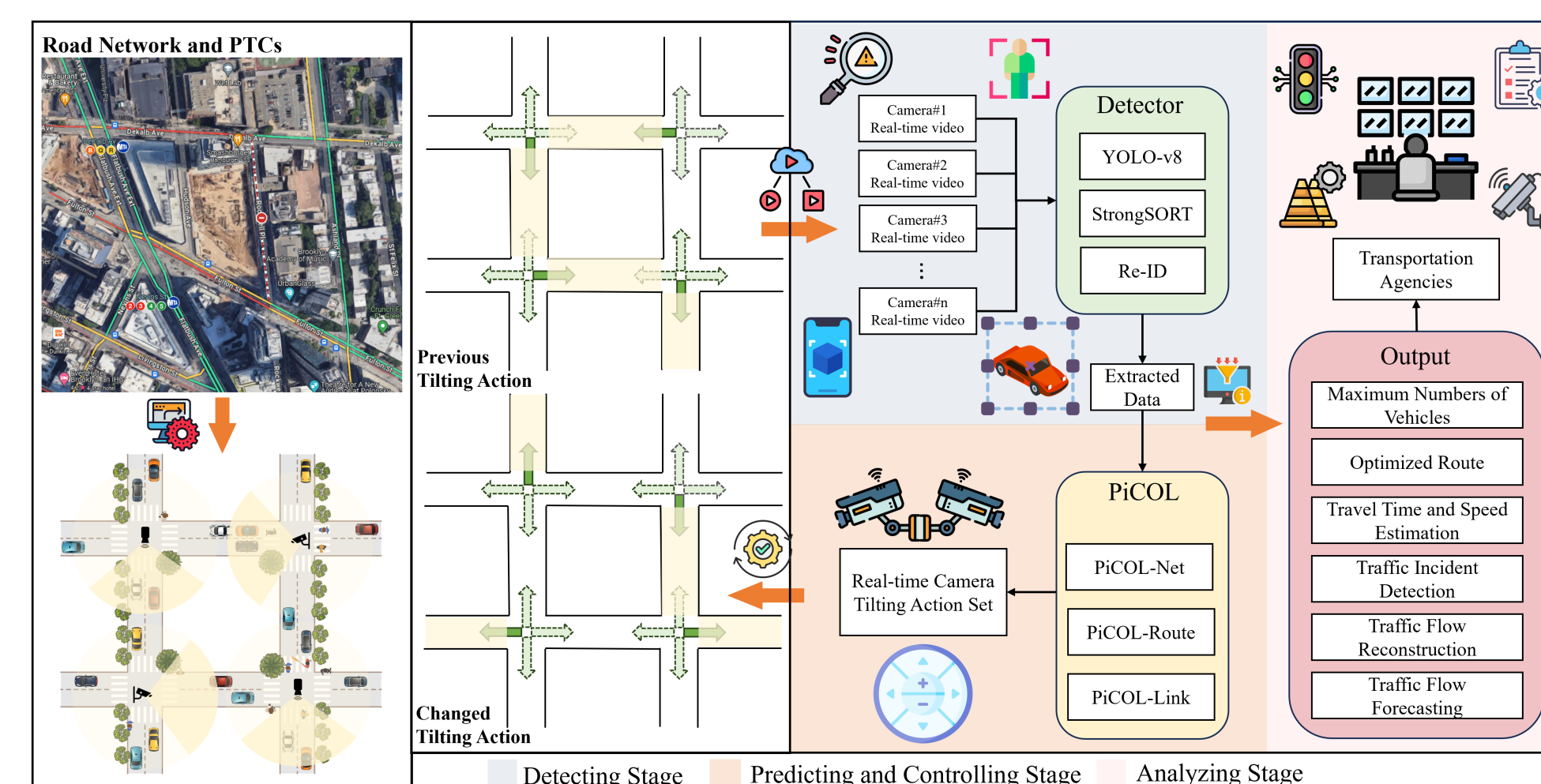
Experiment: Multi-level Traffic Management via TTC-X
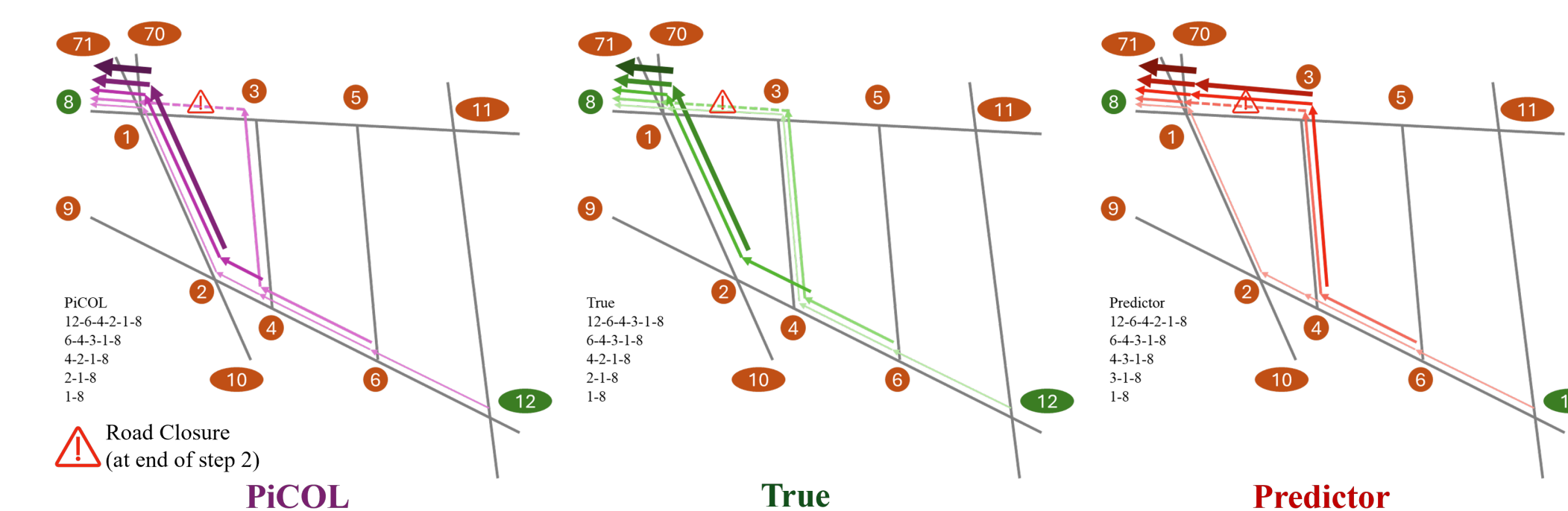
Our SUMO simulation is calibrated using real traffic data to mirror the traffic dynamics of the Flatbush Avenue corridor.

1. Network-level: Maximum Flow Capture

2. Route-level: Dynamic Route Planning

3. Link-level: Traffic State Forecasting and Reconstruction

Forecasting: Predictions   Reconstruction: Fusions