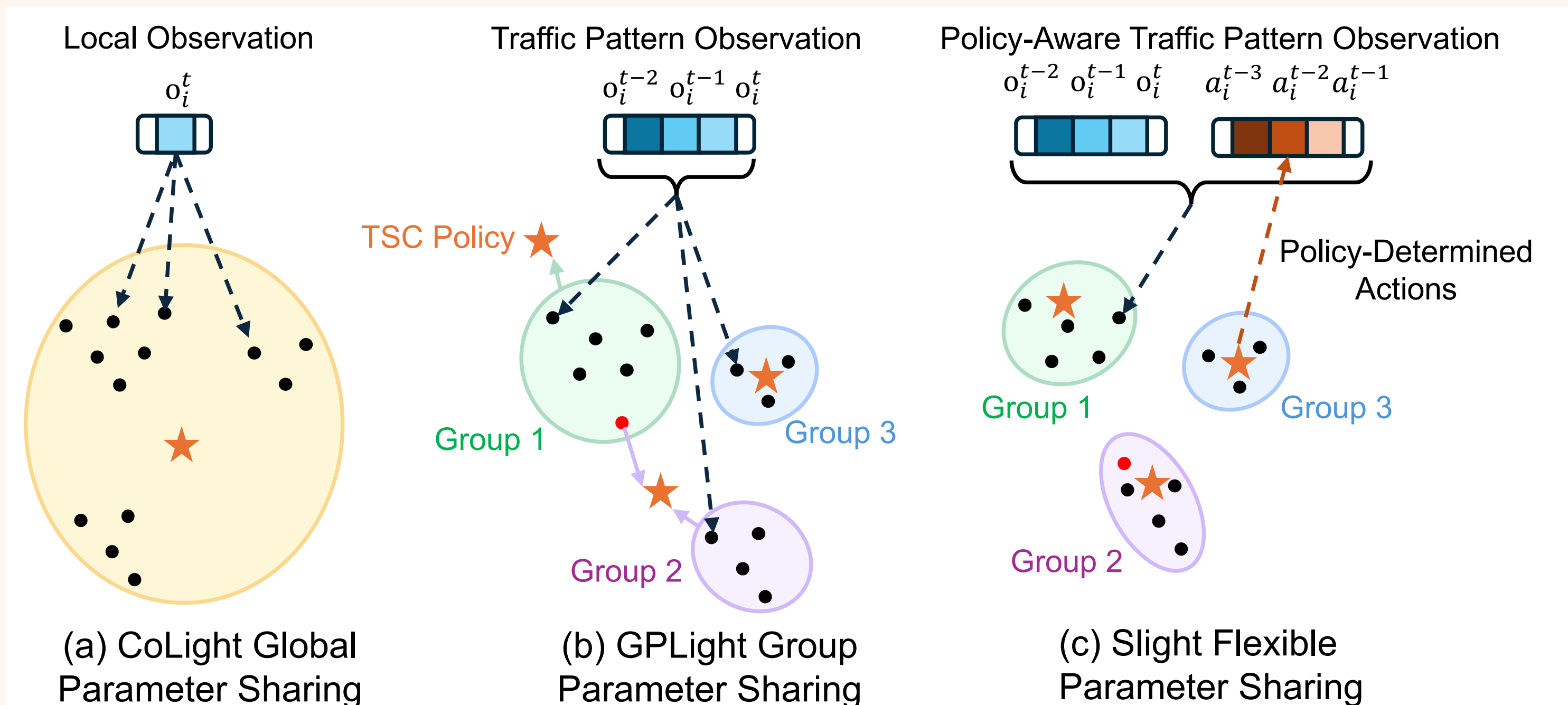
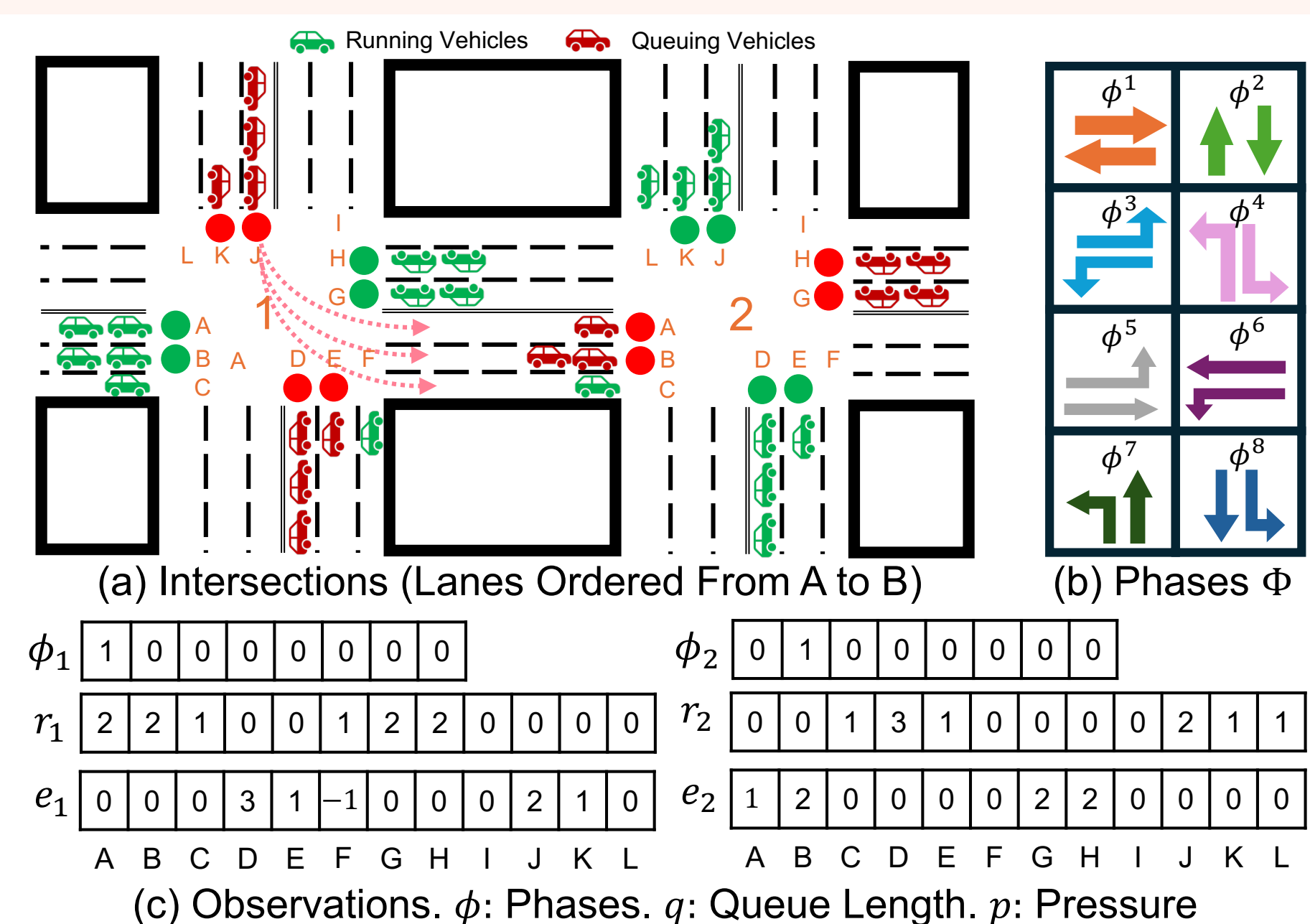


1. Problem



Problem framing: parameter sharing evolves from one global policy to feature groups, but traffic control needs behavior-aware routing.



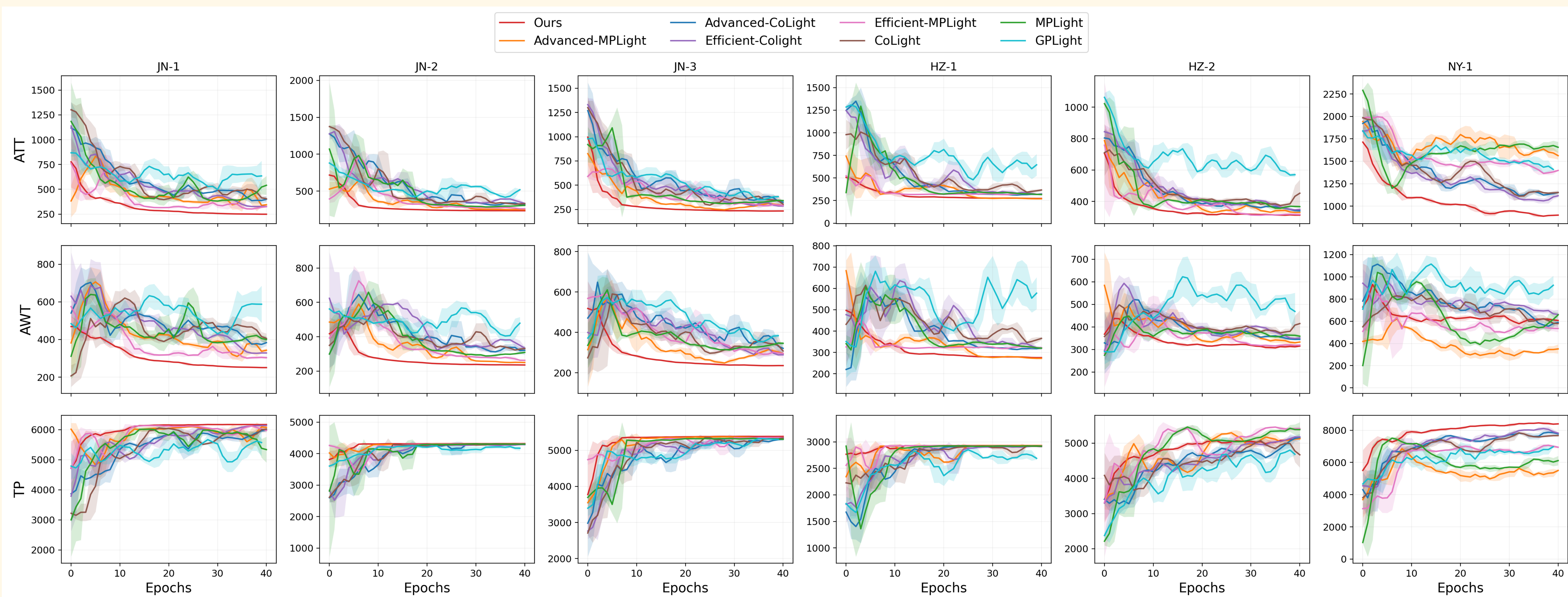
Intersection evidence: similar-looking states can require different policy choices after recent actions and rewards are considered.

Key issue: traffic appearance alone is not a reliable sharing signal.

Needed: compatibility-based routing to learned control principles.

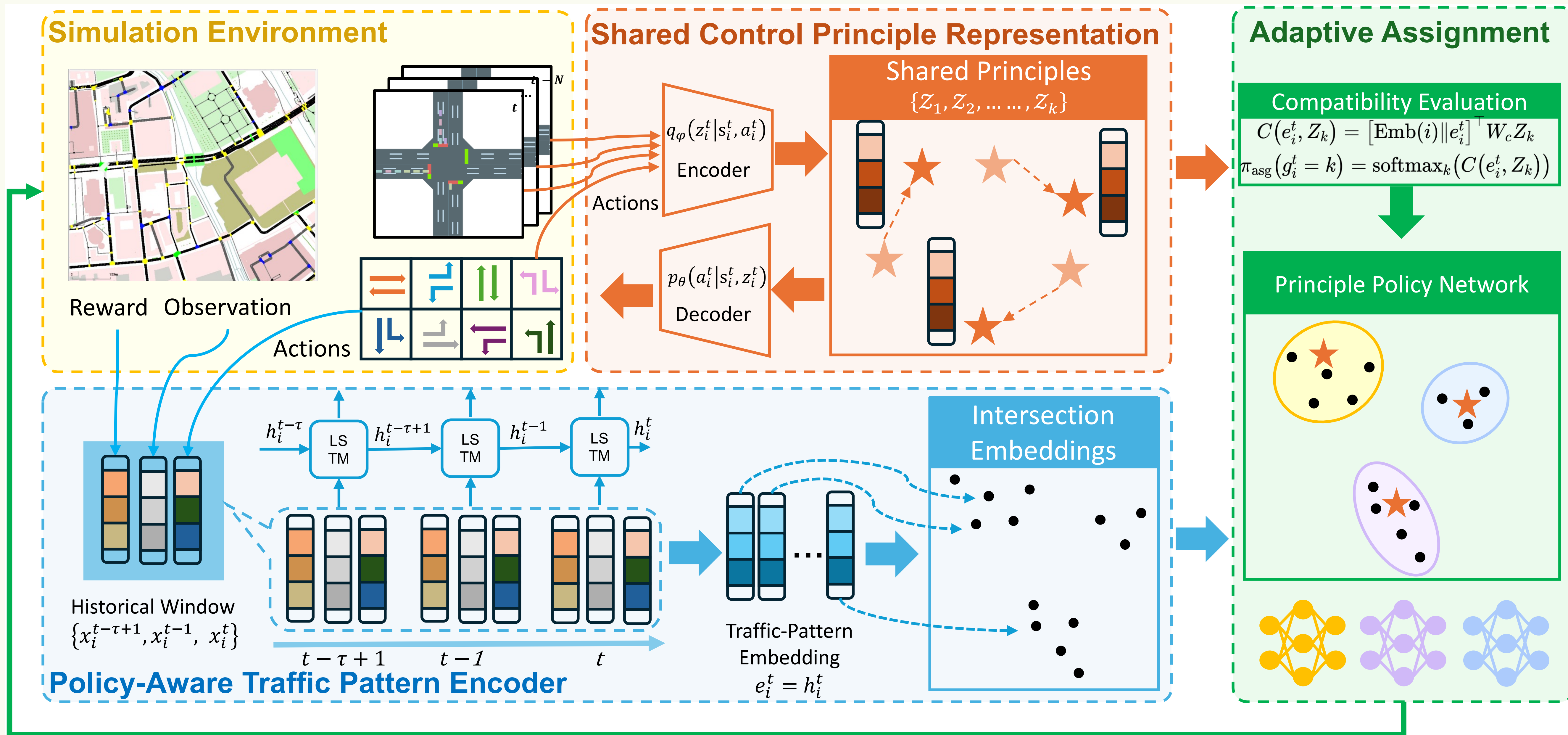
3. Experiments

Learning curves across all six benchmarks



Training evidence: SLight shows strong ATT/AWT reductions and high throughput, with the largest visible separation on NY1.

2. SLight Framework



Pipeline: traffic history forms policy-aware queries; trajectories learn shared principles; compatibility selects reusable policy networks.

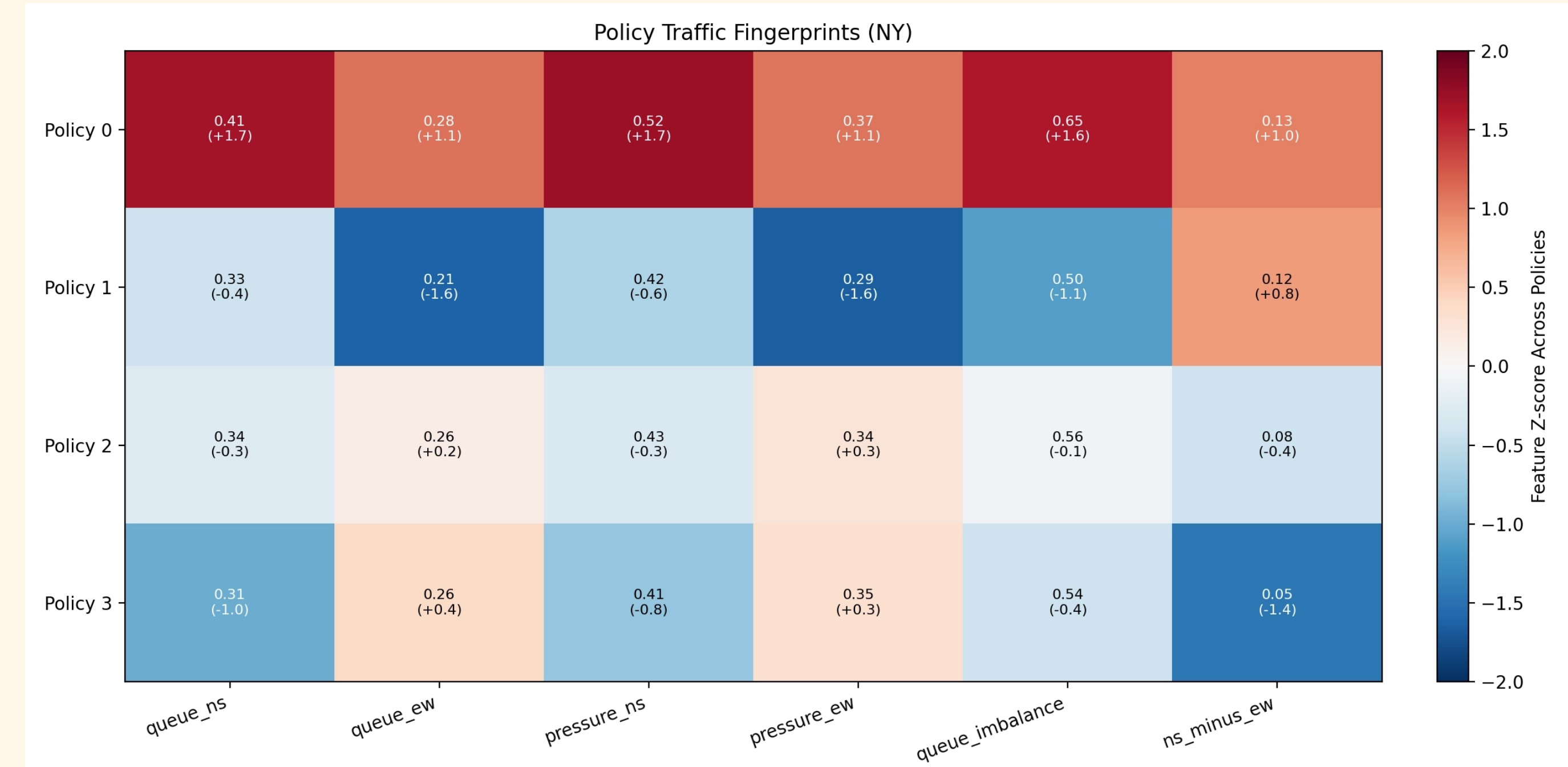
- Policy-aware query:** recent observations, actions, and rewards encode what control behavior the intersection currently needs.
- Shared principles:** CVAE prototypes capture reusable state-action tendencies rather than static road categories.
- Adaptive assignment:** each intersection chooses the most compatible principle policy at every decision point.

Object	Role in SLight
e_i^t	policy-aware traffic query from recent interaction history
Z_k	shared control principle prototype learned from state-action trajectories
Q_k	reusable principle policy network selected by compatibility

Main results

Set	ATT ↓	$\Delta\%$	AWT ↓	TP ↑	NY2 ATT ↓
JN-1	262.1→246.1	-6.1	263.5→248.2	6182/6260	1844.56
JN-2	238.7→234.0	-2.0	240.2→235.3	4316/4355	1441.23
JN-3	241.1→230.9	-4.2	243.4→232.8	5392/5422	1138.66
HZ-1	269.6→272.1	+0.9	271.5→274.4	2933/5514	1374.73
HZ-2	309.2→304.1	-1.7	310.1→305.4	5234/5546	1053.90
NY1	929.4→870.4	-6.4	493.2→532.6	8642/8642	856.94

Main readout: ATT/AWT entries are best non-SLlight → SLlight; TP is SLlight/best. SLlight is best ATT on five of six settings and reaches the lowest NY2 ATT at metropolitan scale.



Policy prototype: NY1 usage is near balanced: P1 26.61% heavy NS, P2 22.98% light NS, P3 25.05% mixed load, and P4 25.36% balanced.