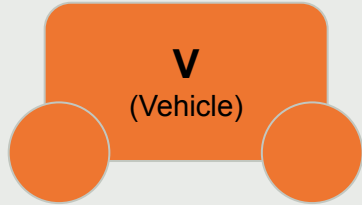# Problem statement

1. Traffic congestion leads to inefficiencies in time loss, fuel consumption. How to evolve rules based system that fails to optimize dynamically?

Goals

1. Develop multi-agent system where
    a. Traffic Lights
    b. Vehicles
    c. Drones
        Collaborate to manage real time traffic
2. AI agents analyize live traffic data + adjust traffic light signal dynamically
3. Enable vehicle-to-infrastructure (traffic light) comms for smarter routing
4. Simulate traffic scenarios - rush hour, accident, roadblock,
5. Ensure fairness in traffic distribution

Definitions

V (Vehicle)

A vehicle is discrete unit of transportation

Str2

Str1

Str3

TrL Str2

TrL Str 1

TrL Str3

TrL (traffic light signal group @ intersection)

A Traffic signal group controls flow of vehicles at intersection of street (StrX) crossing

DR

A drone monitor-time traffic conditions, supplementing data from vehicles + traffic signals

V (vehicle) Data:
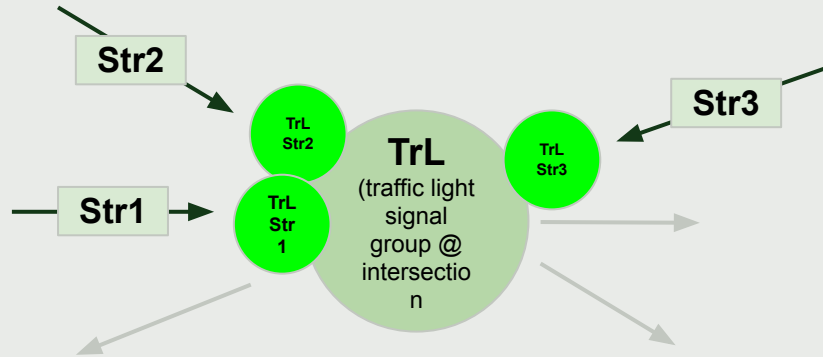
Location (GPS)

Speed_ACTUAL (MPH)

Speed_EXPECTED (Speed Limit per location, time)

Moving (Y/N i.e Speed = 0,+0)

BONUS information:

Destination Location (from Maps service, location)

Predicted Destination (from licensee plate ID + past behavior)

TrL (traffic signal group) Data:

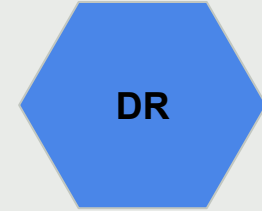**# of Streets inputs @ intersection**

Green Light %time per StrX (i.e. 10 min / 60)

#of V using StrX , per hour ACTUAL

#of V using StrX , per hour EXPECTED

TrL data NOT available/ can't be observed:
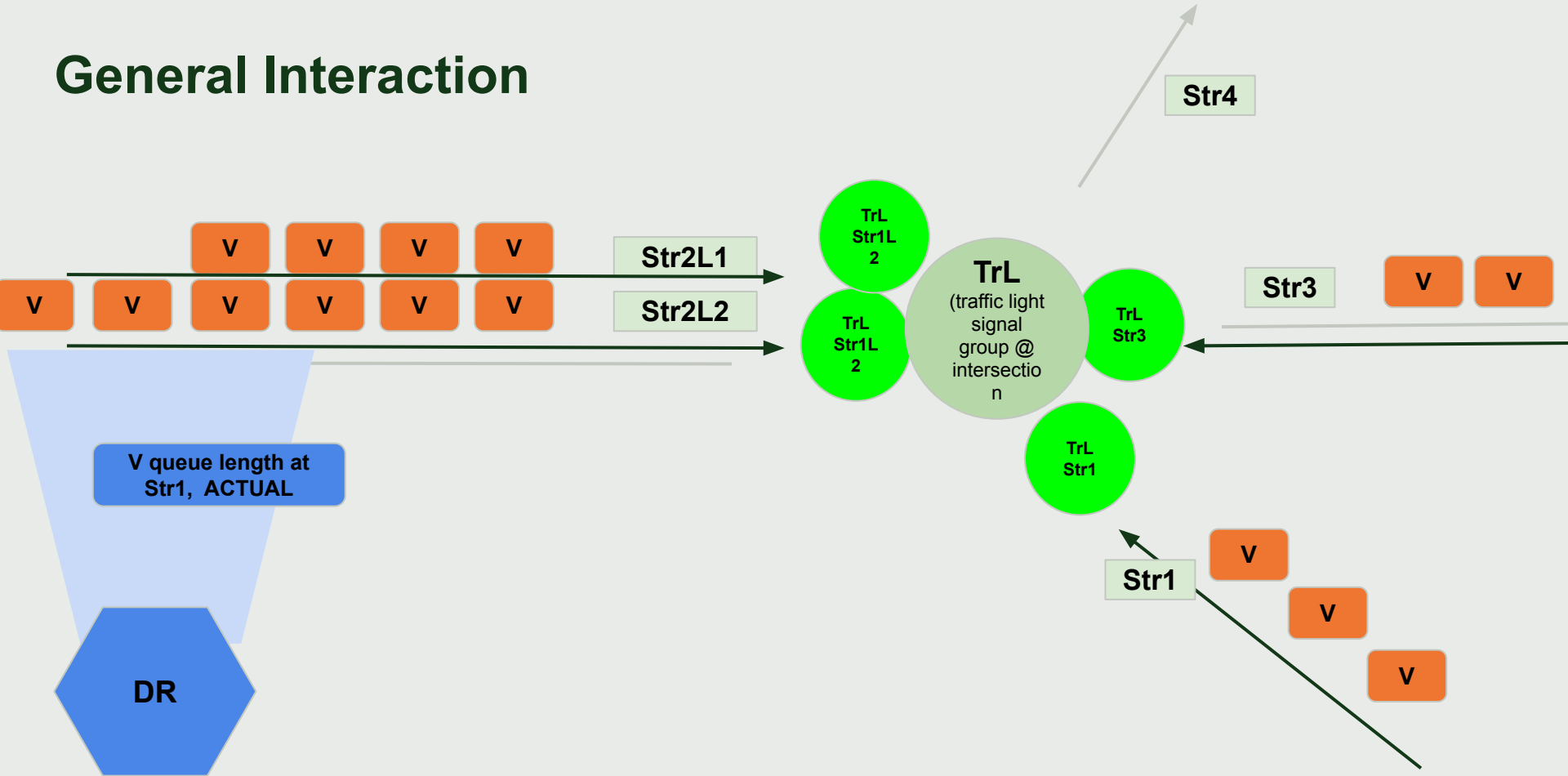- **V** vehicle queue length on **StrX**

Dr (drone) Data:

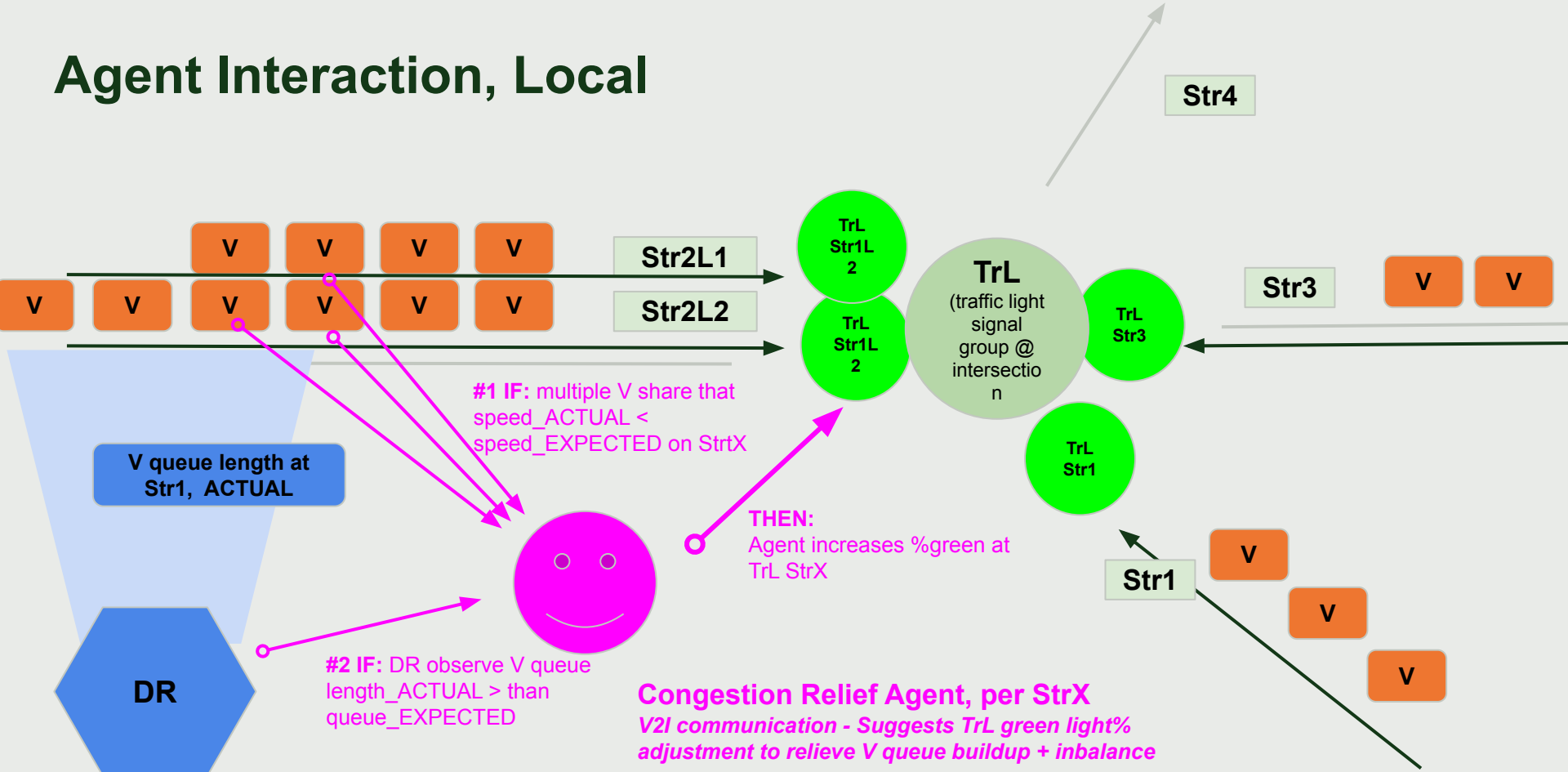**V queue length_ACTUAL at StrX TrL**

V queue length_EXPECTED at StrX TrL

General Interaction
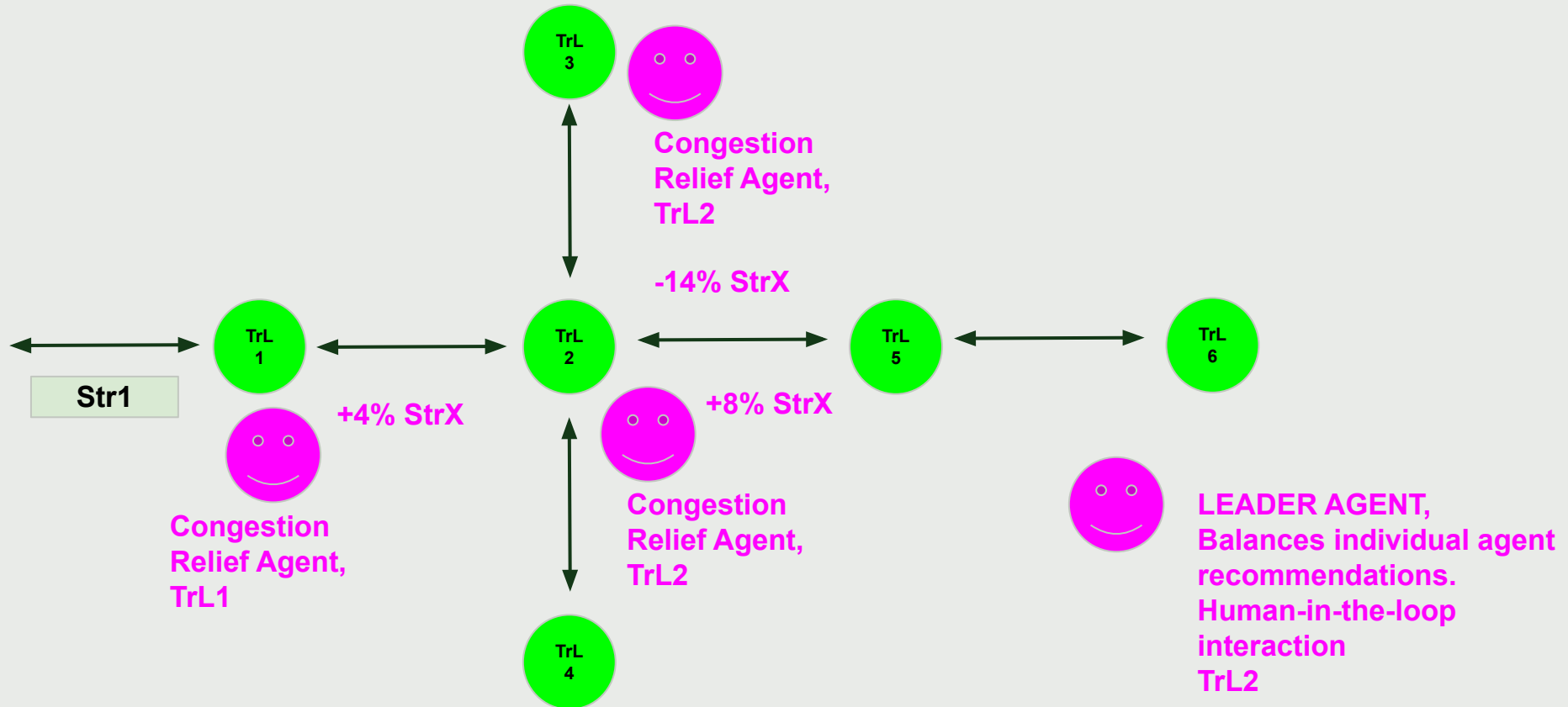
A drone monitor-time traffic conditions, supplementing data from vehicles + traffic signals

Agent Interaction, Local

V **V** **V** **V**

V **V** **V** **V** **V** **V**

Str2L1

Str2L2

Str4

TrL Str1L2

TrL Str1L2

TrL (traffic light signal group @ intersection

TrL Str3

Str3

V **V**

TrL Str1

#1 IF: multiple V share that speed_ACTUAL < speed_EXPECTED on StrtX

V queue length at Str1, ACTUAL

THEN:
Agent increases %green at TrL StrX

#2 IF: DR observe V queue length_ACTUAL > than queue_EXPECTED

Str1

V

V

V

DR

Congestion Relief Agent, per StrX
V2I communication - Suggests TrL green light% adjustment to relieve V queue buildup + inbalance

Multi- Agent Interaction

TrL 3

Congestion Relief Agent, TrL2

-14% StrX

TrL 1

Str1

+4% StrX

Congestion Relief Agent, TrL1

TrL 2

Congestion Relief Agent, TrL2

+8% StrX

TrL 5

TrL 6

LEADER AGENT, Balances individual agent recommendations. Human-in-the-loop interaction TrL2

TrL 4

A drone monitor-time traffic conditions, supplementing data from vehicles + traffic signals