Preparing the infrastructure for automated vehicles

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Adding automated vehicles to the network

- Platooning will have several effects:
  - Smaller following distance – more capacity
  - Platoons will stay in single lane – need for lane advice
  - More uniform arrival pattern – more capacity

- Automated vehicles will use larger safety margins – need for collaborative perception
  - Strategically placed infrastructure detection
  - Increased safety
  - Less need for margins, so better efficiency

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Queue modelling and negotiation

- Automated vehicles have more data available
  - Intended turn direction (6% better traffic efficiency)
  - Desired speed
  - Number of occupants (priority input)
  - Compliance to advice
- Information enabled more accurate queue modelling
- Direct positive effect on several MAVEN systems:
  - Lane advice
  - Signal optimization
  - Route advice
  - Speed advice

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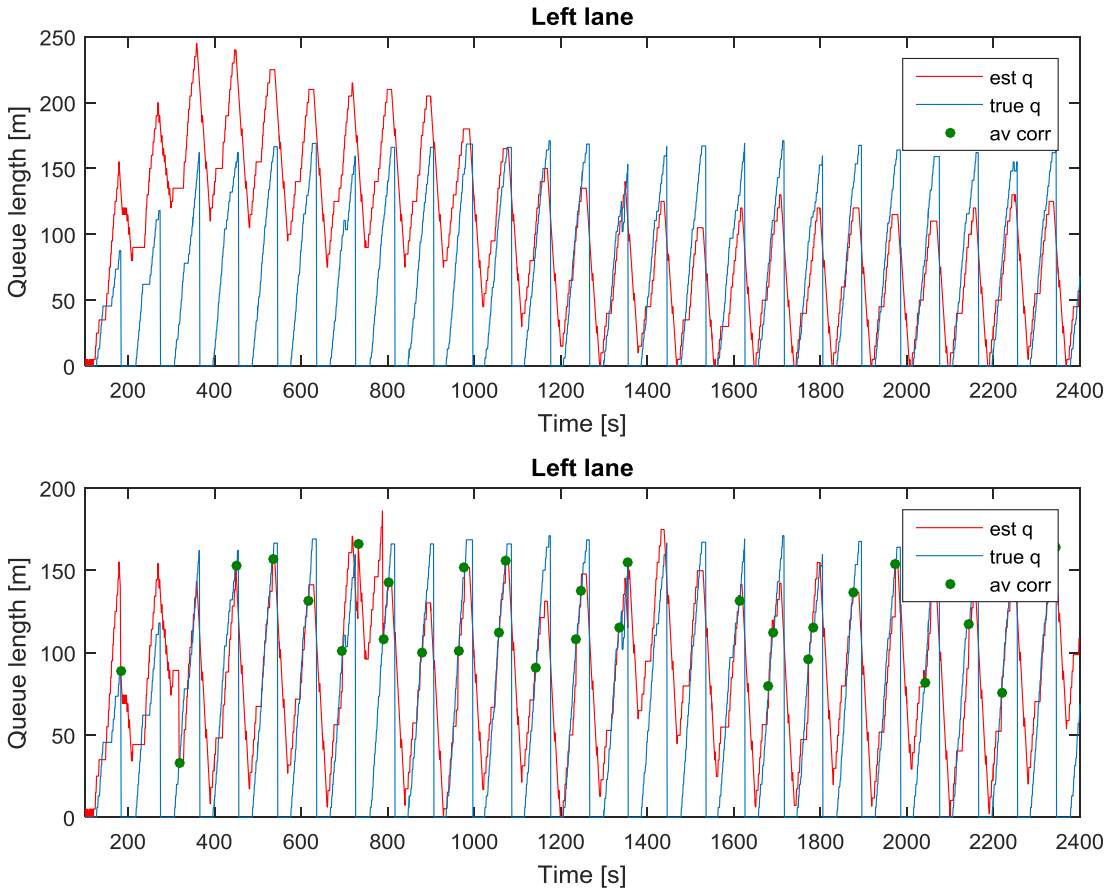
Queue modelling – data fusion

- MAVEN vehicles provide essential corrections



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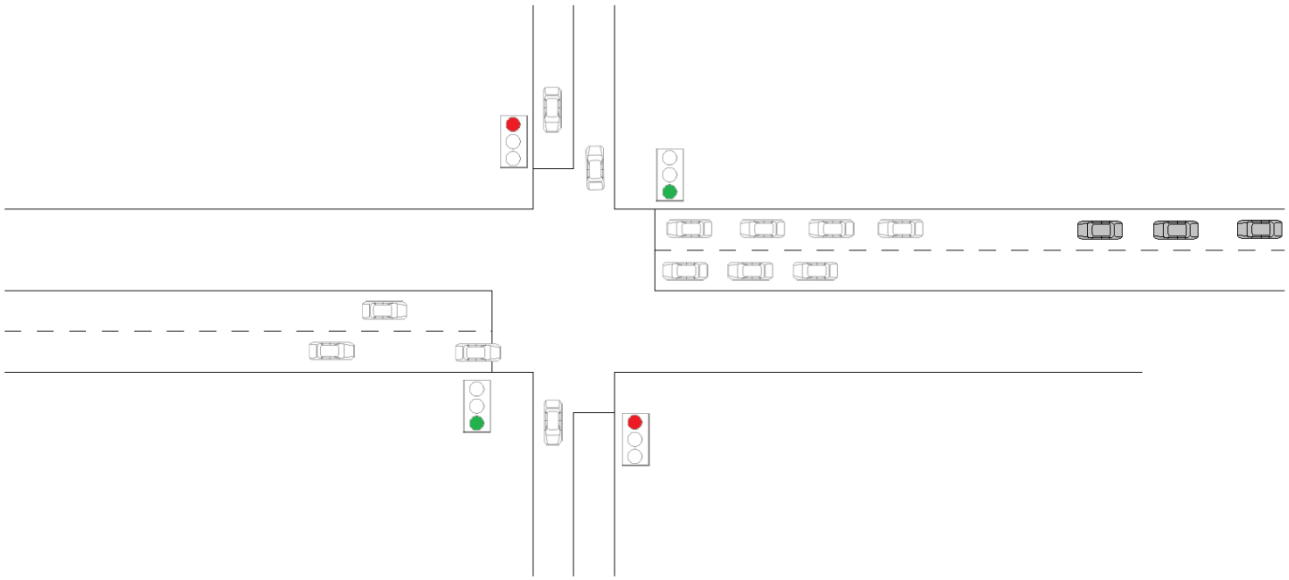
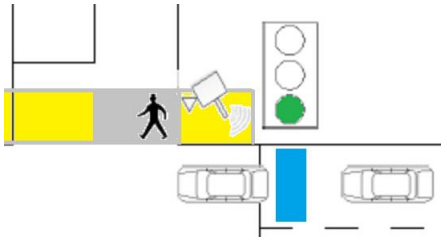
Lane advice

- Counter effect of platoons staying in one lane
- Distribute evenly over lanes, counting for vehicle type





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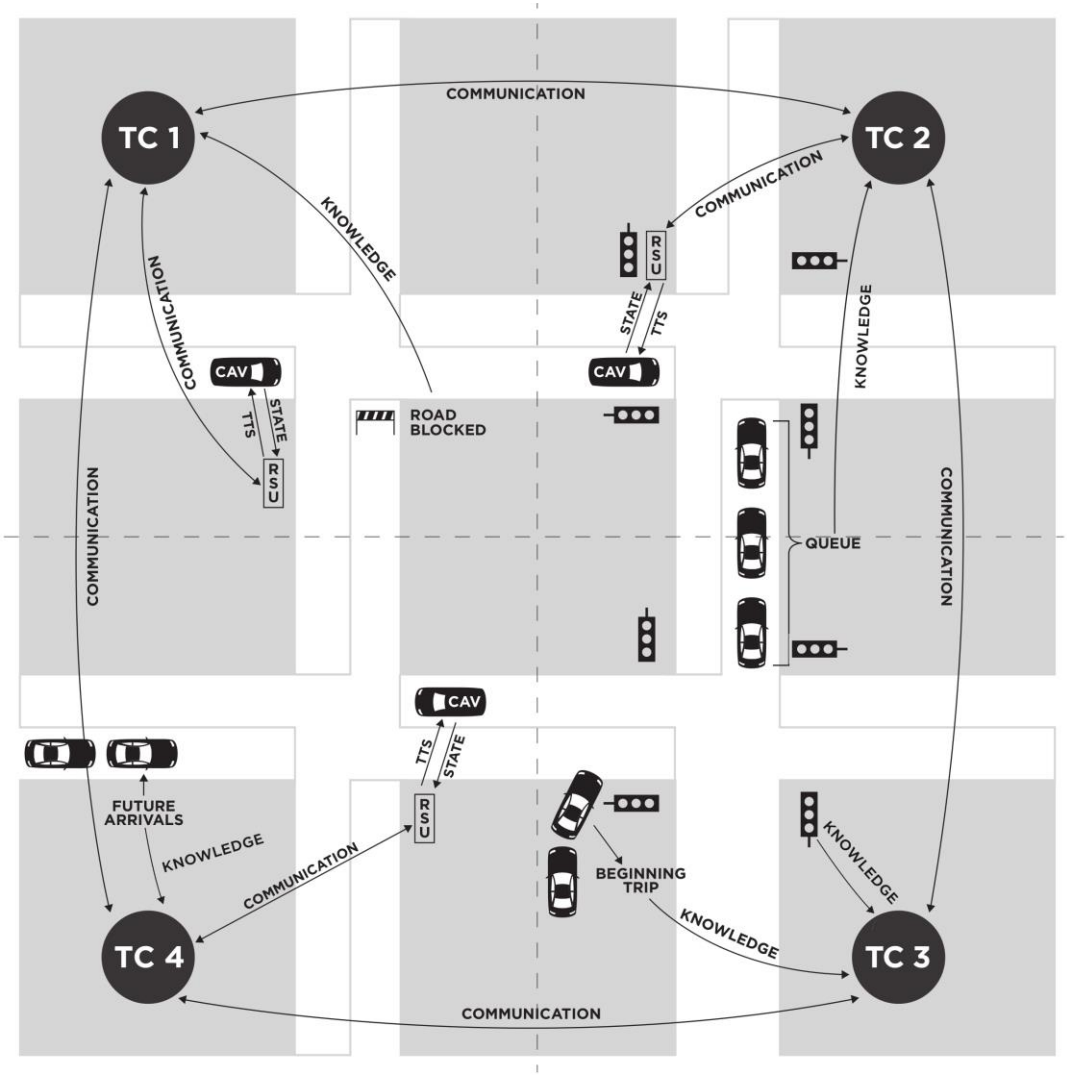
Local level routing

- Passengers accept up to 25% extra travel time
- What do you think?

Solution:

- Interacting agents
- Cloud or local deployment



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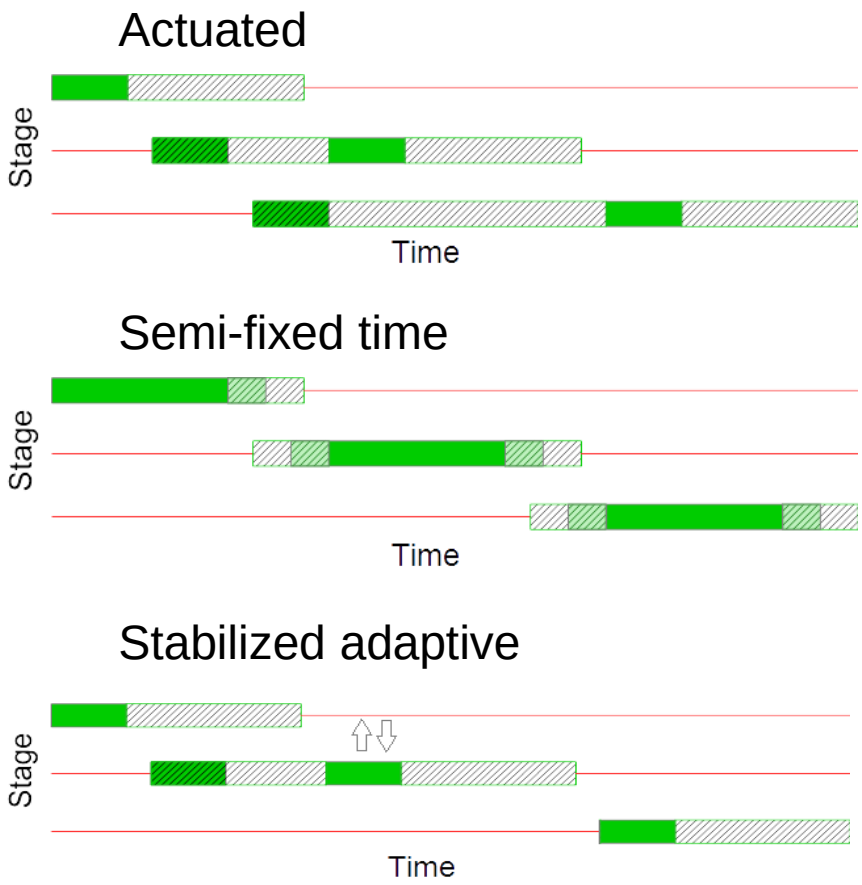
Plan stabilization for adaptive control

- Plan stabilization required for GLOSA
- Trade-off flexibility vs. predictability
- Traditional solution is to limit flexibility on all phases – bad for traffic efficiency
- Applying stabilization to only one stage retains flexibility to others.
- Principle applied to adaptive traffic control to be able to adjust stabilization according to policy.



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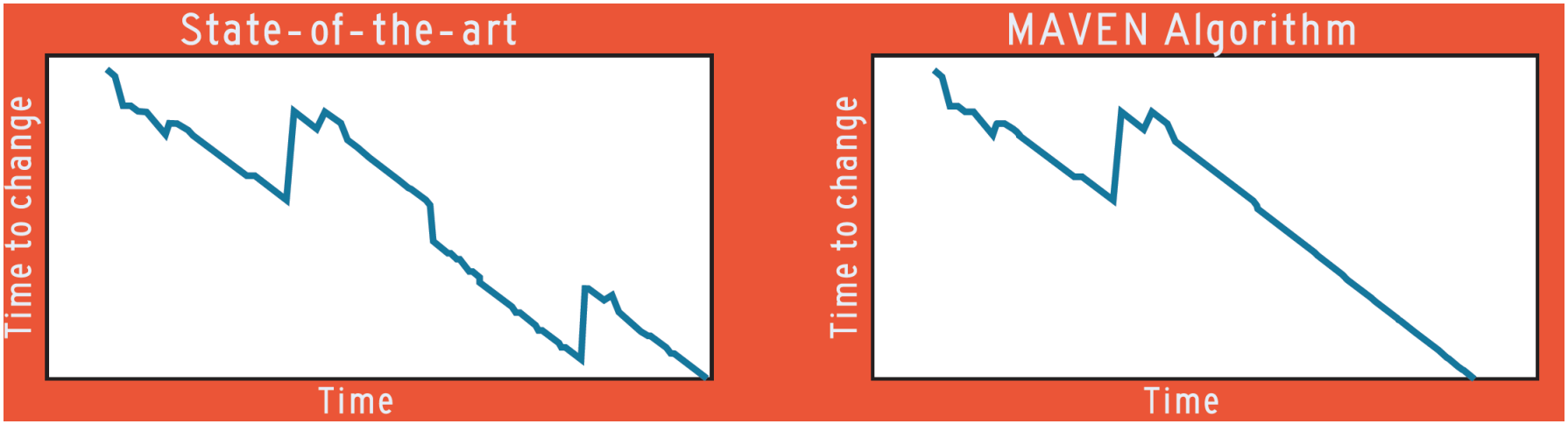
Plan stabilisation behaviour

- Only stabilize signal groups with GLOSA possibilities (no turns, long approach, high volume)
- Take distance into account to allow “fitting” the green phase optimally
- Optionally, listen to acknowledgements / CAM



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Plan stabilisation comparison SotA

- Patented solution clearly outperforms SotA in every category
- Policy configuration gives control over the trade-off

Scenario	Impact(s)	Delay(s)	Stops	GLOSA(%)	MSE(s^2)	MRE(%)	PC(%)
Static	43.2	36.7	0.81	25	0	2.35	0.91
Semi-fixed	37.4	31.0	0.80	27	62	41.89	3.82
Actuated	36.3	29.6	0.84	19	182	84.67	7.62
Stabilized50	35.6	29.7	0.73	51	22	7.95	2.66
Stabilized	32.7	27.0	0.71	53	17	15.01	3.52
Adaptive	32.7	27.0	0.72	46	46	25.86	5.76
AdaptiveNG	33.7	27.0	0.83	6	47	26.90	5.54

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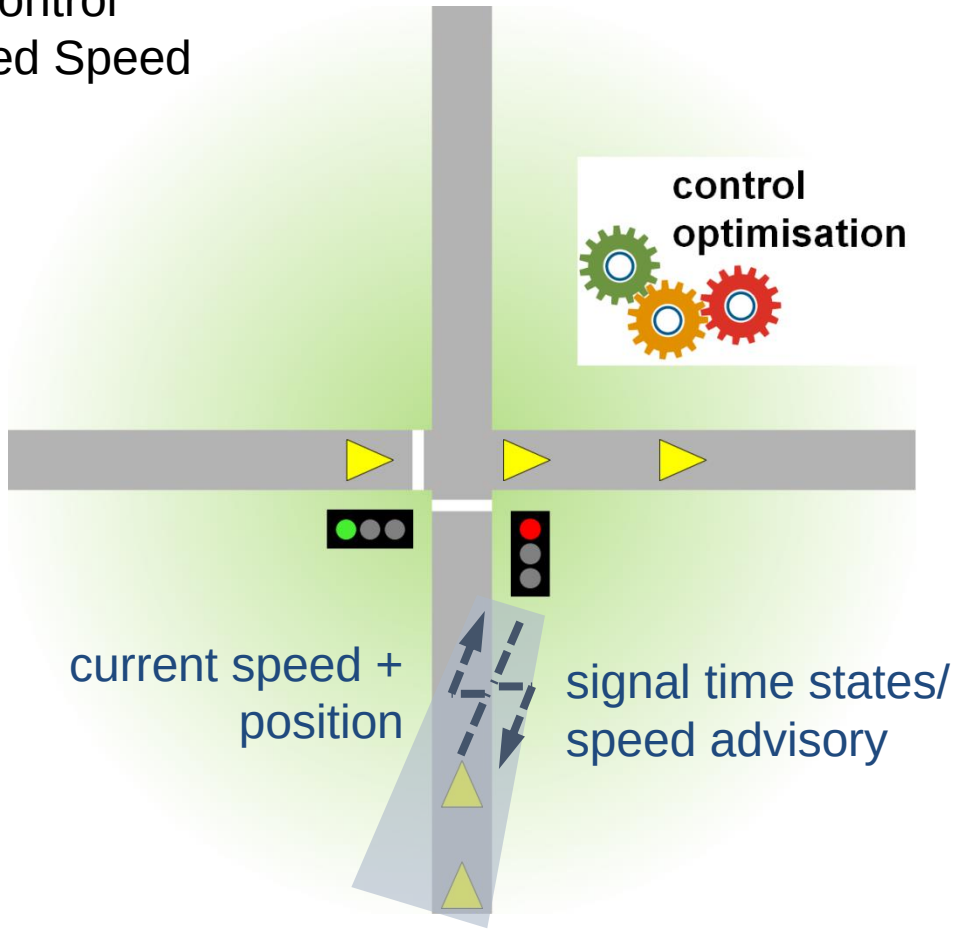
Agent-Aware Green Light Optimal Speed Advice

- Combination of vehicle-actuated control and GLOSA (Green Light Optimized Speed Advisory)
- AGLOSA: Agent-Aware
- bi-directional communication

- Possible detection:
  - V2X communication
  - Video capturing
  - Laser scanning
  - Wireless in-road detectors
  - Loop detectors
  - etc.



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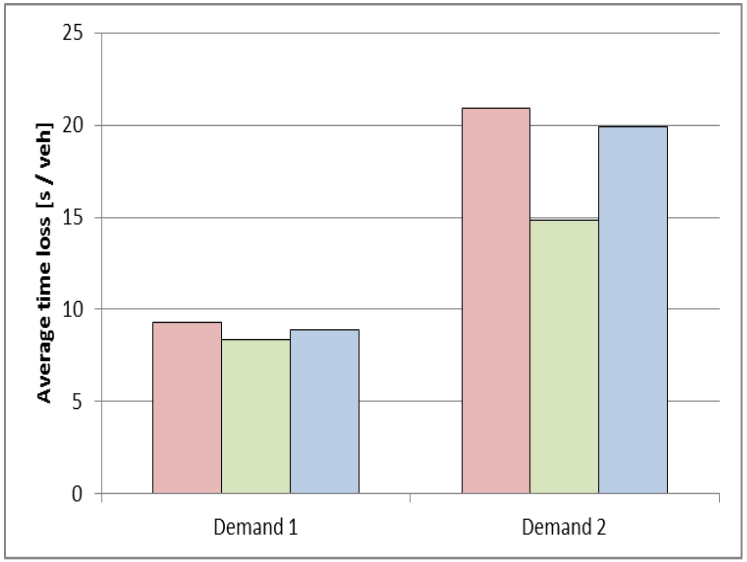
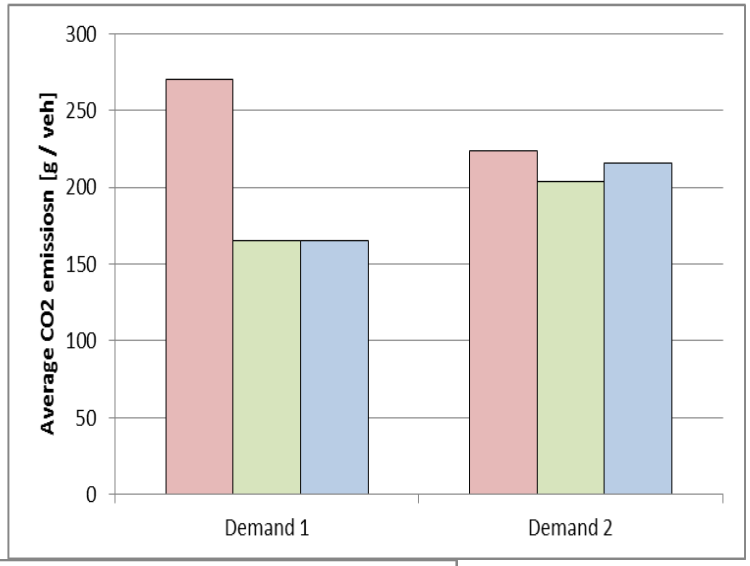
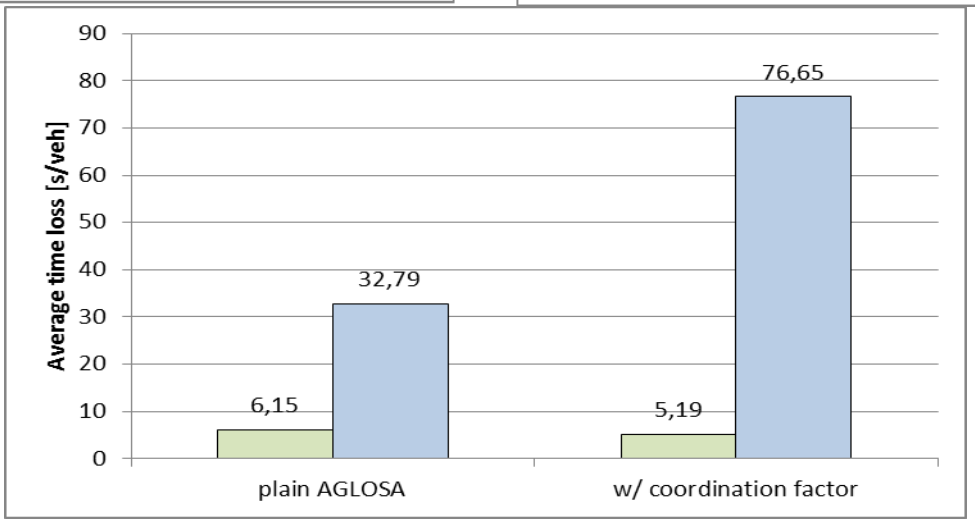
Signal optimization for actuated control – AGLOSA







Red = static
Green = AGLOSA
Blue = coord. AGLOSA

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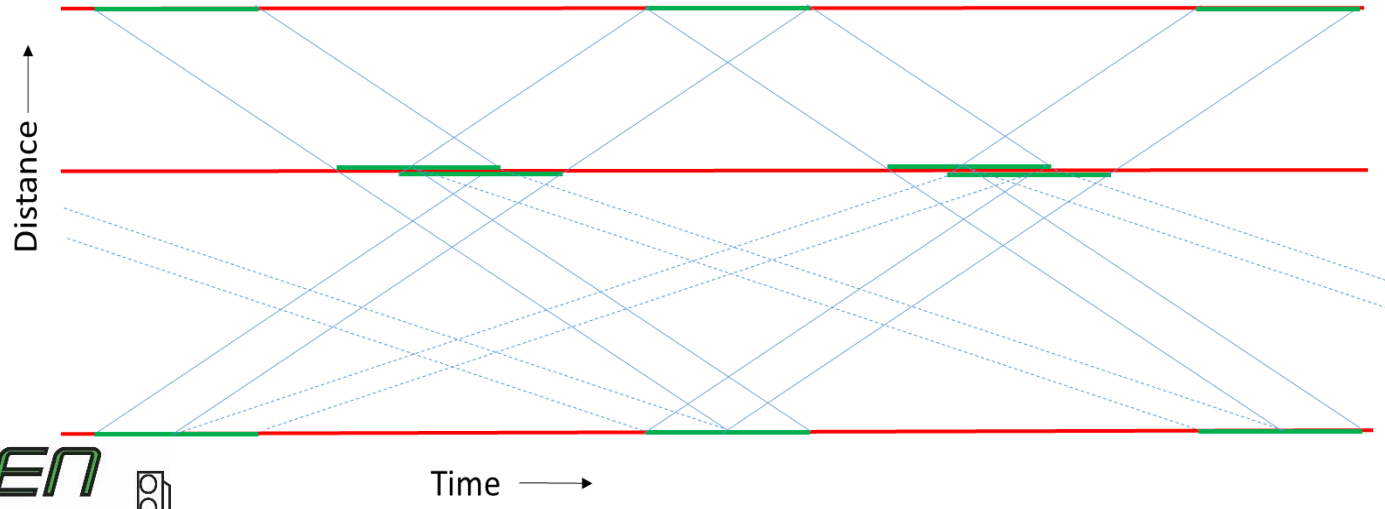
Green wave - theory

- Literature research and internship assignment to compare:
  - Static control
  - Q-learning
  - Agent-based adaptive control
- Q-learning not mature enough to deal with anomalies
- Best performance with agent-based adaptive control
- Synergy with speed advice negative, more work required to improve this



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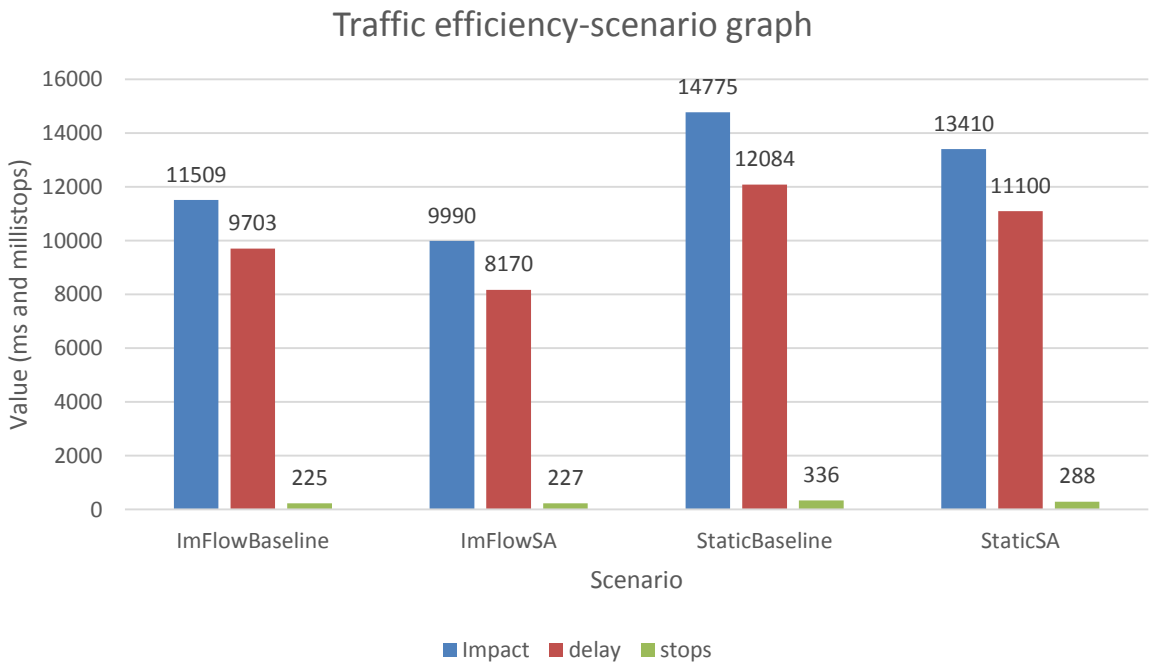
WP4 Green wave – results

- No more stopping in the corridor!
- Video showing greenwave



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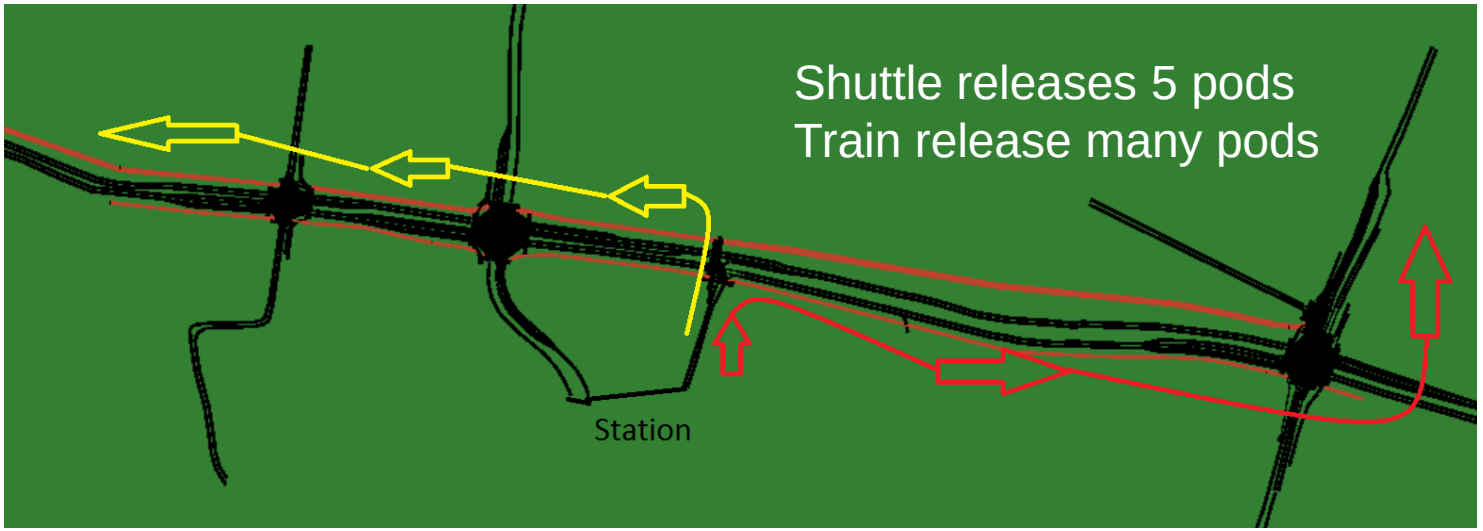
WP4 Special road user categories

- Priority is a disruptive factor, should be managed properly
- Vulnerable road users can actually benefit from predictable control (XCycle)
- Unmanned logistics likely to be the first unmanned fleets on the road
  - Likely lower speed and smaller form factor
  - Use of cycle lane for pods (10 km/h), normal road for shuttles (30 km/h), but could be reassigned.



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Thank you!

Questions?

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