Evaluations of Managed Lane Strategies for Arterial Deployment of Cooperative Adaptive Cruise Control (No. 17-04078)

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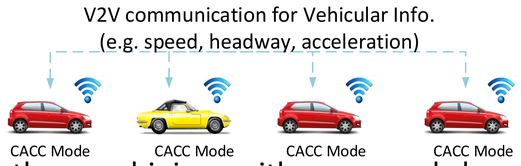
Introduction

Cooperative Adaptive Cruise Control (CACC), as an evolved control schema of currently available ACC in the market, was made possible under CV environment by adding an extra communication layer where equipped vehicles are capable of exchanging their instantaneous driving information (e.g. position, speed, and acceleration rate).



Recently, combining with managed lane strategy, CACC has become a game changer to dramatically elevate the capacity of highway without any significant investment for lane-mile increase. Applying CACC for arterial managed lane strategy, this study presents the findings obtained from the simulation-based evaluation results. Divided into three arterial managed lane strategy categories dealing with 1) mixed-traffic, 2) restricted CACC lane, and 3) dedicated CACC lane, a VISSIM-based simulation test bed is constructed with an actual corridor located in Fairfax, Virginia. It is revealed that the mixed-traffic and restricted CACC lane strategies outperform the dedicated lane strategy

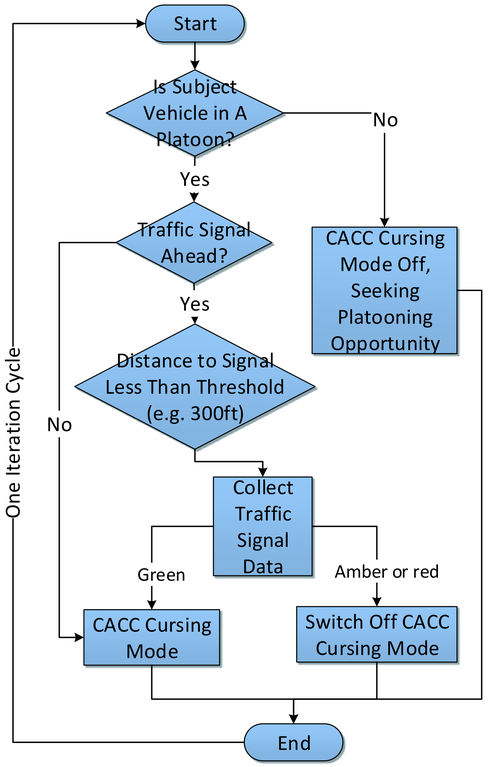
Advantages of CACC

- V2V communication of vehicular information among neighboring equipped vehicles
- Greater string stability compared to ACC
- Enhanced mobility and safety performance
- More comfortable riding experience

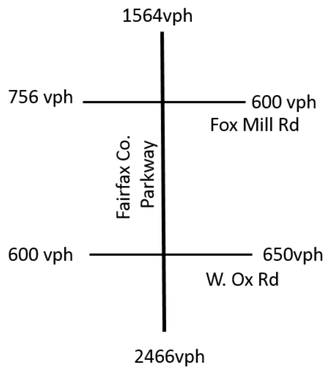
Research Objective

- To investigate the effectiveness of CACC under various managed lane strategies
- To assess the impact of market penetration rate for CACC
- To evaluate system-wide impacts of CACC on arterials mobility improvement

Simulation Test Bed

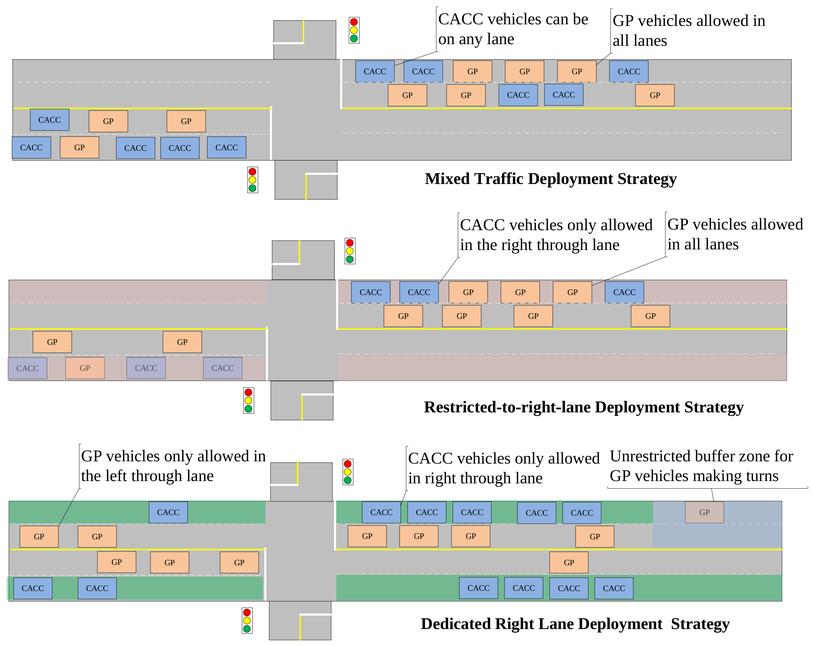


- Three-mile arterial segment
- Two-lane parkway
- Pre-timed signal plan
- Five deployment strategies

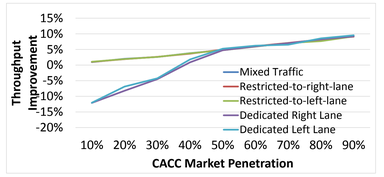


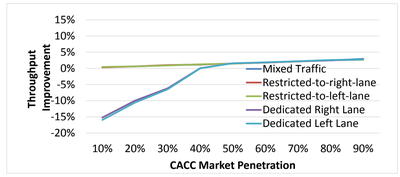
Traffic Demand Chart

Deployment Strategies

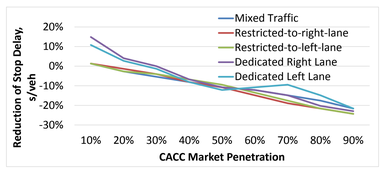


Preliminary Results

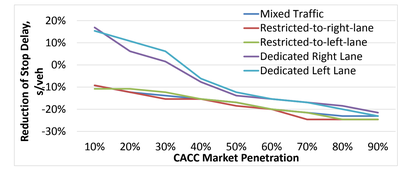




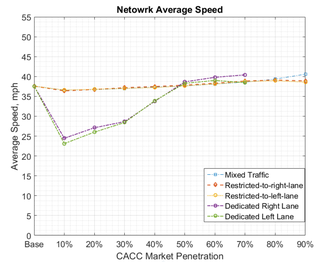
Throughput (above)



Stop Delay Reduction (below)



Segment Average Delay



Category	ID	Deployment Strategy	Right Lane	Left Lane	Market Penetration Rate (MPR)	Replication
Base Case	0	Base Case	GP Only	GP Only	0%	5
Mixed Lane Use	1	Mixed Traffic	CACC + GP	CACC + GP	10%~90%	5
	2	Restricted-to-right-lane	CACC + GP	GP only	10%~90%	5
	3	Restricted-to-left-lane	GP only	CACC + GP	10%~90%	5
Dedicated Lane Use	4	Dedicated Right Lane	CACC only	GP + CACC	10%~70%	5
	5	Dedicated Left Lane	GP + CACC only	CACC only	10%~70%	5

Conclusions

- benefits of CACC technology are observed even at MPR as low as 10% in these deployment strategies
- deploying CACC in one lane with mixing traffic (Strategy 1, 2, or 3) appears to be a better option for the reasons below
- Lane use utilization balance paly an vital role in managed lane deployment for CACC
- The current demand level may not be the best case for showing the potential of CACC

Future Research

- Test adaptive or optimal signal plan for overall assessment
- Implement a optimized managed lane use policy for CACC vehicle (e.g.,
- Evaluate the algorithm under imperfect wireless communication environment (e.g. package drop)