Investigating the Effects of Reserved Lanes for Commercial Truck Platooning on Congestion: A Pennsylvania Turnpike Case Study

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Background and Motivation

- Peloton is currently testing their truck platooning technologies on the Ohio Turnpike.
- NHTSA rulemaking to accelerate connected vehicle technologies
- Understand the impacts and feasibility of dedicating a lane on existing road networks

There are Six Levels of Automation

| Level | Name | Who is Driving? | Who is Monitoring? | Who Intervenes? | |
|-------|---------------------------|--------------------|-----------------------|--------------------|--|
| 0 | No Automation | | | | |
| 1 | Driver Assist | | | | |
| 2 | Partial Automation | | | | |
| 3 | Conditional Automation | | | | |
| 4 | High Automation | | | | |
| 5 | Full Automation | | | | |

Source: Samaras, Constantine (@CostaSamaras)

Research Questions

- How could a dedicated truck platoon lane impact congestion?
 - What are the characteristics of a feasible truck platoon demonstration site?
 - Does the Pennsylvania Turnpike have feasible platoon demonstration sites?
 - What are the safety benefits of a dedicated lane?

Platoons



Source: Elsevier Atlas Carnegie Mellon University Civil and Environmental Engineering

12 Potential Platoon Sites



LOS Varies at Each Platoon Site



Note: Values only reported for those potential platoon sites with at least 3 lanes in the westbound direction

Platoon Site #1 Never Reaches Free Flow



Commercial Truck Platoon Penetration Rate (%)

Platoon Site #7 Maintains LOS



Platoon Site #9 Is not a Feasible Location



Conclusions

- Five and six lane segments in Western and Central Pennsylvania could be viable options.
- Several areas of the turnpike where reserving a lane could have detrimental impacts on traffic flow.
- Time of day and day of week restrictions should be considered.

Policy Implications

- Need to consider how to control access to these platoon lanes.
- PA and Ohio Turnpike could work collaboratively.
- Economic benefits from less severe and prevented heavy duty vehicle crashes and faster travel times.

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Backup Material

Site Characteristics

| Platoon | No. | | | | | Length |
|---------|-------|------------------|-----------------|-----------------|--------------|---------|
| Site # | Lanes | 3 Lane Direction | Interchange | Interchange | County | (miles) |
| 1 | 6 | Both | Warrendale | Butler Valley | Allegheny | 6.2 |
| 2 | 6 | Both | Irwin | New Stanton | Westmoreland | 7.3 |
| 3 | 5 | East/North | New Stanton | Donegal | Westmoreland | 7.9 |
| 4 | 5 | East/North | Donegal | Somerset | Westmoreland | 9.4 |
| 5 | 5 | West/South | Somerset | Bedford | Somerset | 5.0 |
| 6 | 5 | East/North | Breezewood | Fort Littleton | Fulton | 3.4 |
| 7 | 5 | West/South | Willow Hill | Blue Mountain | Franklin | 10.5 |
| 8 | 6 | Both | Valley Forge | Norristown | Montgomery | 5.9 |
| 9 | 5 | West/South | Mid-County | Lansdale | Montgomery | 6.0 |
| 10 | 6 | Both | Mid-County | Fort Washington | Montgomery | 4.1 |
| 11 | 6 | Both | Fort Washington | Willow Grove | Montgomery | 2.6 |
| 12 | 6 | Both | Willow Grove | Bensalem | Montgomery | 7.8 |

RP2: Eastbound AADT



RP2: Westbound AADT



RP2: PA Turnpike Vehicle Class Groups

| Class Group | Class Definition | | |
|-------------|------------------------|--|--|
| 1 | Passenger Car | | |
| 2 | 7,001 to 15,000 lbs. | | |
| 3 | 15,001 to 19,000 lbs. | | |
| 4 | 19,001 to 30,000 lbs. | | |
| 5 | 30,001 to 45,000 lbs. | | |
| 6 | 45,001 to 62,000 lbs. | | |
| 7 | 62,001 to 80,000 lbs. | | |
| 8 | 80,001 to 100,000 lbs. | | |
| 9 | 100,001 lbs. and over | | |

Source: Pennsylvania Turnpike Commission. *Toll Schedule 2017*. Harrisburg, PA, 2017.

Recommended Sites

| Platoon Site # | No. Lanes | 3 Lane Direction | County | Length (miles) | Eastbound Peak Hour Level of Service | %Commercial Trucks Eastbound ^a | Westboud Peak Hour Level of Service | %Commercial Trucks Westbound ^a |
|-------------------|--------------|---------------------|--------------|-------------------|---|---|--|---|
| 1 | 6 | Both | Allegheny | 6.2 | В | 16% | А | 22% |
| 2 | 6 | Both | Westmoreland | 7.3 | А | 12% | А | 16% |
| 3 | 5 | East/North | Westmoreland | 7.9 | А | 26% | NA | NA |
| 4 | 5 | East/North | Westmoreland | 9.4 | А | 27% | NA | NA |
| 5 | 5 | West/South | Somerset | 5 | NA | NA | А | 27% |
| 6 | 5 | East/North | Fulton | 3.4 | А | 26% | NA | NA |
| 7 | 5 | West/South | Franklin | 10.5 | NA | NA | А | 48% |

^aWeighted percentage based on passenger car equivalence.

Note: pcu= Passenger Car Units ; NA= Not Applicable

Note: Level of service only reported for those directions with 3 travel lanes