Capacity and Safety Opportunities and Challenges in the Transition Period

Brad Steckler
Traffic Engineering Director
Indiana Department of Transportation
317-232-5137
bsteckler@indot.in.gov

Andrew Tarko
Professor of Civil Engineering
Director of Center for Road Safety
Purdue University
765-494-5027
tarko@purdue.edu

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Introduction

• Considerable changes of road capacity and safety
• A long transition period expected to start soon
• INDOT practice in transition – new data, methods, and solutions
• Engineering tools to support practice during the transition period
• Anticipated long-term research needs
Anticipated Capacity Effect (road segments)

**Traffic Speed & Flow Rate – Human Control**
(FFS = 70 mph, h = 1.5 sec min., ideal conditions)

**Traffic Density & Flow Rate – Human Control**
(FFS = 70 mph, h = 1.5 sec min, ideal conditions)

**Traffic Speed & Flow Rate – Machine Control**
(S = 70 mph, h = 0.5 sec, ideal conditions)

**Traffic Density & Flow Rate – Machine Control**
(S = 70 mph, h = 0.5 sec, ideal conditions)
Anticipated Safety Effect

• Safety & capacity relationship
• Risk compensation
• Range of opinions:
  • **Opinion 1:** Autonomous vehicles are not safer and even may reduce safety in a mix of self- and human-driven vehicles (Sivak and Schoettle 2015a).
  • **Opinion 2:** Potential benefit considerably reduced due to system failures, cyberterrorism (Bilger 2013), risk compensation, increased travel, higher involvement per crash (Ecenbarger 2009; Fung 2015; Kockelman, et al. 2016; Lin 2013; Ohnsman 2014).
  • **Opinion 3:** Crashes reduced by 90% by eliminating human error (KPMG 2012; Fagnant and Kockelman 2013).
Possible Safety Trends

- **No effect**
- **Initial effect** – Opinions 1 and 2
- **Interim effect** – Opinion 2
- **Final effect** – Opinions 2 and 3

- **Intensive learning and development**

**Crashes**

- **Present**
- **Near future**
- **Distant future**

**Time**

**Transition period**

**Full implementation**

**Pessimistic**

**Optimistic**
INDOT Practice in Transition

• Adapting to advances over near decades — some sustaining, some not — with mix of successes and failures
• Identifying new safety (also security) and capacity challenges
• Integrating vehicle, road, and system
• Instrumenting roads for traffic control and navigation support
• Adjusting decision-making today for (uncertain) design year travel conditions
Current CRS Research on Safety Tools Applicable in the Transition Period

- TSCAN - practical technique of observing near-crashes for safety evaluation of traffic with C/A vehicles (SPR-4102)

- CDB - tool for investigating patterns of crashes and conflicts (SPR-4103)
Near-term Needs of Safety Tools for the Transition Period

- **Rapid** estimation of safety of hybrid and C/A vehicles safety with traffic conflicts,

\[ \text{Crashes} = k \cdot \text{Conflicts} \]

- Identifying traffic and road conditions with increased risk of crash under the presence of C/A vehicles

- **Predicting** the safety and capacity of traffic with C/A vehicles under various road and traffic conditions

*Computer simulation of traffic with imperfect drivers and imperfect autonomous navigation.*
Near-term Needs of Safety Tools for the Transition Period

- Data collection and management (crash, vehicle, and driver records)
- Re-evaluated existing and new safety countermeasures for C/A traffic and hybrid traffic
- Professional development and short courses to address changes in the transportation practice
Long-term Safety Research for the Transition Period

- Roadside instrumentation to support navigation and safety
- Roadside instrumentation to support fighting cyberterrorism
- Countermeasures for road and traffic-related safety hazards
- Traffic control, management, and enforcement of C/A traffic
- Roadway design for traffic with C/A vehicles
- New transportation planning
- Professional development and short courses

“Does your car have any idea why my car pulled it over?”
Perspective