Highway Capacity Increases From Automated Driving

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Capacity increase opportunity

• Today’s highway capacity governed by human driver performance limitations
• Replacing driver with automation can increase capacity by:
  – Shorter vehicle-following gaps
  – Enhanced vehicle following stability IFF automation is cooperative (eliminating shock waves)
  – Narrower lanes for light duty vehicles based on more accurate steering
The Highway Capacity Challenge

- At maximum throughput (2200 veh/hr/lane), vehicles occupy only 5% of road surface
  - Half the lane width for a full-size car or SUV
  - Average longitudinal gap = 9 car lengths
  - 2200 veh/hr = 1.64 s hwy
  - At 60 mph (~100 km/h), this is 144 ft per vehicle (44 m or ~10 vehicle lengths)
Capacity Increase Opportunities

- Partial automation – cooperative ACC to improve vehicle following dynamics and reduce gaps
- Full automation – driver removed from control loop, enabling operations outside driver response capabilities
Mean CACC/ACC Time-Gaps Selected in Vehicle Following (Test Results)
Simulated Lane Capacity vs. CACC Market Pen.

With addition of Vehicle Awareness Devices
NAHSC “Pipeline” Capacity Estimates – Individual Automated Vehicles

Achievable capacity will be ~25% less to allow for merging and lane changing
NAHSC “Pipeline” Capacity Estimates – Platooned Light-Duty Vehicles

vs. Platoon Length

Achievable capacity will be ~25% less to allow for merging and lane changing

vs. Intra-Platoon Gap
Automated Truck Platoon Capacity

• NAHSC studies (1997)
Traffic Flow Stability

- Drivers’ car-following response lags cause shock wave instabilities (“stop and go”)
- Commercially available autonomous ACC systems can have comparable or worse lags
- *Cooperative* ACC dramatically reduces lags and improves stability
- Cooperative fully automated systems can also eliminate flow instabilities