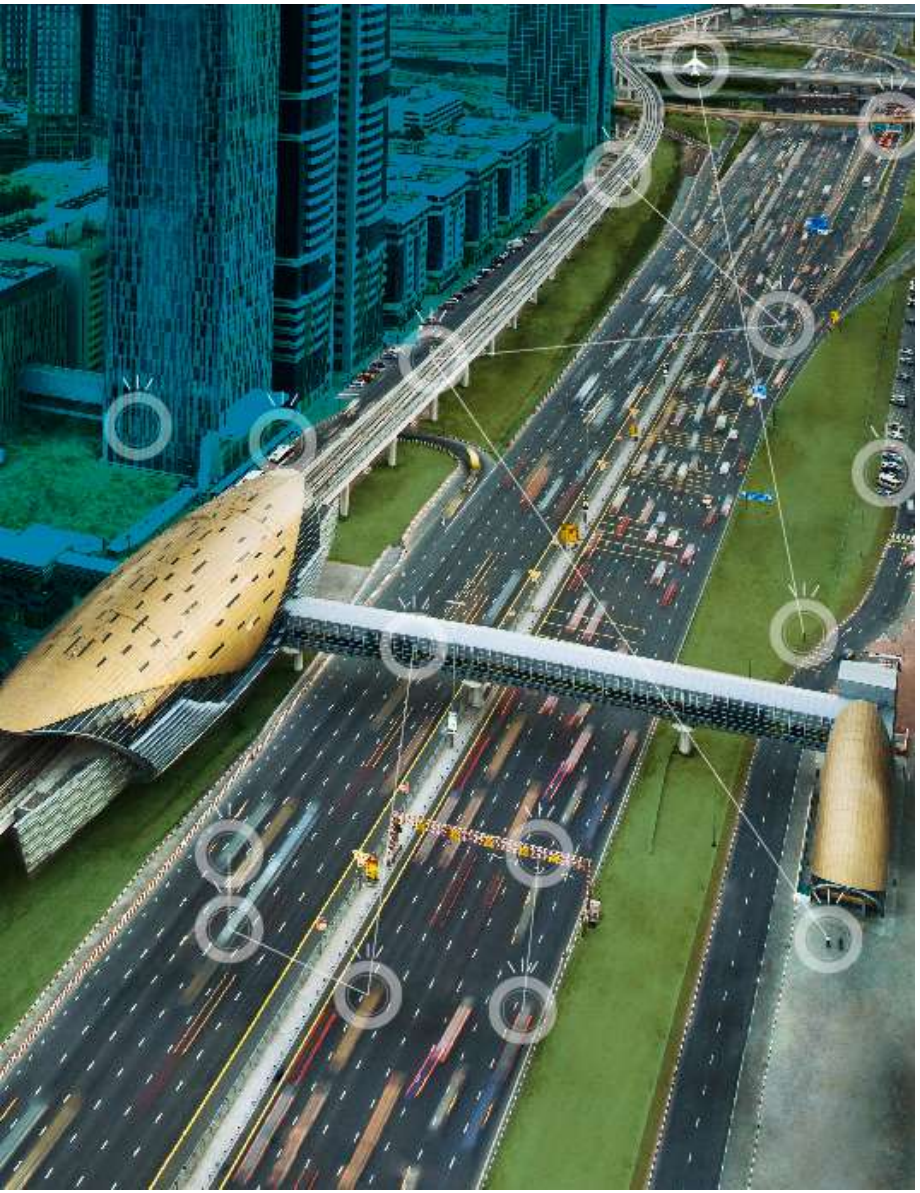

Automation in Transportation:

What Lies Ahead?

Jim Barbaresso

Fellow and Senior Vice President

HNTB Corporation

Technology Takes the Wheel

August 30, 2019

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DISRUPTIVE FORCES AT WORK

We're on the cusp of a transformation in transportation, driven by advances in vehicle **A**utomation, **C**onnectivity, **E**lectrification and **S**haring. These advances will require changes to our transportation infrastructure...in some unexpected ways.

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AUTOMATED VEHICLE BUSINESS CASES

- Ride-hailing and fleets of shared use vehicles
- First and last mile opportunities
- Residential, CBD and campus circulation
- Automated transit
- Truck automation and platooning
- Package and food delivery
- Highway maintenance operations

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Ride-Hailing Services

- Introduction in geofenced areas of cities
- Entertainment and sports venues
- Transit stations, mobility hubs and airports
- Impacts:
  - Curb management needs
  - Reduced parking requirements – more productive use of real estate
  - Parking structure design considerations
  - Repurpose parking for automated vehicle staging, queuing and charging
  - Buy rides, not cars – garaging and residential home design considerations

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First and Last Mile Services

- Deliver residents / workers to and from mobility hub or transit stop
- Remote parking shuttles
  - Residential communities
  - Resorts / beaches / parks
  - Airports and event venues
  - Commercial / business parks
- Impacts:
  - Remote parking facilities
  - Reduced congestion in sensitive areas
  - Concessions and TOD around mobility hubs

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Circulators

- Campus, Airport and CBD Circulation
- Planned Community Circulators
- Examples:
  - University of Michigan
  - Jacksonville Ultimate Urban Circulator
  - Columbus, OH
  - Babcock Ranch, FL
  - Treasure Island, San Francisco
- Impacts:
  - Reduced congestion
  - Walkable communities

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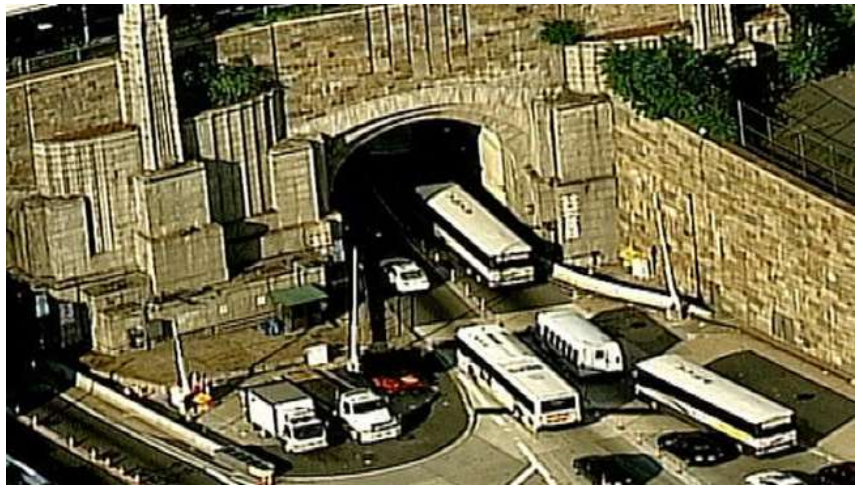
Transit Automation

- Higher Speed on Dedicated Roadways or Lanes
  - Bus Rapid Transit (BRT) solutions
  - Alternative to Light Rail and APMs
- Slow Adoption Rate Among Bus Manufacturers - Shuttle Makers Fill the Void
- Challenges of Precision Docking, Platooning, and Charging
- Current Plans
  - Lincoln Tunnel Pilot
  - MDX XT Lane Concept
  - Osceola County, FL
  - Houston METRO



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Automated Goods Movement

- Intermodal connectivity at ports and airports
- Assembly and distribution centers
- Long-haul trucking efficiencies
- Local delivery
  - Land vehicles
  - Unmanned aerial vehicles
- Impacts:
  - More efficient inventory handling = reduced space needs
  - Docking solutions and building design

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Truck Platooning

- Impacts:
  - Less wheel wander = pavement wear pattern
  - Less time for pavement slabs to recover
  - Dedicated lanes for truck platoons on highways
  - Bridge weight limits

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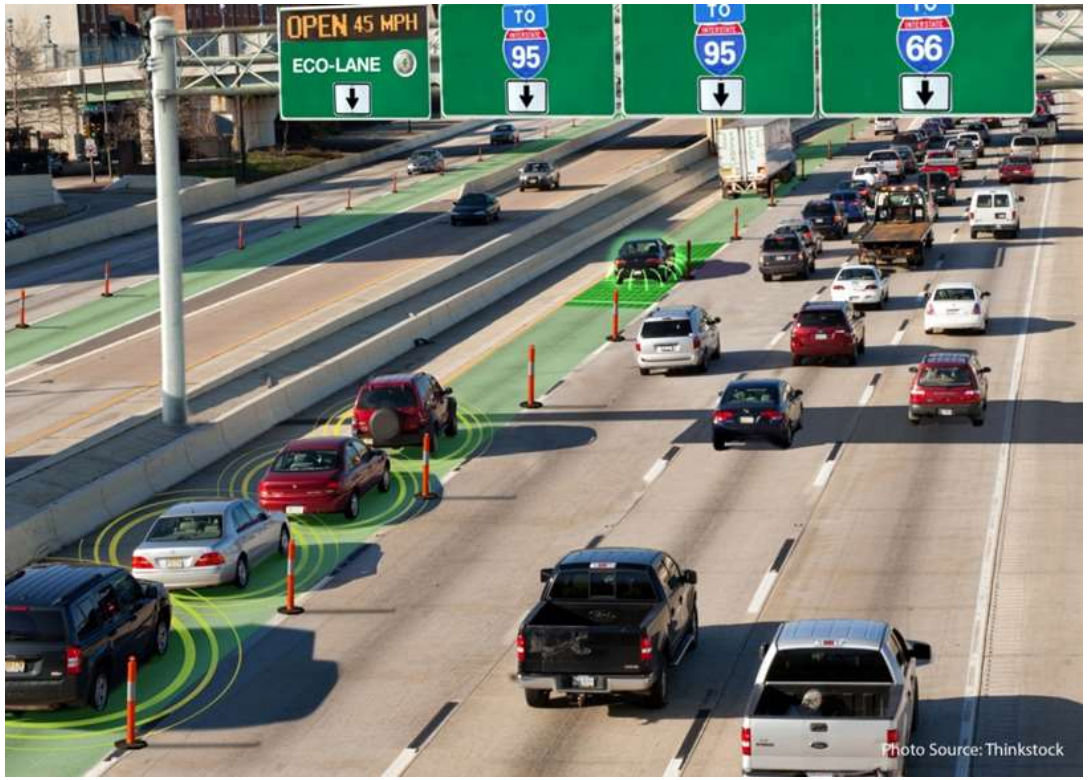

TRANSITIONING ON OUR HIGHWAYS

- Managed lanes in a new context
- Should we separate automated vehicles from others to generate the most benefits?
- At what penetration rate should we dedicate a lane?
- Incrementally increase the number of special lanes as the fleet turns over?

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Highway Construction, Maintenance & Operations

- Construction processes and equipment
- Inspections
- Mowing
- Sweeping

INFRASTRUCTURE IMPACTS

- MUTCD changes
- Design criteria changes – ODD for ADS
- If cars don’t crash
  - Traffic signalization impacts
  - Signage
  - Seamless travel between roads and modes

Source: University of Texas

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Expected Benefits of Automated Vehicles

INCREASED MOBILITY FOR NON-DRIVERS IS RECOGNIZED AS THE SINGLE MOST IMPORTANT BENEFIT OF AUTONOMOUS VEHICLES.

52%
Increase mobility for non-drivers

43%
Reduce accidents and increase safety

23%
Improve the environment

23%
Improve safety for pedestrians and bicyclists

22%
Reduce congestion

19%
Increase ability of existing highways to handle more traffic

19%
No benefits from autonomous vehicles

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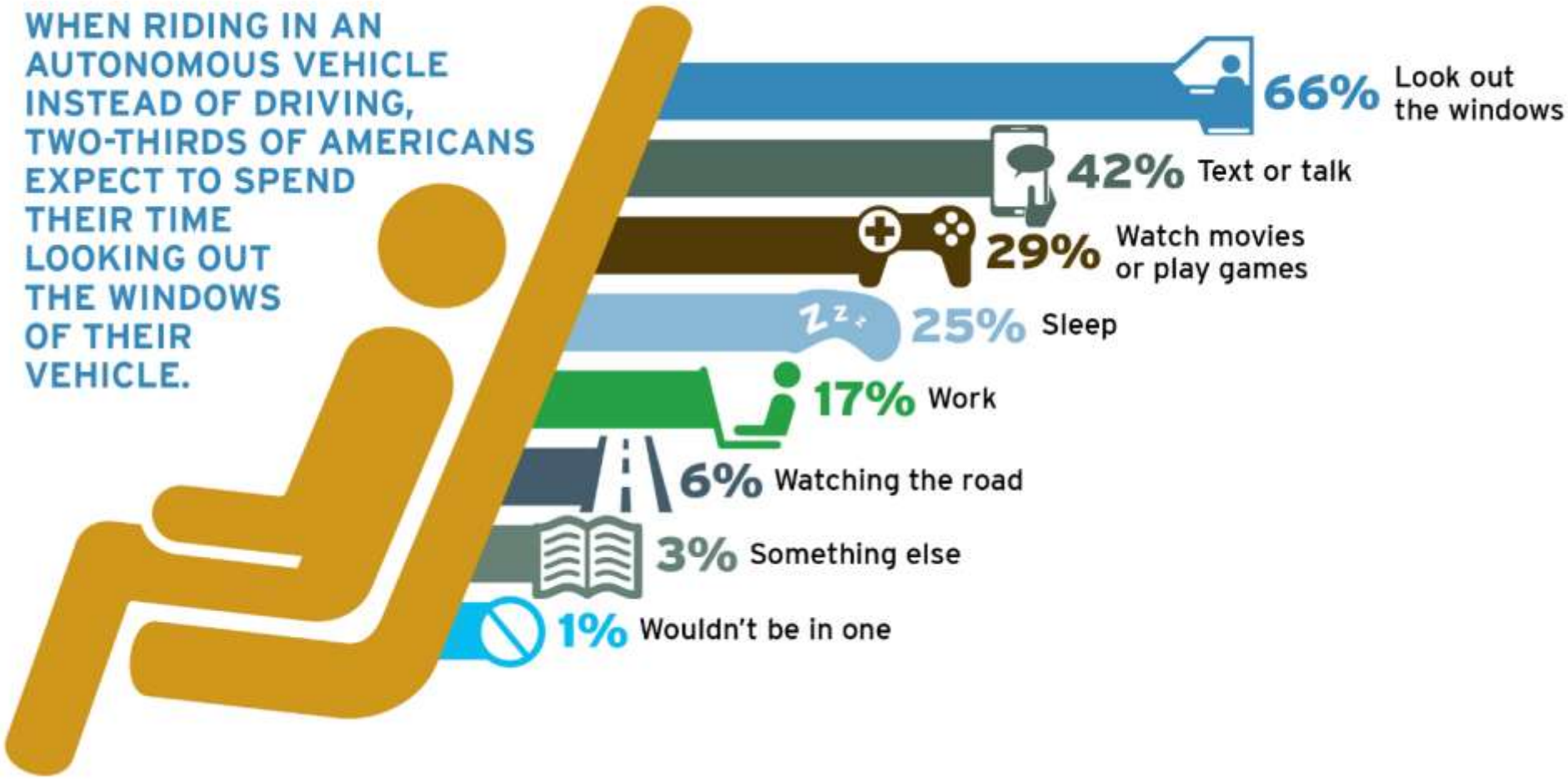
What People will do in Automated Vehicles



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WHAT LIES AHEAD?

- More VMT or less?
- Less parking?
- Private versus fleet ownership models?
- Impacts on transit?
- Climate impacts?
- Quality of life?
- Urban form?

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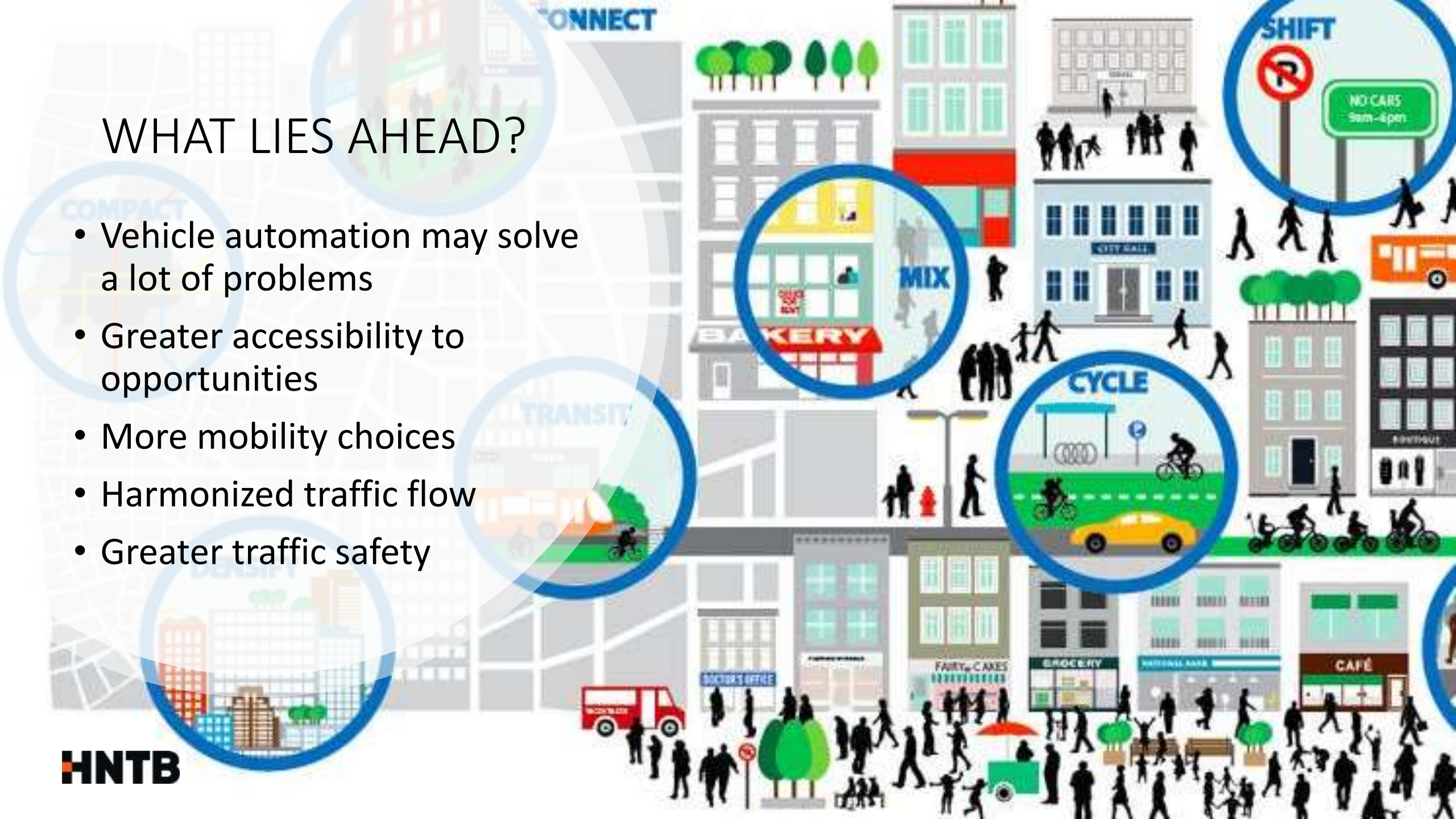
WHAT LIES AHEAD?

- Vehicle automation may solve a lot of problems
- Greater accessibility to opportunities
- More mobility choices
- Harmonized traffic flow
- Greater traffic safety



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WHAT LIES AHEAD?

- On the other hand…
- Vehicle automation may promote longer commutes
  - Work, sleep, eat on your ride
- Impacts:
  - Urban sprawl
  - Large lot developments and rural transformation
  - Property value decreases in urban core
  - Decentralization of housing and jobs to exurban areas
  - Additional strain on infrastructure

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WHAT LIES AHEAD?

- “Nomadization”
  - Untethered to place
  - Work, sleep, eat and live in your automated vehicle
  - Highways as homesteads
  - Strip cities / “sprawl on steroids”

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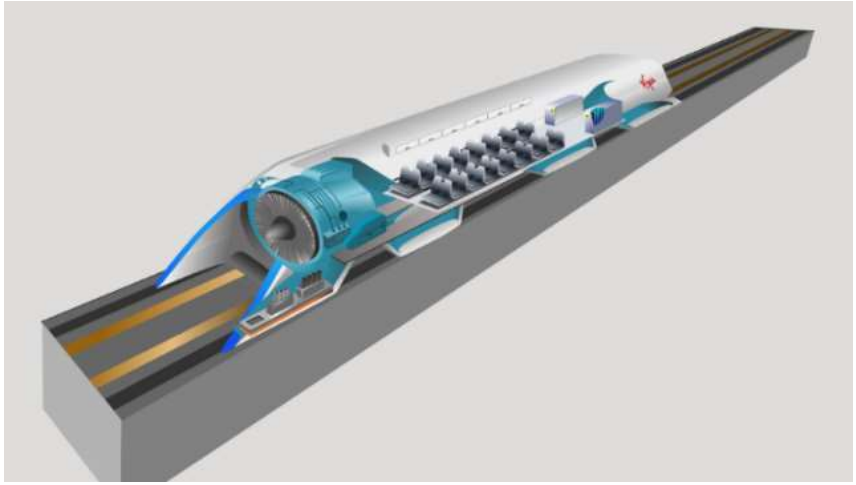
WHAT LIES AHEAD?

- This is just the beginning…
- Future of mobility
  - “Flying cars”
  - Hyperloop networks
- What impacts will they bring?



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GAME CHANGER

- Automated Vehicles will change the face of transportation
- Impacts on operations, urban form and land use, transportation system design, intermodal coordination, parking, green space
- Future can’t be left to chance

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