A Convergence in Shared Mobility:
Demand-responsive fully automated vehicles,
for carsharing & ridesharing across Austin, Texas

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A Paradigm Shift for Travelers:
Shared fully-Automated Vehicles

- Less than 20% of newer (& 15% of all) personal vehicles are in-use at peak times, even with 5-minute pickup & drop-off buffers.
- Car-sharing programs like ZipCar & Car2go have expanded quickly, with the number of U.S. users doubling every year or two over the past decade.
- Shared fully-Automated Vehicles (SAVs) can overcome car-sharing barriers, like return-trip certainty & vehicle access distances.

A Shared fully-Automated Vehicle fleet...
SAVs’ Place in a World of Shared Mobility

Time / Technology Evolution

Degree of Shared Mobility

AVs = automated vehicles
HH = household
LX = NHTSA level of automation
DRS = dynamic ride-sharing
Network **Speeds & Sampled Trips**

- **Hourly-varying link speeds** estimated using agent-based DTA simulation software (**MATSim**) serving region’s entire trip table.
- **12 mi x 24 mi geofence (734 TAZs)** serves highest-demand area.
- 100k trips drawn from regional trip table, with **56.3k trips** having O&D within geofence (1.3% of total regional trips). These will use **SAVs**.
Relocation across the Network

- Identify areas (blocks) with imbalanced travel demand & available SAVs.

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- Find nearby SAV in pull block to move into push block.

- Set path from target SAV into the new block.
1. New trip finds nearest SAV.

2. **Path** is planned from SAV to trip Origin & then to trip Destination.

Dynamic ride sharing (DRS)

4. New trip comes online, searches for nearest SAV.

5. If SAV claimed or occupied, check DRS match, testing all pick-up/drop-off order combinations.

6. If success, set the new route & continue moving; Else find the next nearest SAV.
One SAV’s 24-hour day
Case Study Results

- **24-hour day** with 56,300 trips served (1.3% of regional trips).
- Avg. trip length: **5.64 mi.**
- **Excellent Level of Service**
  - LOS is better with DRS if fleets sized equally.
- **Some extra unoccupied VMT is realized.**
- Replacement rate & reduced VMT gains are large for small amount of shared rides.

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<tr>
<th>Measure</th>
<th>With DRS</th>
<th>Without DRS</th>
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<tr>
<td>SAV fleet size</td>
<td>1715</td>
<td>1715</td>
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<tr>
<td>Veh. replacement rate</td>
<td>10.77</td>
<td>10.77</td>
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<tr>
<td>Average wait time</td>
<td>1.18 min</td>
<td>1.87</td>
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<td>% Waiting &gt; 10 min.</td>
<td>1.45%</td>
<td>5.56%</td>
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<td>5-6 PM avg. wait</td>
<td>4.49 min</td>
<td>8.96 min</td>
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<td>Avg. total trip time</td>
<td>14.71 min</td>
<td>14.97 min</td>
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<tr>
<td>New VMT introduced</td>
<td>4.49%</td>
<td>7.92%</td>
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<tr>
<td># rides shared</td>
<td>6152</td>
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<tr>
<td>% VMT shared</td>
<td>4.83%</td>
<td>0%</td>
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Questions & Implications for Cities…

- **Parking**
  - 10:1 replacement means 9 spaces per SAV not needed.

- **Passenger pick-up locations**
  - Stations or pick-up anywhere?

- **SAVs at rest**
  - Park anywhere, use depots or mix?

- **Traditional transit impacts**
  - Helps solve first-mile / last-mile problem
  - Replace or enhance existing service?
Questions & Implications for Cities (2)...

- **Density**
  - A significant enabler to success.
  - What could be done to ramp-up implementation?

- **Public vs. Private systems**
  - What are the advantages of each?
  - What are the barriers to entry?
  - Natural monopoly issues?

- **Implementation details**
  - Low-speed vehicles.
  - Getting the geofence size right.
  - Use electric SAVs & charging stations?
Questions & Implications for Cities (3)…

- **Dynamic Ride Sharing**
  - DRS, no DRS, or a mixed system?
  - Tight departure windows?
  - Ride-share refusals?

- **SAV Reservations & Priority Scheduling**
  - Should they be allowed?

- **Membership**
  - Should it be required or not?
Questions & Implications for Cities (4)…

- **Special population impacts**
  - Disabled persons
  - Elderly
  - Children
  - Visitors to the city

- **Special industry impacts**
  - Taxi drivers
  - Car rental companies

- **Environmental impacts**
  - Fewer cold-starts, possibly more VMT, net reductions.
Thank you for your time!

Questions?