A Convergence in Shared Mobility:

Demand-responsive fully automated vehicles, for carsharing & ridesharing across Austin, Texas

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2014 Automated Vehicle Symposium

July 18, 2014

*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.


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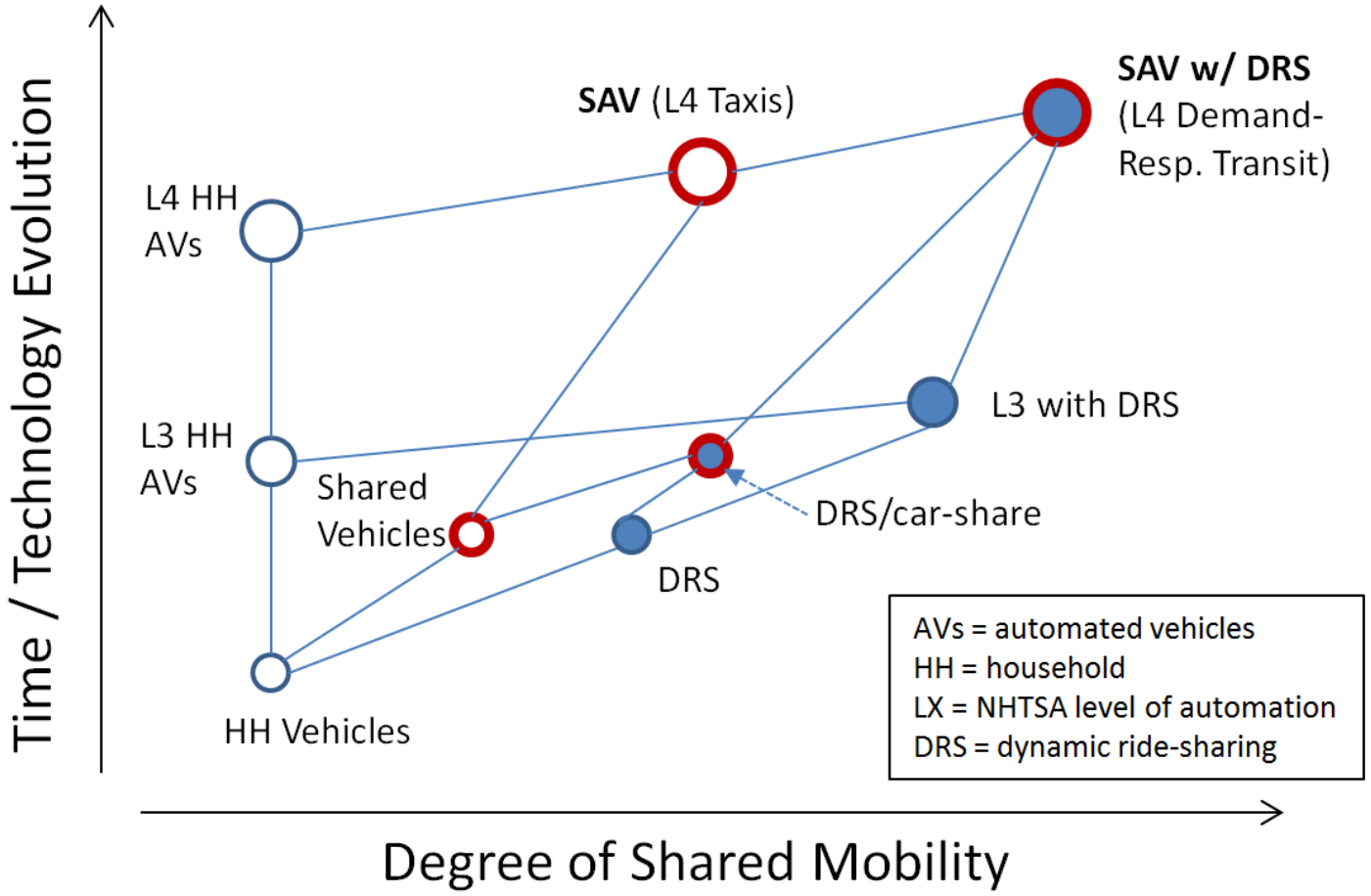
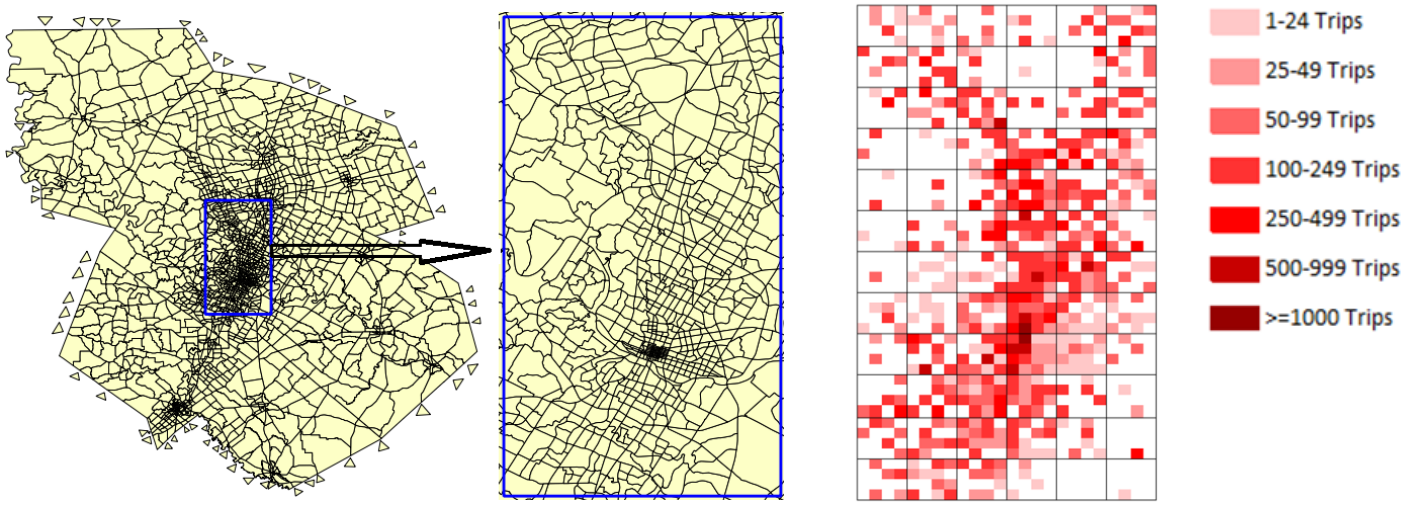
A Shared fully-Automated Vehicle fleet…

SAVs' Place in a World of **Shared Mobility**



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**.



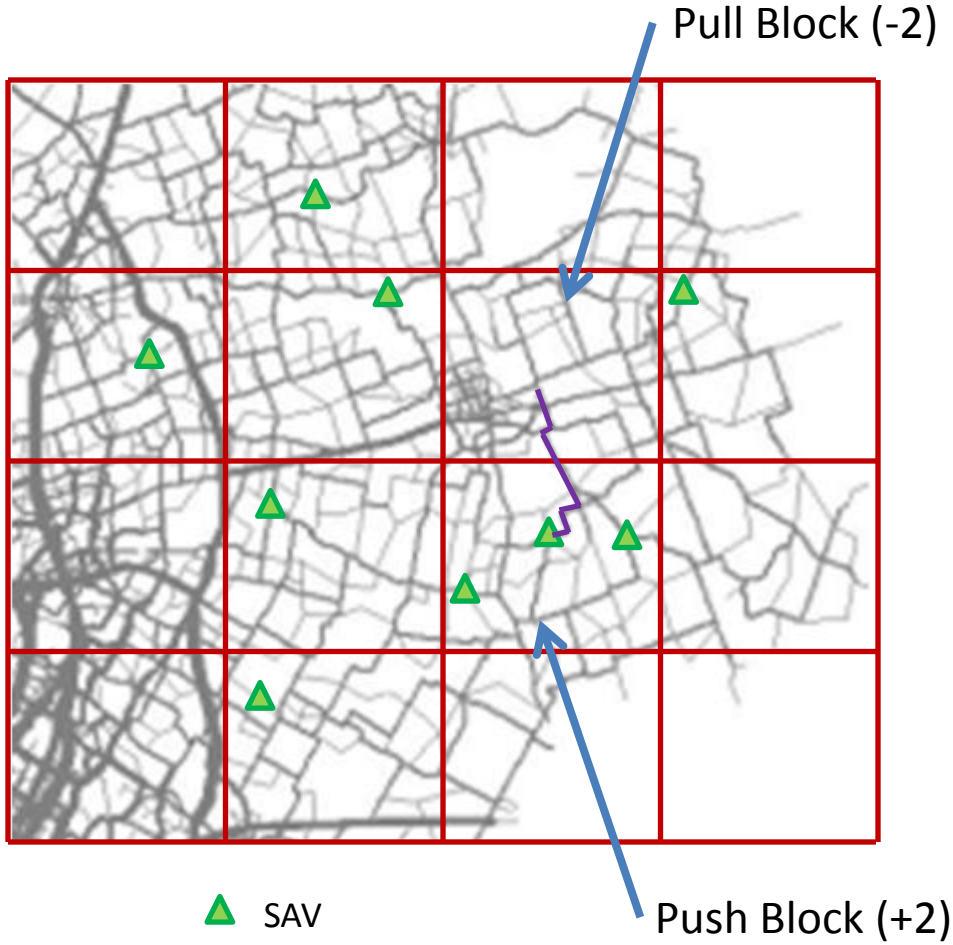
Austin Regional Network Geofence Origin-Based Trip Intensity

Relocation across the **Network**

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

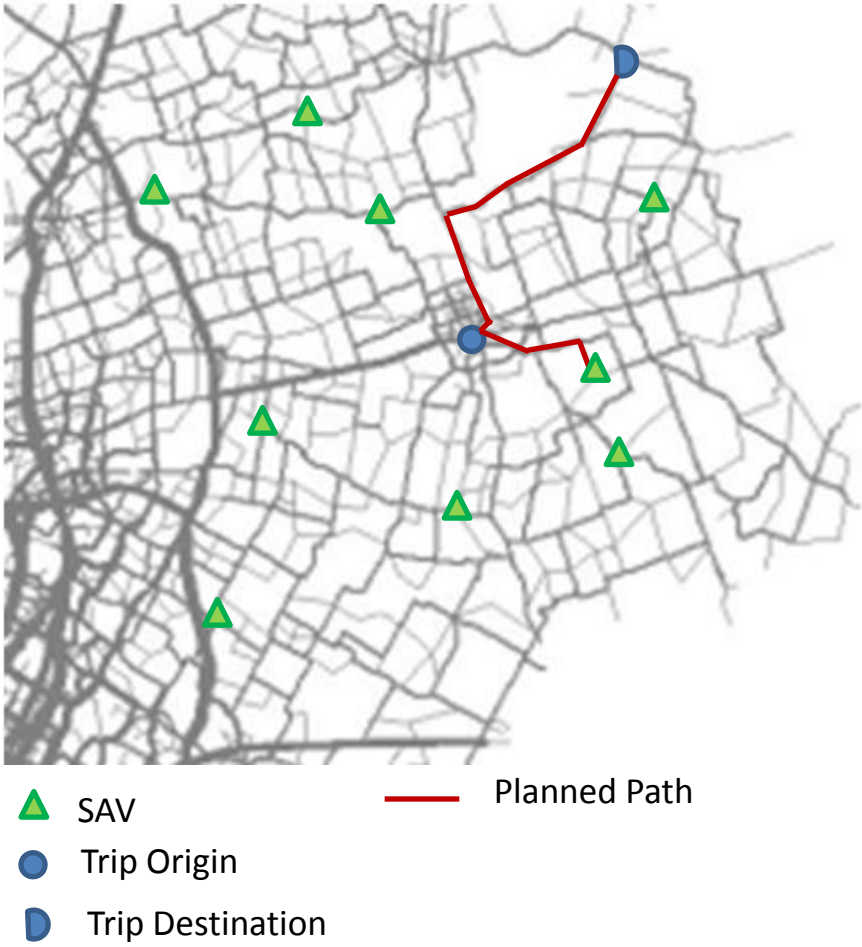
-3	-2	-2	0
-1	0	-5	0
-2	-2	2	-2
-3	0	-1	0

- Find **nearby SAV** in pull block to move into push block.
- **Set path** from target SAV into the new block.



SAV Operation

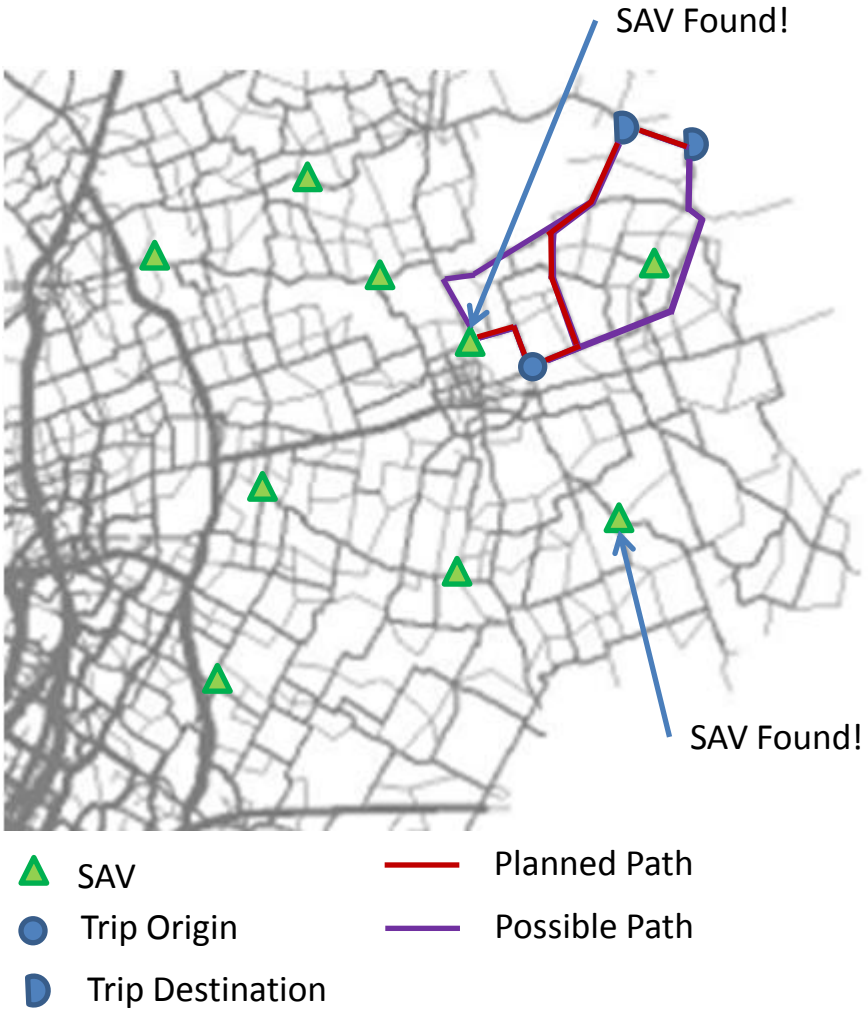
1. New trip finds nearest **SAV**.
2. **Path** is planned from SAV to trip Origin ● & then to trip Destination ◗ .
3. Movement, pick-up & drop-off.



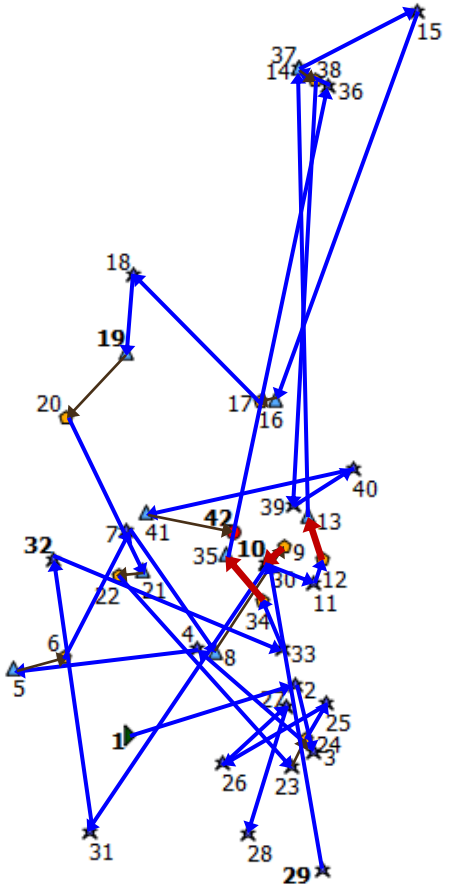
Dynamic ride sharing (**DRS**)

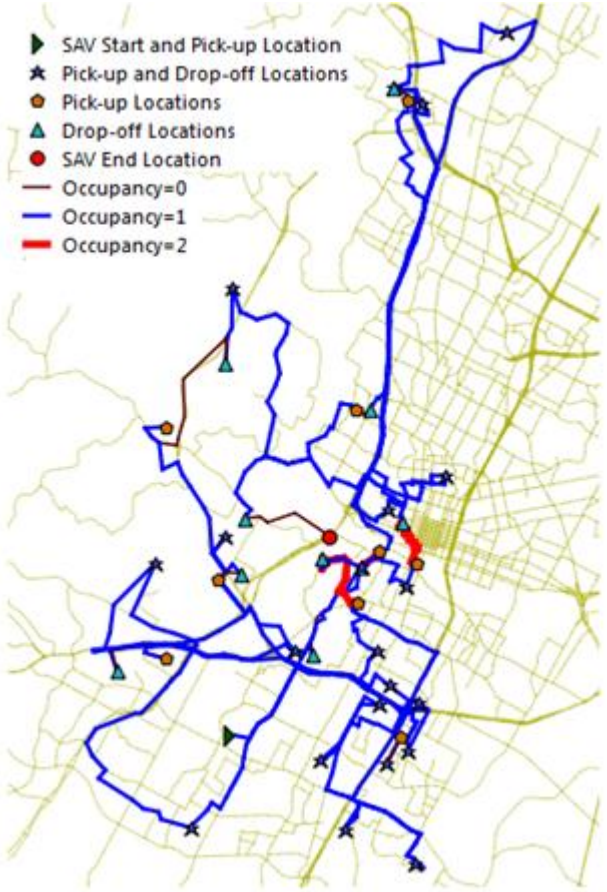
4. New trip comes online, searches for nearest **SAV**.
5. If SAV claimed or occupied, check DRS match, testing all pick-up/drop-off **order combinations**.
6. If success, set the **new route** & continue moving;

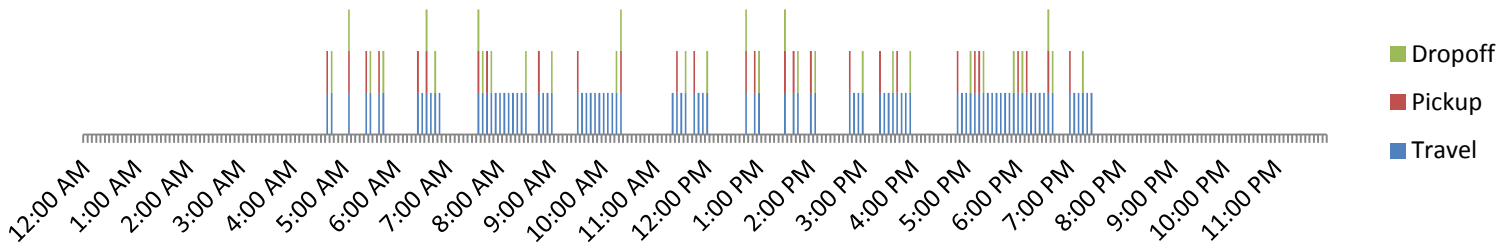
   Else find the next nearest **SAV**.



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.

Measure	With DRS	Without DRS
SAV fleet size	1715	1715
Veh. replacement rate	10.77	10.77
Average wait time	1.18 min	1.87
% Waiting > 10 min.	1.45%	5.56%
5-6 PM avg. wait	4.49 min	8.96 min
Avg. total trip time	14.71 min	14.97 min
New VMT introduced	4.49%	7.92%
# rides shared	6152	0
% VMT shared	4.83%	0%

Questions & Implications for Cities…

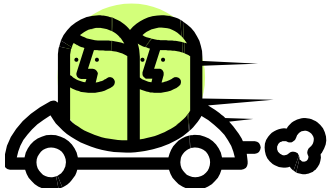
- **Parking**
  - 10:1 replacement means 9 spaces per SAV not needed.
- Passenger **pick-up locations**
  - Stations or pick-up anywhere?
- SAVs **at rest**
  - Park anywhere, use depots or mix?
- Traditional **transit impacts**
  - Helps solve first-mile / last-mile problem
  - Replace or enhance existing 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?

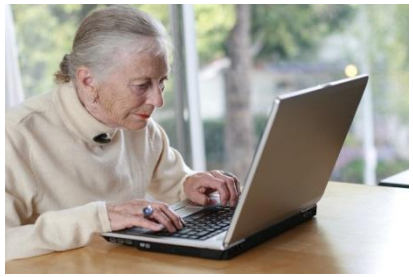


- SAV **Reservations** & Priority **Scheduling**
  - Should they be allowed?

- **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?