High Capacity Transit in the Future World of Automated Vehicle Technology

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My Perspective

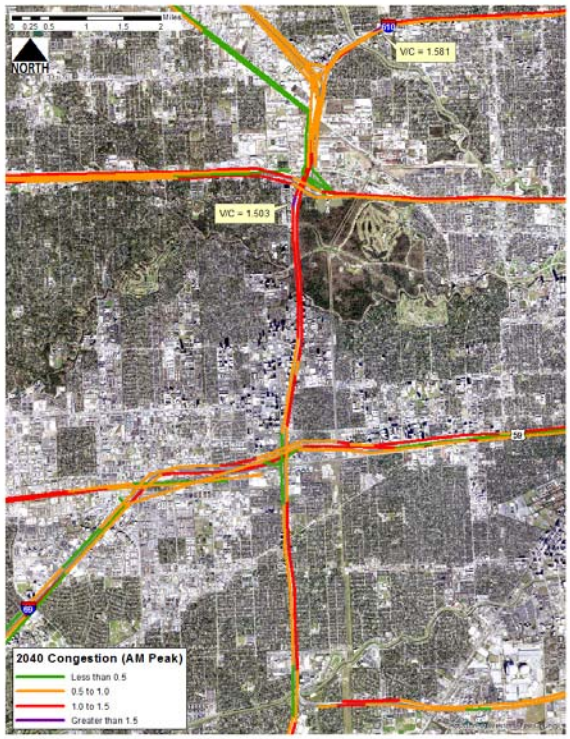
- 40 years specializing in fully automated transit
- Principal Investigator – NCHRP 20-102(02) Impacts of Laws and Regulations on AV Technology Introduction in Transit Operations
  - Study Findings on AV fully automated/autonomous vehicle technology have major policy implications

A local ***Policy Framework for an integrated, multimodal transportation system*** should guide AV technology application in public transit service

Why it is Important to Think Outside the Houston Box

We must develop the HCT Policy Framework now while there is time to stay ahead of massive congestion:

- ***Houston is 2x as big in population as today*** the roadway system will be overwhelmed with traffic
- ***New HCT service types and technologies*** must be implemented on a regional scale to sustain mobility
- ***It will take all of the next 20 to 30 years*** to plan and implement such major changes to the system.



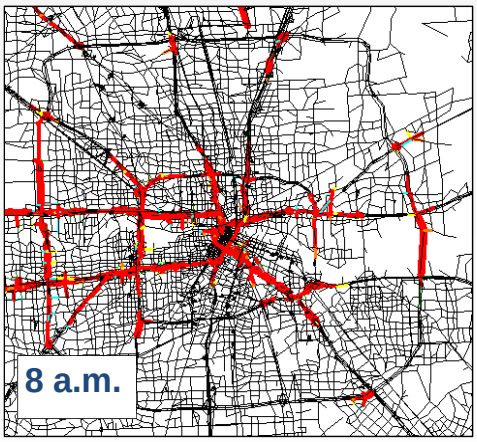
Traffic Congestion in 2040-50 will be Massive

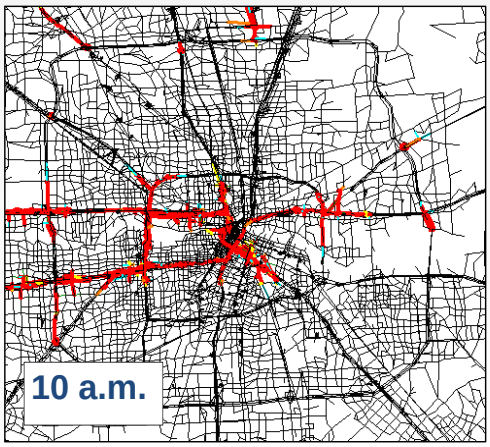
2040 H-GAC Regional Travel Demand Model – most severe demand overloads occur along 610 Loop, the Katy Freeway, West Sam Houston Tollway and Westpark Tollway

- Demand/Capacity color coding represents the average traffic demand over the 3-hour morning peak period
- Red indicates demands exceed capacity
- **LOS F traffic congestion will last all day long at these levels of demand overload.**

Houston Regional Operational Analysis for 2035 Freeway Operations

Urban Core Traffic Congestion Will Last All Day Long in 2035-2040



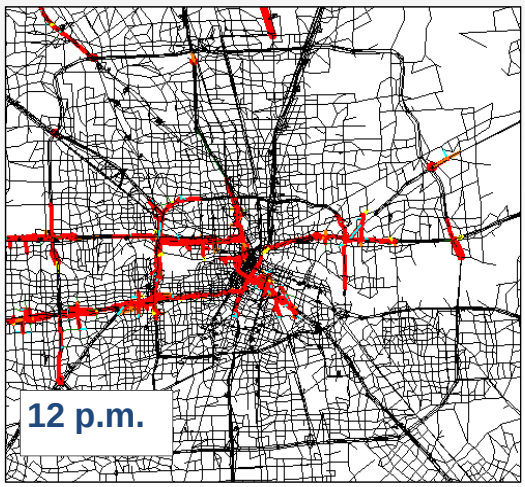


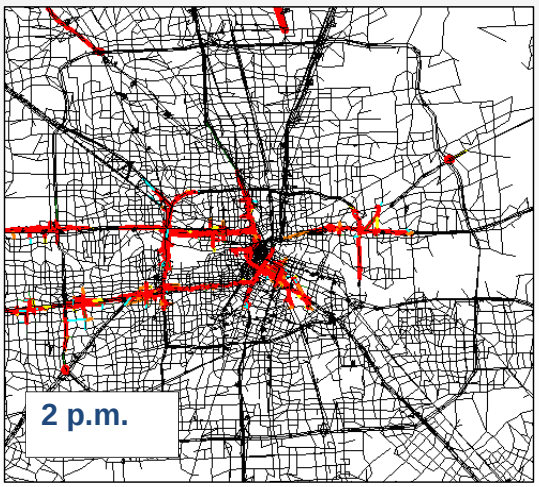
Source: 2012 TxDOT HSR Ridership Study

Red Segments Designate Level-of-Service (LOS) F Operating Conditions with Cascading Congestion Queues

Houston Regional Operational Analysis for 2012 TxDOT HSR Study

Urban Core Traffic Congestion Will Last All Day Long in 2035-2040





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Houston Regional Operational Analysis for 2012 TxDOT HSR Study

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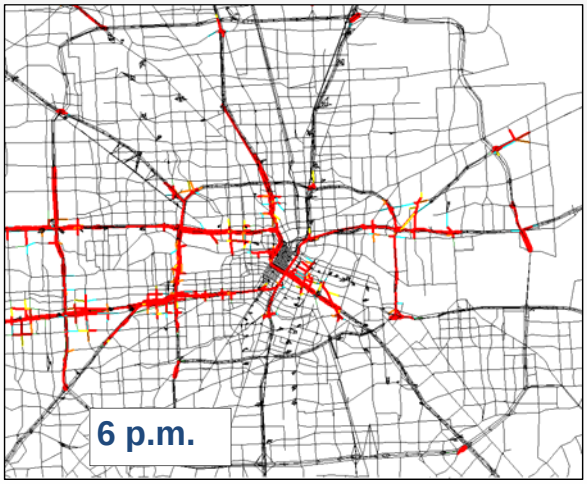
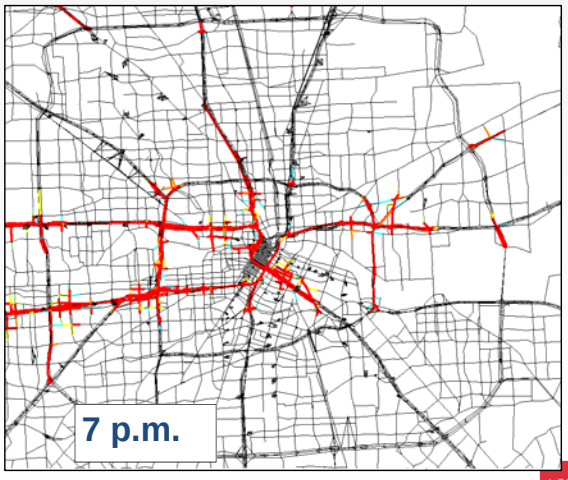




Source: 2012 TxDOT HSR Ridership study

What is the Paradigm Shift We Are Facing?

Impacts of Vehicle Automation on Our Roadway System

AV Technology will transform the transportation world over the next 30 years

Source: 2getthere

Source: Easy Mile

Source: Mercedes

Source: Audi

Source: Nissan

Driving Automation Levels in accord with SAE J3016

- NHTSA refers to these higher Driving Automation Levels as Highly Automated Vehicles (HAVs)
- SAE J3016 refers to higher levels as Automated Driving Systems (ADS)
- **L3**– Automated System conducts some parts of driving task and monitors driving environment in some instances, but Human Driver must be ready to take control
- **L4** – Automated System conducts driving tasks and monitors driving environment, but only in certain environments and under certain conditions
- **L5** – Automated System conducts all driving tasks and monitors all driving environments – THIS IS WHEN "AUTONOMOUS" BECOMES REAL

Expected Readiness Timeline for AV Technology – Autos and Transit

- Today – **L3** operations on Freeways/Highways
- Near-Term (5 -10 Years) – **L3** operations on major arterials and selected city streets within Urban Centers, **L4** operations in protected Campus Environments, on Freeways and Managed/HOV lanes
- Medium-Term (10 -15 Years) – **L4** operations in low speed in mixed traffic along most city streets and in selected neighborhoods/districts
- Long-Term (15 -20 Years) – **L4** and **L5** operations in all environments, and with fully automated transit systems

How Will New AV Technology Change Traffic Congestion and Mode Choice?

Scenario A: Utopian View –

- Steadily decreasing number of cars and vehicle trips
- Roadway capacity dramatically increasing
- AVs traveling home after dropping us off at work
- We can turn most parking lots into public parks

How Will New AV Technology Change Traffic Congestion and Mode Choice?

Scenario B: Dystopian View –

- Connected roadways move AV vehicles much more efficiently and capacities will increase
- Everyone will enjoy a private ride to work in their own personal AV and then send it home
- Empty vehicle movements will dramatically increase the number of vehicle-trips
- Resulting traffic congestion will continue to increase to record levels

How Should We Approach High Capacity Transit?

EXAMPLE OF AN INTEGRATED MULTIMODAL POLICY FRAMEWORK FOR HCT

How are Other World-Class Regions Addressing HCT and AV Integration?

- Europe/Asia governments planning strategy
  - Integrated multimodal transit system concepts as coordinated policy frameworks spanning all transit service types/technologies and managed across local agencies
- Japanese national planning program integrates AV technology into their large-scale transit system.

Why Consider Japan as an Example?

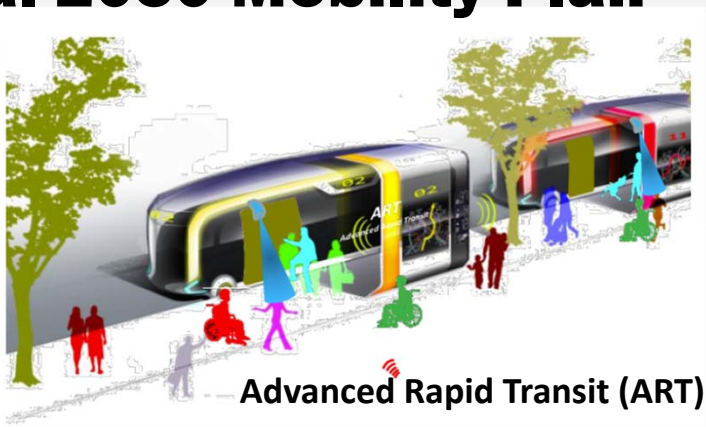
Over a Decade of Notable AV Transit R&D – Japan has thought deeply about the societal implications of AV technology

Source: Wikimedia

2 Million Passengers Carried in Automated Buses at 2006 Expo in Aichi Japan

Japan's National 2050 Mobility Plan

Policy Objective – Sustainable and inclusive mobility for all in Japanese society using connected and automated vehicle driving technology integrated with conventional mass transit.



Advanced Rapid Transit (ART)

Official name of the national program on connected and automated vehicles is:

SIP-adus – Cross-Ministerial Strategic Innovation Promotion Program, Innovation of Automated Driving for Universal Services

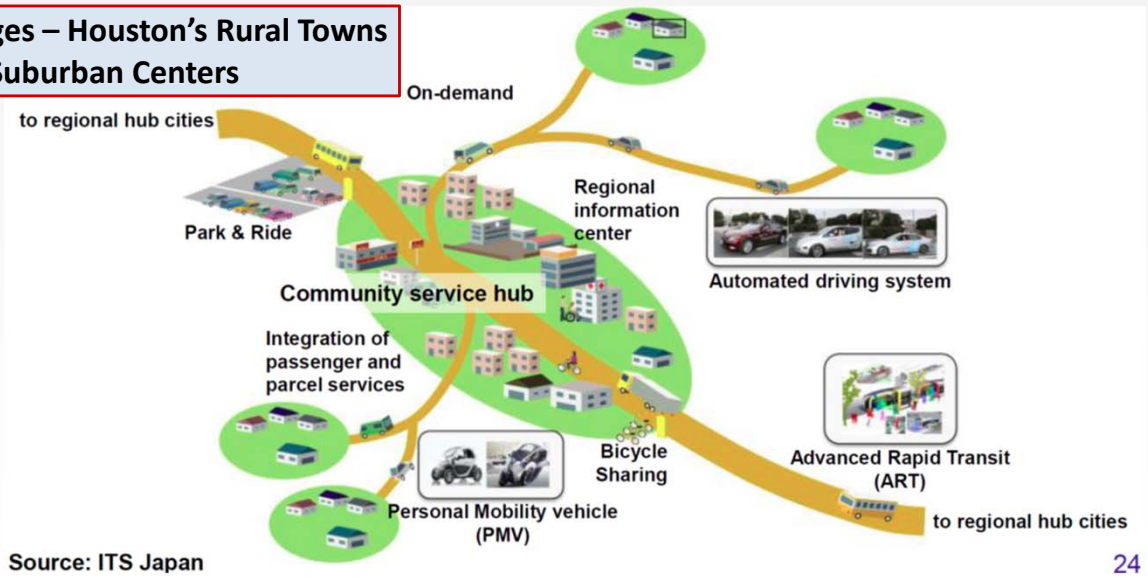
Japan's National 2050 Mobility Plan

Policy Approach – Development of an Integrated multimodal high-capacity transportation system which interconnects three types of "cities"

- Villages – rural towns and suburban centers planned around transportation hubs with connections to HCT travel corridors
- Regional Hub Cities – travel connections by HCT within 1 hr
- Mega-Cities – interconnected by HSR for competitive advantage in the global economy

District FM/LM and Circulator Service in "Villages" and Urban Districts/Major Activity Centers

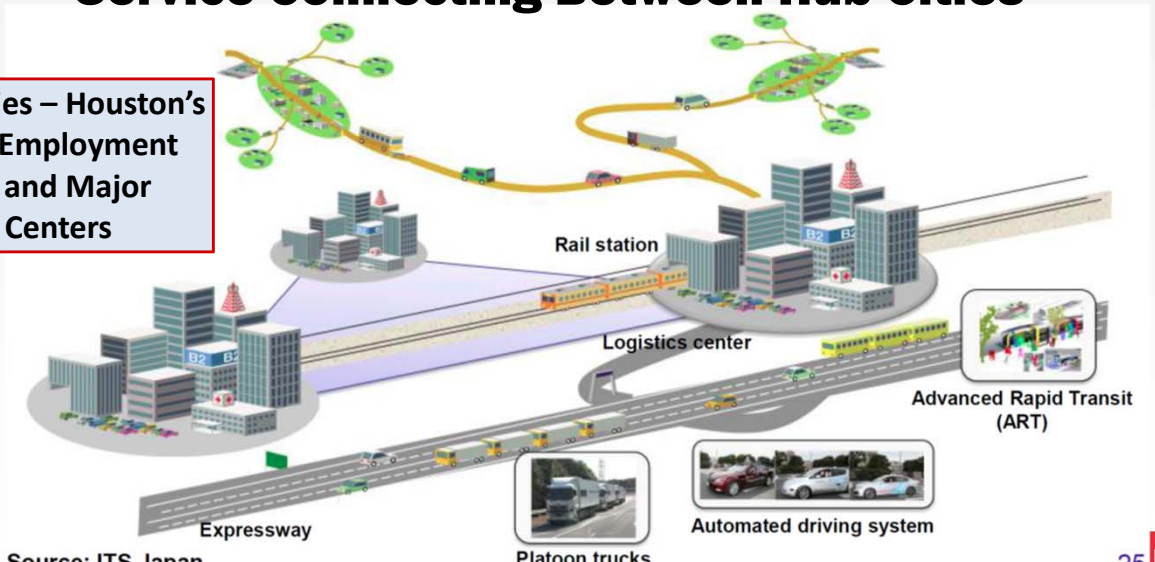
Villages – Houston's Rural Towns and Suburban Centers



Source: ITS Japan

Regional Commuter and Subregional Corridor Service Connecting Between Hub Cities

Hub Cities – Houston's Largest Employment Centers and Major Activity Centers



Source: ITS Japan

Mega-Region Service Connecting Mega-Cities

Mega-Cities – Houston's Regional Urban Core and CBD

Source: ITS Japan

Considerations

- Think outside the box
  - Identify all necessary transit service types/technologies necessary to implement over the next 30 years
- Assess the Impacts of Automation Technology
  - Prepare for the transportation paradigm shift as Automated Vehicles dramatically change our transportation system
- Prepare Integrated Multimodal High Capacity Transit Policy
  - Incorporate new transit service concepts and transit technologies which complement our current transit service
  - Form a well-integrated and fully coordinated plan