ITS ePrimer
Module 5: Personal Transportation

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Instructor

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Learning Objectives

1. Learn of capabilities, features, and limitations of ITS technologies for personal transportation
2. Understand deployment opportunities and constraints
3. Understand how ITS personal transportation applications impact the user and the transportation system in terms of mobility and accessibility
4. Understand emerging and future trends in ITS technologies for personal transportation
Real-Time Travel Information

Information types and impacts

Pre-Trip
- Trip departure time
- Mode of travel
- Route choice

En Route
- Change route
- Change mode (if alternate mode with parking available)
- Expected arrival times
Real-Time Travel Information

Dissemination

- **Web**
  - Every State DOT offers traveler information Web site
  - Pre-trip information
  - Wide geographic area coverage
  - Images from CCTV cameras on real-time conditions

- **511 Phone System**
  - More than 40 511 systems
  - Highest usage under major events
    - Extreme weather
    - Major road closures
Real-Time Travel Information

Dissemination

Changeable Message Signs (CMS)
- Expected travel times to destinations
- Alerts on incidents, inclement weather, other events
- Location important (prior to decision point)
- Emergency Messages
  - AMBER Alert
  - LEO Alert
  - SILVER Alert
Real-Time Travel Information

Dissemination
Changeable Message Signs (CMS)

CMS Implementation in Michigan DOT

https://www.youtube.com/watch?v=tUNgPSx0rxk
Real-Time Travel Information

Dissemination

- Highway Advisory Radio (HAR)
- E-mail
- TV/Radio
- Kiosks
- Private Information Providers
  - In-vehicle navigation
  - Handheld devices
- Social Networking Media
Real-Time Travel Information

Dissemination

Increasing use of mobile applications and social networking

http://maps.google.com/

http://www.waze.com/livemap/
Real-Time Travel Information

Data Sources

- Fixed sensors approximately 0.5 mile apart in each travel lane (e.g., loops, radar, video)
- Event information from incident management teams, police patrols
- CCTV
- Probe vehicles
  - ETC transponders
  - Cell phones
  - Bluetooth readers
Real-Time Travel Information

Data Collection-Fusion-Utilization

- Fixed Sensors
- Truck Fleets
- Taxies
- Cell phones
- PNDs

Collection

Fusion (Multiple sources – Various data)

Planning - PM

Traffic Operation

Speed Information
Real-Time Travel Information

Benefits

Improve Traveler Decision Making
- Make accurate and timely decisions
  - Routing
  - Time of departure
  - Mode
  - Not make the trip
- Sense of “self control” to traveler

Reduce Frustration and Irrational Behavior
- Improve perceived level of service
Real-Time Travel Information

Benefits

Spread or Reduce Peak Traffic Demand
- Over space: alternative routes
- Over time
- Alternative modes
- Eliminating discretionary trips

Field Evaluation Results
- Traveler information users perceived time savings
- In-vehicle travel time savings are small
Real-Time Travel Information

Transit Dissemination
- Web
- Mobile Applications
- Station/Transit Stop Displays
- In-vehicle Displays

Content
- Maps/schedules
- Expected arrivals real-time
  - Transit vehicle tracking (AVL)
- Online Trip Planner
Parking Information

Public Agencies/Operators
- Maps with Parking Facilities
- Information on the Web: location/characteristics

Parking Lots
Space Availability

Private Service Providers
Web/Mobile Applications
- Real-time Parking Availability
- Online Reservation/Payment

City of San Francisco: Parking Information Web site
http://sfpark.org/
Parking Information

Multimodal Information

- Driving Times
- Parking Availability at Transit Stations
- Transit Information
  - Departure/Arrival Times

- Influences Mode Choice
  - Travel Time Savings
  - Perceived Congestion
Driver Assistance Systems

- Night Vision
- Adaptive Cruise Control
- Collision Warning
- Collision Avoidance
  - Front collision
  - Lane keeping
- Precision Docking
  - Precise stopping at transit stops
  - Reduces passenger boarding and alighting times
- Driver Impairment Monitoring
- On-Board Monitoring for Commercial Vehicles
Driver Assistance Systems

Advanced Driver Assistance System
https://www.youtube.com/watch?v=5vuKvW_5QVM

Precision Docking – Real World Demonstration
http://www.youtube.com/watch?v=JvXLdifNfmg
Driver Assistance Systems

Adaptive Cruise Control (ACC)
Conventional cruise control + radar sensors
Adjust speed to maintain a preset headway (min. 1 sec)

Cooperative ACC (CACC)
ACC systems + wireless data communications among vehicles
- Allows adoption of shorter gaps
- Potential to increase lane capacity
Driver Assistance Systems

Lane Capacity vs. CACC Market Penetration

With addition of “Here I Am” vehicles ("Vehicle Awareness Devices")

Lane Flow (vphl)
Driver Assistance Systems

Collision Warning (CW)

Available/Planned in Private Automobiles

Operational on Transit Systems

- Forward CW
  - Samtrans (San Mateo Bay Area)
- Rear Impact CW
  - Ann Arbor Transit
- Lane Change/Merge CW
  - Pittsburgh Transit
Driver Assistance Systems

Impairment Monitoring

Technology to monitor driving performance and physiological factors

Approaches:
- Ocular measures—image processing, eye-tracking
- Doppler radar illumination of face/body
- Head movement monitoring using capacitor plates
- Stereo image processing of eyes/face/head
- Lane-keeping and steering input patterns
Driver Assistance Systems

On-Board Monitoring for Commercial Vehicles developed for FMCSA

- Speed Selection
- Following Distance
- Attention (Inattention)
- Fatigue

Factors that may be influencing the recommended speed:

- HHDD Warning - Recommend 45 mph
- Speed Limit
- Recommended Speed

Factors influencing the recommended speed:

- Icy

EVT 2 s EVT 1 s

FD/FCW Looming icons from ACAS

Following Time-Gap

Influencing Factors

Icy

EVT 2 s EVT 1 s

Lane Departure Visual Warning
Direction Flashes at 2.5 Hz
Traveler Comfort and Convenience

In-Vehicle Navigation and Route Guidance Systems
- GPS-based
- Turn-by-turn directions
- May include real-time traffic information
- Additional Information (Parking, Yellow Pages)
- Autonomous or through subscription

Transit Fare Payment Systems
- Magnetic cards
- Smart cards for multiple transit lines/agencies
- Mobile phones
Traveler Comfort and Convenience

Electronic Toll Collection (ETC)
- Toll paid through transponders without stopping
- ETC increases toll lane capacity 4 times
- ETC transponders may operate across states/facilities
- ETC mandatory for congestion pricing implementation

Open Road Tolling (ORT): toll collection at highway speeds
- Higher capacity
- Improved safety
- Reduced fuel and emissions
Traveler Comfort and Convenience

Mobile applications for ride-share services
Traveler Comfort and Convenience

Carsharing

- Car availability without car ownership
- Designed for occasional car users
- Offered by private companies and car manufacturers through membership
- Extensive tech use (mobile applications) for operations

Benefits
- Reduction in auto ownership
- Increase in transit ridership
- Reduction in fuel consumption/emissions
Traveler Comfort and Convenience

Carsharing: North American Member Growth

- 2002: 16,007 members
- 2003: 32,647 members
- 2004: 62,348 members
- 2005: 73,590 members
- 2006: 118,656 members
- 2007: 211,170 members
- 2008: 318,898 members
- 2009: 377,597 members
- 2010: 516,100 members
- 2011: 639,428 members
- 2012: 907,834 members
Electrified Vehicles

Increasing interest in Electric Vehicles = 3.5% U.S. car sales
- Rising fuel costs
- Environmental concerns
- Improved Technology/Options for Electric Vehicles

Types/Options:
- Electric Vehicles (EVs)
  - Batteries
  - Zero emissions
  - Limited range
- Hybrid Electric Vehicles (HEVs)
- Plug-In Hybrids (PHEVs)
Personal Rapid Transit (PRT)

Concept: Alternative to Conventional Transit in Low Density Areas

- Small driverless vehicles (up to 15 passengers)
- Dedicated tracks/Off-line Stations
- High Capacity (2 seconds Headways)
- Point-to-Point Service/Passenger Comfort
- Limited Implementations

Morgantown PRT system, West Virginia. Courtesy of West Virginia University.
Personal Rapid Transit (PRT)

Recent Implementations
- ULTRA Heathrow airport
  (2.4 miles, 21 vehicles)

  ULTRA PRT system
  http://www.ultraglobalprt.com/

- 2getthere Abu Dhabi
  (1.1 mile, 13 vehicles)

  2getthere PRT system
  http://www.2getthere.eu

Source: Ultra Global PRT 2013
Personal Rapid Transit (PRT)

Recent/Planned Implementations
- Suncheon, South Korea
- Heathrow airport expansion

Feasibility Studies
- “Last Mile” solution for transit systems
- Major employment centers/business parks
- San Jose International Airport-ground access
Vehicles, Internet, Phone, and the Future

Cooperative Vehicle-Infrastructure Systems

Vehicle-to-vehicle (V2V)

- Communications
  - DSRC
  - Mobile Devices
- Applications
  - Active Safety Systems
    - Reduce crashes by 80%
  - Driver Alerts (Queue Warning)
Connected Vehicles—Queue Warning

- Bottleneck Traffic Queue Backup into mainline
- Limited Visibility Due to Roadway Geometry
- Auditory & Visual Alerts
- Alert Drivers Approaching Upstream

Vehicles, Internet, Phone, and the Future
Vehicles, Internet, Phone, and the Future

Cooperative Vehicle-Infrastructure Systems

Vehicle-to-Infrastructure (V2I)

- SPaT (Signal Phasing and Timing) Message
- Applications
  - Safety
  - Mobility
    - Improved traffic signal control
    - Dynamic route advisory
  - Environment
    - Speed advisory for minimum fuel/emissions
Vehicles, Internet, Phone, and the Future

Dynamic Speed Advisory (source: BMW)

V2I Example: SPaT message
Summary

Traveler Information
- Increased usage of mobile devices as data sources and information dissemination
- Multimodal applications

Driver Assistance Systems
- Several in-vehicle systems to improve safety

Emerging Applications
- Connected Vehicle (CV) technologies (V2V, V2I, I2V)
  - Prevent most accidents
  - Improved control, incident management, travel information
  - Effectiveness depends on penetration rates of CV vehicles
References

References (cont’d)

- Overview of PRT systems and links to PRT Web sites. Maintained by J. B. Schneider. 

- ITS JPO Connected vehicle initiative: 
  www.its.dot.gov/connected_vehicle/connected_vehicle.htm


Questions?

- What are the critical characteristics of traveler information systems?
- What are the impacts of multimodal information on mode choice?
- What are the benefits of carsharing?
- What are the key characteristics of PRT systems?
- What are the benefits of CV technology?