Bus Guidance Technology

Presented to the East Bay BRT Policy Steering Committee
May 21, 2010
What is Bus Guidance?

- Technology that automates or assists the operator in the steering, docking, acceleration and deceleration of the bus.

- There are two general types of guidance:
  - Mechanical
  - Electronic

- Further information - Wikipedia
Benefits of Bus Guidance

- Improved vehicular safety in traffic
- Better ride quality and improved passenger cabin safety
- May permit narrower dedicated bus lanes
- May reduce long-term pavement cost
- Aids level boarding and
- Creates narrow horizontal gap at boarding platform to comply with ADA
Bus Guidance Technology

- **Mechanical Guidance**
  - Kassel Kerb (England & throughout Europe)
  - Concrete Guideway w/ Guide wheel (Essen, Manheim, Adelaide)
  - Horizontal Guide wheel for Precision Docking (Cleveland, Eugene)
  - Subsurface guide rail (Nancy, France)

- **Electronic Guidance**
  - Optical Guidance (Rouen France, Las Vegas NV)
  - Magnetic Guidance (Netherlands)
  - Magnetic Guidance with Redundant Technologies (Lane County/AC Transit)
    - Magnetic Guidance
    - Differential GPS
    - Inertial Navigation System
Kassel Kerb

Used throughout Europe
Concrete Guideway (O-Bahn)
Essen, Germany & Adelaide
Australia
Guide wheels for Precision Docking
Subsurface Guide Rail
Nancy, France
Electronic Guidance
Visual Detection

- Siemens-Systra
  (Rouen France, Las Vegas NV)
- Uses optical sensors to follow painted lines
Magnetic Guidance

- Phileas Bus, Eindhoven, Netherlands
What options are possible for BRT?

- Guide wheel for precision docking with no mechanical guidance along bus lanes
- Magnetic Guidance
Current Research

- California-Oregon Vehicle Assistance & Automation (VAA) Team
  - USDOT Federal Transit Administration and Research and Innovation Administration
  - Caltrans
  - AC Transit
  - Lane Transit District (Eugene-Springfield)
  - Partners for Advanced Transit and Highways (PATH)
  - Local Bay Area Industrial partners
    - ContainerTrac
    - Integrated Motion Inc.
    - Bob McGee's Machine Co.
  - International interest
California-Oregon VAA Project

- **2003 - Automated Bus demonstration**
  - Three-bus platoon with fully automated functions

- **2005 - ITS World Congress, San Francisco**
  - Demonstration of Lane Assist and Precision Docking Systems
California-Oregon VAA Project (cont.)

2008 - Field Tests and Demonstration, East 14th Street, San Leandro

- First real world test
  - urban setting, uneven street crowns, potholes and obstacles, mixed with city traffic
- Test demonstrated system’s accuracy and reliability
  - 1/4 inch tolerance
- Lessons learned will benefit future development and future deployment
- Demonstrated strong inter-agency partnerships
- Positive response from transit agencies
Current Research Activities

- **2009-2011 Revenue Service Test**
  - Sponsored by the Federal Transit Administration’s Intelligent Transportation Systems Joint Program Office

- **California/Oregon team selected magnetic guidance as the primary guidance technology based on thorough evaluation and technical merits**

- **Project Goals**
  - Demonstrate the technical merits and feasibility of VAA technology in revenue service
  - Assess benefits and costs
  - Evaluate attitudes of passengers and operators

- **Budget**
  - $1.9 million in federal funds + $500k California cost share
Research Project Purpose

- Address deployment issues
- Assess benefits and costs in revenue-service operations
- Document public perceptions

Full range of VAA applications for BRT
- Highway and urban BRT application
- Precision docking and guidance
- Very low to highway speeds (65 mph)
- Degrees of driver assistance
VAA Project Description

- LTD, Eugene Oregon
  - 2.5 miles of single/double dedicated ROW
  - One 60ft New Flyer BRT bus
  - Functions to be tested:
    - Lane guidance for on dedicated BRT lane
    - Precision docking

- AC Transit
  - A 4 mile section of HOV lane, on the California State Route 92 freeway from Hesperian Blvd. to the Hayward-San Mateo Bridge toll plaza
  - Two buses
  - Functions to be tested:
    - Lane guidance on HOV lane
    - Guidance through toll bridge
Research Project Schedule

**Major Activities**

- System Design (3/10/2010)
- Component Development (4/15/2010)
- Bus Component Integration (9/1/2010)
- Software Development and Integration (11/25/2010)
- Track Preparation (9/30/2010)
- Performance test and Evaluation (3/15/2011)
- Operation Preparation (9/15/2011)
- Operational Test and Data Collection (9/30/2011)

**Independent evaluation to be conducted by Center for Urban Transportation Research – University of South Florida**
The Technology

- PATH System
  - Differential GPS + Inertial Navigation Systems + Magnets to steer bus
  - Redundancy to ensure performance & safety

Differential GPS Unit
Magnets in Pavement + Sensors on the Bus

- Minimally subject to interference
  - Missing magnets (detectable)
  - Unwanted magnets (detectable)
- Not compatible with heavily damaged asphalt
- Installation costs of $10-20k per lane mile
- No maintenance needed
Magnets in Pavement +
Sensors on the Bus
Steering Actuator Prototype
Fabrication & Bench Tests
Computer Processors
GPS/INS System
Prototype (for AC Transit)
Research Project Next Steps

- Complete Bench Testing
- Install equipment on PATH bus
- Test on closed track
- Transplant equipment onto AC Transit bus
- Test on closed track
- Test on SR 92 without passengers
- Test on SR 92 with passengers
- Complete evaluation