Bus Rapid Transit

Jennifer Flynn and Cheryl Thole
Senior Research Associates
Commuter Choice Workshop
January 2012
Tampa, FL
What is Bus Rapid Transit?

BRT is an enhanced bus system that operates on bus lanes or other transitways in order to combine the flexibility of buses with the efficiency of rail.

BRT operates at faster speeds, provides greater service reliability and increased customer convenience.

BRT uses a combination of advanced technologies, infrastructure and operational investments that provide significantly better service than traditional bus service.

Source: Federal Transit Administration
BRT Elements

Running Ways
Stations
Vehicles
Fare Collection
Intelligent Transportation Systems
Service and Operating Plans
Branding Elements

Integration of Elements
Running Ways

- Mixed traffic
- Arterial curb bus lanes
- Shoulder busways and bus lanes
- Arterial median busways
- Exclusive busways (can use railroad right-of-way)
Stations

- Spacing 0.25 – 2 miles depending on density
- Accommodations for waiting passengers
- Permanent, substantial, weather-protected
- Amenities and passenger information
- Safe and secure
- Convey identity and image
- Design integrated with surroundings
- Supportive of TOD
Stations

- Differentiated from other transit stations/stops
  - Can be multimodal
- Designated platform, possibly raised
- Access is important
- Facilitates quick boarding and exit
Stations

Rapid Bus - Oakland
Metro Rapid, Los Angeles, CA
Stations

Boston, MA
LYNX Lymmo – Orlando, FL
Stations

Kansas City MAX
Stations

Metro Orange Line, Los Angeles, CA
Cleveland Health Line

Stations
Stations

Curitiba, Brazil
Stations

Ottawa
Stations

Brisbane, Australia
Vehicles

- Conventional or special BRT vehicles
- May be guided mechanically or electronically
- Variety of sizes
- Multiple wide doors
- High or low floor
- Environmentally-friendly (air quality, noise)
- Key element for conveying image and identity
Fare Collection

- Fast, efficient so as to speed boarding
- Simple to understand
- Minimal on-vehicle transactions
- Cashless
  - Smart cards (multi-use)
  - Pre-purchased tickets
  - Passes
- Proof of payment
  - Enter station
• Automated vehicle location
  – real-time information
  – next vehicle
  – stop announcements
• Precision docking
• Signal priority/preemption
  – reduce vehicle bunching
  – consistent wait times
  – on-time performance
• Surveillance & security
  – at stations, on vehicles
Service and Operating Plans

- More direct than local service
  - Anchored by major activity centers
- Major corridors
  - Feeder routes
  - Operate in low-density residential
- Flexible
  - Effect on Land use
  - No map
Branding is important for individuals to recognize the system.

- Consistent and unique graphics.
- Image branding and frequent, reliable service results in higher ridership.
- Creates a positive customer experience.
Los Angeles Orange Line

• Began Oct. 2005
• $350M, $25M per mile
• 14 mile busway
• 4-5 minute headways
• Projected ridership: 7,500 per day
• Actual: 23,900 per day (Oct 2010)
Cleveland Health Line

- Began Aug. 2008
- $200M, $28.5M per mile
- 7 miles (4.4 miles bus lanes)
- 5 minute headways
- Ridership: 12,300 per day
- 60% increase over old Route 6
Kansas City MAX

- Began July 2005
- $21M, $3.5M per mile
- 6 miles (3.75 miles bus lanes)
- 10 minute headways
- Ridership: 4,400 per day
- Ridership doubled over previous service
Eugene EmX

- Began Jan. 2007
- $25M, $6.25M per mile
- 4 miles (2.6 miles bus lanes)
- 10 minute headways
- Ridership: 4,700 per day
- 74% increase over old Route 11
• Began March 2010
• $54M, $6M per mile
• 9 miles (2.25 miles bus lanes)
• 15 minute headways
• Ridership: 14,000 per day
York VIVA

- Opened in stages
  - Sep. 05 to Jan. 06
- $150M, $2.7M per mile
- 55 miles collectively
- 70+ stations
- 15 minute headways
- Ridership: 10,000 per day
BRT Network
- Viva Blue
- Viva Purple
- Viva Orange
- Viva Pink
- Viva Green
BRT System Performance

- Travel Time
- Reliability
- Image and Identity
- Passenger Safety and Security
- System Capacity
- Accessibility
Travel Time

• In LA (Metro Rapid), signal priority and low floor vehicles aided in a:
  – 28 to 33% decrease in travel time
  – No appreciable impact on cross–street traffic

• In Eugene, over 80% of riders perceived travel time on the EmX to be faster
  – Due to travel time, decreased signal delay, shortened dwell time
Reliability

• In LA (Orange Line), respondents who made the same trip by any mode prior to the opening of the Orange Line, 85 percent reported a reduction in travel time by switching to the Orange Line

• In Eugene, customers increased ratings of ridership along the Franklin corridor
BRT System Benefits

- Higher Ridership
- Capital Cost Effectiveness
- Operating Cost Efficiency
- Transit Supportive Development
- Environmental Quality
Increased Ridership

Net Corridor Ridership Gains with BRT

- LA (Orange Line)
- Boston Silver Line (Washington Street)
- Eugene
- Kansas City
- Las Vegas
- Pittsburgh (West Busway)
- Cleveland
# Improved Capital Cost Effectiveness

<table>
<thead>
<tr>
<th><strong>Mode</strong></th>
<th><strong>Length (Miles)</strong></th>
<th><strong>Capital Cost (millions of US$) per Mile</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Boston Silver Line Phase 1 - Washington St</strong></td>
<td>BRT (surface)</td>
<td>$11.90</td>
</tr>
<tr>
<td><strong>Boston Silver Line Phase 2 - Waterfront</strong></td>
<td>BRT (surface and underground)</td>
<td>$137.00</td>
</tr>
<tr>
<td><strong>Los Angeles Orange Line</strong></td>
<td>BRT (exclusive Row)</td>
<td>$21.93</td>
</tr>
<tr>
<td><strong>Eugene EmX</strong></td>
<td>BRT (mixed flow)</td>
<td>$6.25</td>
</tr>
<tr>
<td><strong>Las Vegas Max</strong></td>
<td>BRT (exclusive Row)</td>
<td>$2.60</td>
</tr>
<tr>
<td><strong>Salt Lake North South Corridor</strong></td>
<td>LRT (surface)</td>
<td>$26.50</td>
</tr>
<tr>
<td><strong>Minneapolis Hiawatha Corridor</strong></td>
<td>LRT (surface 1.5 mile tunnel)</td>
<td>$52.80</td>
</tr>
<tr>
<td><strong>Los Angeles Gold Line</strong></td>
<td>LRT (surface)</td>
<td>$62.70</td>
</tr>
<tr>
<td><strong>Washington (WMATA) Entire Metrorail System</strong></td>
<td>HRT</td>
<td>$145.50</td>
</tr>
<tr>
<td>Statistic</td>
<td>Rapid Transit Mode</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>--------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>BRT</strong></td>
<td><strong>LRT</strong></td>
</tr>
<tr>
<td>ROW Options</td>
<td>Exclusive or Mixed Traffic</td>
<td>Exclusive or Mixed Traffic</td>
</tr>
<tr>
<td>Station Spacing</td>
<td>1/4 to 1 Mile</td>
<td>1/4 to 1 Mile</td>
</tr>
<tr>
<td>Vehicle Seated Capacity</td>
<td>40 to 85 Passengers</td>
<td>65 to 85 Passengers</td>
</tr>
<tr>
<td>Average Speed</td>
<td>15-30 mph</td>
<td>15-30 mph</td>
</tr>
<tr>
<td>P/H/D (exclusive ROW)</td>
<td>Up to 30,000</td>
<td>Up to 30,000</td>
</tr>
<tr>
<td>P/H/D (arterial)</td>
<td>Up to 10,000</td>
<td>Up to 10,000</td>
</tr>
<tr>
<td>Capital ROW Cost/Mile</td>
<td>$0.2M to $25M/Mile</td>
<td>$20M to $55M/Mile</td>
</tr>
<tr>
<td>Capital Cost/Vehicle</td>
<td>$0.45M to $1.5M</td>
<td>$1.5M to $3.5M</td>
</tr>
<tr>
<td>O&amp;M/SH</td>
<td>$65 to $100</td>
<td>$150 to $200</td>
</tr>
</tbody>
</table>

## BRT Land Development Benefits

<table>
<thead>
<tr>
<th>City</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pittsburgh</td>
<td>$500M in development around stations</td>
</tr>
<tr>
<td>Ottawa</td>
<td>$700M in development around stations 13 years after opening of first segment</td>
</tr>
<tr>
<td>Boston</td>
<td>$650M in development occurred along the Washington Street Corridor</td>
</tr>
<tr>
<td>Cleveland</td>
<td>$4.3 Billion in development occurring along the Euclid Corridor</td>
</tr>
<tr>
<td>Brisbane</td>
<td>+ 20% gain in residential values near stations after one year, initiation of several joint development projects</td>
</tr>
</tbody>
</table>
Urban Integration and Livability

• BRT projects designed with local context in mind
  – Create a sense of place
  – Scale and character of the community
  – Quality of life for whole community
• Channel a wide spectrum of benefits
  – Economy
  – Aesthetics
  – Public health
  – Community development
• Design focus:
  – Context
  – Livability
  – Accessibility
Environmental Quality

- BRT can improve environmental quality by decreasing VMT
  - Attracting choice riders
  - Supporting land development along corridors
- Newer technologies for vehicle propulsion has an impact as well
A-01. Assessment

These questions are designed to assess the extent of your involvement with BRT.

*What is the name of your transit agency?

*Please choose your agency's the level of involvement with BRT.

- [ ] Not currently planning BRT
- [ ] Early planning stages (conceptual)
- [ ] Currently planning BRT
- [ ] Currently implementing BRT
- [ ] Currently operating BRT
• APTA database
• Operating (approx. 25%), planning/implementing (approx. 25%), no plans
• Vehicles
  – Type, length, capacity
• Stations
  – Spacing, amenities, elements, near/far side
• Corridor Characteristics
  – Length
BRT Survey

- Running Way
  - Types
- Staff
  - Addition of new staff
- Operations
  - Travel speeds, headways
- Ridership
- Fare Collection
  - Off board, fare box, TVMs
- Marketing
- Capital Costs
# BRT Survey

## Currently Operating

<table>
<thead>
<tr>
<th>Agency</th>
<th>Route</th>
<th>State</th>
<th>Total Length (Miles)</th>
<th>Number of stations</th>
<th>Number of BRT Buses</th>
<th>Bus Manufacturer Type</th>
<th>Propulsion System</th>
<th>AM Peak Headway</th>
<th>AM Off Peak Headway</th>
<th>PM Peak Headway</th>
<th>PM Off Peak Headway</th>
<th>Average Operational Speed (MPH)</th>
<th>Average Weekday Ridership</th>
<th>Intelligent Transportation System Technologies</th>
<th>Fare Payment Method</th>
<th>Total Capital Cost of Project (Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community Transit</td>
<td>Swift BRT - SR 99</td>
<td>WA</td>
<td>16.7</td>
<td>29</td>
<td>15</td>
<td>New Flyer</td>
<td>Hybrid Electric</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>15</td>
<td>24</td>
<td>4300</td>
<td>AVL, APC, real time information (stations, vehicles, internet), Cameras (Vehicles, stations), TSP, smart card techniques</td>
<td>Proof of payment, ticket vending machine, other</td>
<td>$30</td>
</tr>
<tr>
<td>City of Albuquerque</td>
<td>The Red Line (Central Avenue)</td>
<td>NM</td>
<td>11</td>
<td>N/A</td>
<td>N/A</td>
<td>Hybrid Electric</td>
<td>Hybrid Electric</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>N/A</td>
<td>5100</td>
<td>AVL, APC, real time information (stops, bus, internet), TSP.</td>
<td>On board fare box, other</td>
<td>N/A</td>
</tr>
<tr>
<td>Foothill Transit</td>
<td>Silver Streak (El Monte Busway)</td>
<td>CA</td>
<td>40</td>
<td>20</td>
<td>N/A</td>
<td>Hybrid Electric</td>
<td>CNG</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>20</td>
<td>N/A</td>
<td>4700</td>
<td>AVL, APC, real time information (Bus), TSP.</td>
<td>On board fare box, proof of payment</td>
<td>$28</td>
</tr>
<tr>
<td>Greater Cleveland Regional Transit Authority</td>
<td>Healthline (Euclid Corridor)</td>
<td>OH</td>
<td>9.38</td>
<td>58</td>
<td>N/A</td>
<td>Hybrid Electric</td>
<td>Hybrid Electric</td>
<td>5</td>
<td>5</td>
<td>15</td>
<td>15</td>
<td>N/A</td>
<td>10500</td>
<td>AVL, APC, real time information (stops, bus, cameras (Vehicles), TSP, Smart card techniques, Vehicles guidance and control</td>
<td>Proof of payment, ticket vending machine</td>
<td>$200</td>
</tr>
<tr>
<td>Honolulu, Hawaii</td>
<td>Route B – City Express!</td>
<td>HI</td>
<td>8</td>
<td>41</td>
<td>N/A</td>
<td>Hybrid Electric</td>
<td>Hybrid Electric</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>N/A</td>
<td>6300</td>
<td>AVL, Real time information (Vehicles).</td>
<td>On board fare box</td>
<td>N/A</td>
</tr>
<tr>
<td>Honolulu, Hawaii</td>
<td>Route A – City Express!</td>
<td>HI</td>
<td>19</td>
<td>N/A</td>
<td>N/A</td>
<td>Hybrid Electric</td>
<td>Hybrid Electric</td>
<td>15</td>
<td>15</td>
<td>30</td>
<td>30</td>
<td>N/A</td>
<td>9000</td>
<td>AVL, Real time information (Vehicles).</td>
<td>On board fare box</td>
<td>N/A</td>
</tr>
<tr>
<td>Honolulu, Hawaii</td>
<td>Route C – County Express</td>
<td>HI</td>
<td>39</td>
<td>50</td>
<td>N/A</td>
<td>Hybrid Electric</td>
<td>Hybrid Electric</td>
<td>10</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td>N/A</td>
<td>4000</td>
<td>AVL, Real time information (Vehicles).</td>
<td>On board fare box</td>
<td>N/A</td>
</tr>
<tr>
<td>Kansas City Area Transportation Authority</td>
<td>Max Main</td>
<td>MO</td>
<td>6</td>
<td>47</td>
<td>14</td>
<td>Gillig</td>
<td>Gasoline</td>
<td>10</td>
<td>10</td>
<td>30</td>
<td>N/A</td>
<td>N/A</td>
<td>4800</td>
<td>AVL, Real time information (Internet), Cameras (Vehicles), Smart card techniques</td>
<td>On board fare box</td>
<td>$23</td>
</tr>
<tr>
<td>King County Metro Transit</td>
<td>RapidRide - A Line</td>
<td>WA</td>
<td>11</td>
<td>51</td>
<td>16</td>
<td>New Flyer</td>
<td>Hybrid Electric</td>
<td>10</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td>4.1</td>
<td>N/A</td>
<td>AVL, APC, real time information (Stops), cameras (Vehicles), TSP, smart card collection techniques</td>
<td>On board fare box, proof of payment, other</td>
<td>$262</td>
</tr>
<tr>
<td>Lane Transit District</td>
<td>Franklin EmX</td>
<td>OR</td>
<td>4</td>
<td>10</td>
<td>4</td>
<td>New Flyer</td>
<td>Hybrid Electric</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>17</td>
<td>6000</td>
<td>AVL, APC, cameras (Vehicles), TSP.</td>
<td>N/A</td>
<td>$22</td>
</tr>
<tr>
<td>Lane Transit District</td>
<td>EmX Springfield Gateway</td>
<td>OR</td>
<td>7.8</td>
<td>15</td>
<td>N/A</td>
<td>Hybrid Electric</td>
<td>Hybrid Electric</td>
<td>10</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td>N/A</td>
<td>N/A</td>
<td>AVL, APC, cameras (Vehicles), TSP.</td>
<td>On board fare box</td>
<td>$41.30</td>
</tr>
<tr>
<td>Livermore Amador Valley Transit Authority (WHEELS)</td>
<td>The Rapid</td>
<td>CA</td>
<td>16</td>
<td>50</td>
<td>14</td>
<td>Gillig</td>
<td>Hybrid Electric</td>
<td>10</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td>N/A</td>
<td>N/A</td>
<td>AVL, APC, real time information (Stops, internet), cameras (Vehicles), TSP, smart card techniques</td>
<td>On board fare box</td>
<td>$21</td>
</tr>
</tbody>
</table>
• Collect BRT information in an easy format
• Develop a consistent framework for assessing system performance of BRT components
• Empower planners with tools to make investment decisions that best respond to local needs
• Fully incorporate BRT into the larger context of transit system planning
• First Published in August 2004, updated 2009
Thank you for your attention

Cheryl Thole
Senior Research Associate
thole@cutr.usf.edu
Tel: +1-813-974-9920

Jennifer Flynn
Research Associate
flynn@cutr.usf.edu
Tel: +1-813-974-6529

National Bus Rapid Transit Institute
www.nbrti.org

Center for Urban Transportation Research
www.cutr.usf.edu

University of South Florida
Tampa, Florida, USA