Bus Rapid Transit Study

County Council Briefing
May 3, 2011
Presentation Overview

- Purpose of the Study
- What is BRT?
- Project Scope of Work
- Technical Analysis
- Results

EmX median busway (Eugene, OR)
Purpose of the Study

• Test the feasibility of a network system of BRT routes providing access to county activity centers within the existing right of way
What is Bus Rapid Transit (BRT)?

**BRT** is based on *rapid transit principles*. It combines the most attractive features of light rail with the lower costs of bus technology.

Instead of trains and tracks, **BRT** invests in improvements to roadways, rights-of-way, intersections, and traffic signals to speed up bus transit service.
Major BRT Elements in this Study

- Stylish Vehicles
- Attractive Stations
- Guideways and Rights of Way
- Faster Fare Collection
- Intelligent Transportation Systems
- Operations
- Land Use

Cleveland HealthLine (GCRTA)

Transit signal priority (TCRP Synthesis 83)

Arterial Bus Lane Albany NY 5 (CDTA, New York)
**BRT Elements**

**Stylish Vehicles**
- Easy, low-floor boarding
- Comfortable interiors
- Modern and sleek design
- Multiple wide doors

**Attractive Stations**
- Comfortable
- Attractive
- Accessible and Welcoming

MAX BRT vehicle with multi-door level boarding (Las Vegas, NV)

MetroRapid station (Los Angeles, CA)
BRT Elements (continued)

Guideways and rights-of-way

• Separating BRT vehicles from other traffic increases speed and reliability.
• Several options
  – Exclusive bus ways
  – Bus only lanes
  – Mixed flow lanes with queue jumpers
• Assume guideways constructed within right-of-way, except at intersections

Rendering of Silver Line BRT in bus-only lane (Boston, MA)
Guided busway (Leeds, London)
Intelligent Transportation Systems

- **Real time information**
  - At stations, via cell phone/PDA, or on internet
  - Provide next bus arrival, delay, trip planning information

*RAPID BRT information display (Phoenix, AZ)*

*Cleveland Healthline vending machines*

*Metro SmarTrip fare pass*
BRT Elements (continued)

Intelligent Transportation Systems

• Increase service reliability
  – Transit signal priority
    ▪ Applied to roadway LOS C or D
    ▪ Not signal pre-emption
  – Queue jumps
    ▪ Applied at existing right-turn only lanes
    ▪ Through- and right-turning traffic volumes would not hinder queue jump
• TSP preferable to queue jumps in study
Intelligent Transportation Systems – transit signal priority

Bus detection concept (TCRP Synthesis 83)
BRT Elements (continued)

Intelligent Transportation Systems – queue jumps

[Diagram images of traffic control systems for bus stops]
BRT Elements (continued)

Queue Jump Example
BRT Elements (continued)

Operations
• Fewer stops/one-seat ride
• Frequent service throughout most of the day
• Easy to understand routes
• Intermodal connections
• Works in concert with local bus service

Land use
• Serving developments with at least:
  – 6 households per acre
  – 5 employees per acre
• Includes all approved master plans
Other Elements to Consider

Land Use

- Coordinate transit-supportive land uses with BRT stations to create transit-friendly environments

Station Access

- Depending on station location, customers can walk, bike, take a shuttle bus, or drive/park-and-ride

Service Branding

- Different than typical local bus service
- BRT is a new service with a new image

Cleveland, OH

Phoenix, AZ
Project Scope Summary

- Screen all County roadways for potential BRT corridors
- Conduct planning-level corridor analyses to determine potential BRT treatments
- Determine travel demand and identify routes for network
- Determine capital and O&M costs for BRT network

Reversible median busway (Eugene, OR)
Study Methodology

- All county roadways
- Roads from BRT system concept
  - Roads from PCN corridors

High-level Roadway Screening

Corridor Development and Initial Corridor Screening

Field Review

Screened BRT corridors

Operating statistics

Demand Modeling/Policy Area Analysis

Refined Route Assessment

Proposed BRT Network
  - 16 routes, 150 miles

Define BRT Routes and Station Locations

Capital/O&M Costs
The Proposed Network
16 Corridors, 150 Miles

Montgomery County BRT Study

Current Proposed Routes
- MD 586/Veirs Mill Road
- Georgia Avenue (South)
- Muddy Branch/Lakeforest Mall
- MD 355 North
- MD 355/Connecticut Avenue
- MD 355 South
- Montgomery Mall/Old Georgetown Road
- University Boulevard
- US 29/Columbia Pike/Colesville Road
- North Bethesda Transitway
- Purple Line
- Corridor Cities Transitway

LRT Options

* - No treatments recommended on highway facility
April 2011
## The Proposed Network

<table>
<thead>
<tr>
<th>Route</th>
<th>From</th>
<th>To</th>
<th>Route Length (miles)</th>
<th>Number of Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD 586/Veirs Mill Road</td>
<td>Rockville Metrorail Station</td>
<td>Wheaton Metrorail Station</td>
<td>6.7</td>
<td>11</td>
</tr>
<tr>
<td>Georgia Avenue North</td>
<td>Montgomery General Hospital</td>
<td>Wheaton Metrorail Station</td>
<td>9.8</td>
<td>12</td>
</tr>
<tr>
<td>Georgia Avenue South</td>
<td>Wheaton Metrorail Station</td>
<td>Silver Spring Transit Center</td>
<td>3.9</td>
<td>6</td>
</tr>
<tr>
<td>Rockville Metrorail-Life Sciences Center</td>
<td>Life Sciences Center</td>
<td>Rockville Metrorail Station</td>
<td>5.3</td>
<td>7</td>
</tr>
<tr>
<td>MD 124/Muddy Branch Road</td>
<td>Lakeforest Mall</td>
<td>Life Sciences Center</td>
<td>7.2</td>
<td>10</td>
</tr>
<tr>
<td>MD 185/Connecticut Avenue</td>
<td>Georgia Avenue and Bel Pre Road</td>
<td>Medical Center Metrorail Station</td>
<td>9.5</td>
<td>10</td>
</tr>
<tr>
<td>MD 355 North</td>
<td>MD 355 and Stringtown Road</td>
<td>Rockville Metrorail Station</td>
<td>14.6</td>
<td>16</td>
</tr>
<tr>
<td>MD 355 South</td>
<td>Rockville Metrorail Station</td>
<td>Bethesda Metrorail Station</td>
<td>8.8</td>
<td>13</td>
</tr>
<tr>
<td>MD 650/New Hampshire Avenue</td>
<td>White Oak Transit Center</td>
<td>Fort Totten Metrorail Station</td>
<td>8.8</td>
<td>9</td>
</tr>
<tr>
<td>Montgomery Mall/Old Georgetown Road</td>
<td>Montgomery Mall Transit Center</td>
<td>Bethesda Metrorail Station</td>
<td>6.9</td>
<td>9</td>
</tr>
<tr>
<td>Randolph Road</td>
<td>White Flint Metrorail Station</td>
<td>Glenmont Metrorail Station</td>
<td>5.5</td>
<td>7</td>
</tr>
<tr>
<td>MD 193/University Boulevard</td>
<td>Wheaton Metrorail Station</td>
<td>Takoma/Langley Park Transit Center</td>
<td>6.4</td>
<td>9</td>
</tr>
<tr>
<td>US 29/Columbia Pike/Colesville Road</td>
<td>Burtonsville Park-and-Ride Lot</td>
<td>Silver Spring Transit Center</td>
<td>13.5</td>
<td>11</td>
</tr>
<tr>
<td>ICC</td>
<td>Life Sciences Center</td>
<td>Briggs Chaney Park-and-Ride lot</td>
<td>22.9</td>
<td>3</td>
</tr>
<tr>
<td>North Bethesda Transitway</td>
<td>Montgomery Mall Transit Center</td>
<td>Grosvenor Metrorail Station</td>
<td>5.1</td>
<td>7</td>
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<tr>
<td>Midcounty Highway</td>
<td>Snowden Farm Parkway and Stringtown Road</td>
<td>Shady Grove Metrorail Station</td>
<td>13.4</td>
<td>10</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>148.3</strong></td>
<td><strong>150</strong></td>
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</table>
**Project Assumptions**

- Operate in existing rights-of-way
- High-capacity articulated BRT vehicles
- Dedicated lanes where possible
- Traffic signal improvements where possible
- Queue jump lanes in areas where TSP is not feasible
- Off-board fare collection
- Real-time passenger information at major stations
- Stations approximately every 1/2-mile to mile, terminating at major activity centers or at other premium transit stations
- Minimum density thresholds assumed for BRT system
Basis for Forecasting Ridership

- 2040 horizon year
  - “No-build” conditions
    - Projects in the MWCOG constrained long-range plan
    - Purple Line and Corridor Cities Transitway in operation as light rail
    - Round 8.0 land-use forecast (MNCPPC – MWCOG)
  - Use MDAA II model (Phase 2 model)
    - Rider survey-based model
    - Specific application for transit
    - FTA Accepted for Purple Line and CCT

- 2020 model run
  - Tested land-use implications against 2040 conditions
- Assumes baseline auto/transit costs for travel
All results compared to 2040 No-build

- 85,000+ increase in daily transit trips
- 210,000 to 270,000 daily BRT boardings
- Majority of corridors with over 1,000 daily boardings per mile
- Average of 24% improvement over modeled local bus speeds
- O&M costs for Ride On and Metrobus decrease by 14% and 3%, respectively
- BRT network reduces Ride On and Metrobus boardings, permitting redeployment of resources
## Ridership: Daily and By Route Mile – Preliminary Results

<table>
<thead>
<tr>
<th>Route Name</th>
<th>Daily Boardings</th>
<th>Daily Boardings/Route Mile</th>
<th>Required Peak Headway</th>
<th>% of 2040 Achieved w/ 2020 LU</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD 355 South</td>
<td>28,200 - 35,300</td>
<td>3,600 - 4,500</td>
<td>2.8 - 2.3</td>
<td>72%</td>
</tr>
<tr>
<td>Randolph Road</td>
<td>16,000 - 20,000</td>
<td>3,500 - 4,400</td>
<td>3.9 - 3.2</td>
<td>82%</td>
</tr>
<tr>
<td>MD 97/Georgia Avenue South</td>
<td>10,500 - 13,100</td>
<td>3,000 - 3,800</td>
<td>3.0 - 2.5</td>
<td>92%</td>
</tr>
<tr>
<td>MD 355 North</td>
<td>37,600 - 47,000</td>
<td>2,700 - 3,400</td>
<td>2.4 - 2.0</td>
<td>72%</td>
</tr>
<tr>
<td>North Bethesda Transitway</td>
<td>8,200 - 10,200</td>
<td>2,700 - 3,400</td>
<td>4.6 - 3.8</td>
<td>80%</td>
</tr>
<tr>
<td>MD 193/University Boulevard</td>
<td>14,600 - 18,300</td>
<td>2,300 - 2,900</td>
<td>2.9 - 2.5</td>
<td>84%</td>
</tr>
<tr>
<td>Rockville Metro-LSC</td>
<td>10,000 - 12,500</td>
<td>2,100 - 2,600</td>
<td>5.9 - 4.9</td>
<td>77%</td>
</tr>
<tr>
<td>MD 586/Veirs Mill Road</td>
<td>12,700 - 15,900</td>
<td>2,000 - 2,500</td>
<td>6.1 - 5.1</td>
<td>84%</td>
</tr>
<tr>
<td>Lakeforest Mall/Muddy Branch Road</td>
<td>9,400 - 11,700</td>
<td>1,600 - 2,000</td>
<td>6.5 - 5.4</td>
<td>73%</td>
</tr>
<tr>
<td>MD 187/Old Georgetown Road</td>
<td>7,700 - 9,600</td>
<td>1,500 - 1,900</td>
<td>7.0 - 5.8</td>
<td>95%</td>
</tr>
<tr>
<td>MD 97/Georgia Avenue North</td>
<td>14,700 - 18,400</td>
<td>1,500 - 1,900</td>
<td>3.1 - 2.6</td>
<td>88%</td>
</tr>
<tr>
<td>MD 650/New Hampshire Avenue</td>
<td>10,600 - 13,200</td>
<td>1,400 - 1,800</td>
<td>5.2 - 4.3</td>
<td>81%</td>
</tr>
<tr>
<td>US 29</td>
<td>14,700 - 18,400</td>
<td>1,200 - 1,500</td>
<td>3.1 - 2.6</td>
<td>92%</td>
</tr>
<tr>
<td>MD 185/Connecticut Avenue</td>
<td>6,600 - 8,300</td>
<td>800 - 1,000</td>
<td>5.7 - 4.7</td>
<td>94%</td>
</tr>
<tr>
<td>Mid-County</td>
<td>6,700 - 8,400</td>
<td>600 - 700</td>
<td>6.8 - 5.7</td>
<td>83%</td>
</tr>
<tr>
<td>ICC</td>
<td>4,900 - 6,100</td>
<td>200 - 300</td>
<td>8.1 - 6.8</td>
<td>44%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>213,100 - 266,400</strong></td>
<td><strong>1,600 - 2,000</strong></td>
<td></td>
<td><strong>80%</strong></td>
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</table>
## Operations Cost and Farebox Recovery – Preliminary Results

<table>
<thead>
<tr>
<th>Route Name</th>
<th>Annual O&amp;M Cost</th>
<th>Farebox Revenue</th>
<th>O&amp;M Cost/Boarding</th>
<th>Farebox Recovery Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Randolph Road</td>
<td>$5,480,000 - $6,576,000</td>
<td>$4,759,894 - $4,569,499</td>
<td>$0.92 - $1.11</td>
<td>87% - 69%</td>
</tr>
<tr>
<td>MD 586/Veirs Mill Road</td>
<td>$4,855,000 - $5,826,000</td>
<td>$3,779,355 - $3,628,181</td>
<td>$1.03 - $1.23</td>
<td>78% - 62%</td>
</tr>
<tr>
<td>Rockville Metro-LSC</td>
<td>$4,580,000 - $5,496,000</td>
<td>$2,972,133 - $2,853,247</td>
<td>$1.23 - $1.48</td>
<td>65% - 52%</td>
</tr>
<tr>
<td>North Bethesda Transitway</td>
<td>$3,827,000 - $4,592,400</td>
<td>$2,433,826 - $2,336,473</td>
<td>$1.26 - $1.51</td>
<td>64% - 51%</td>
</tr>
<tr>
<td>MD 193/University Boulevard</td>
<td>$7,574,000 - $9,088,800</td>
<td>$4,358,906 - $4,184,549</td>
<td>$1.39 - $1.67</td>
<td>58% - 46%</td>
</tr>
<tr>
<td>MD 187/Old Georgetown Road</td>
<td>$4,064,000 - $4,876,800</td>
<td>$2,294,123 - $2,202,358</td>
<td>$1.42 - $1.70</td>
<td>56% - 45%</td>
</tr>
<tr>
<td>MD 355 South</td>
<td>$16,152,000 - $19,382,400</td>
<td>$8,404,554 - $8,068,371</td>
<td>$1.54 - $1.84</td>
<td>52% - 42%</td>
</tr>
<tr>
<td>MD 97/Georgia Avenue South</td>
<td>$6,497,000 - $7,796,400</td>
<td>$3,133,053 - $3,007,731</td>
<td>$1.66 - $1.99</td>
<td>48% - 39%</td>
</tr>
<tr>
<td>Lakeforest Mall/Muddy Branch Rd</td>
<td>$5,845,000 - $7,014,000</td>
<td>$2,799,293 - $2,687,321</td>
<td>$1.67 - $2.00</td>
<td>48% - 38%</td>
</tr>
<tr>
<td>MD 355 North</td>
<td>$26,657,000 - $31,988,400</td>
<td>$11,199,794 - $10,751,802</td>
<td>$1.90 - $2.28</td>
<td>42% - 34%</td>
</tr>
<tr>
<td>MD 97/Georgia Avenue North</td>
<td>$11,747,000 - $14,096,400</td>
<td>$4,391,566 - $4,215,904</td>
<td>$2.14 - $2.57</td>
<td>37% - 30%</td>
</tr>
<tr>
<td>MD 650/New Hampshire Avenue</td>
<td>$8,495,000 - $10,194,000</td>
<td>$3,155,462 - $3,029,244</td>
<td>$2.15 - $2.58</td>
<td>37% - 30%</td>
</tr>
<tr>
<td>MD 185/Connecticut Avenue</td>
<td>$6,836,000 - $8,203,200</td>
<td>$1,974,190 - $1,895,223</td>
<td>$2.77 - $3.32</td>
<td>29% - 23%</td>
</tr>
<tr>
<td>US 29</td>
<td>$15,735,000 - $18,882,000</td>
<td>$4,385,845 - $4,210,411</td>
<td>$2.87 - $3.44</td>
<td>28% - 22%</td>
</tr>
<tr>
<td>Mid-County</td>
<td>$7,922,000 - $9,506,400</td>
<td>$2,010,904 - $1,930,468</td>
<td>$3.15 - $3.78</td>
<td>25% - 20%</td>
</tr>
<tr>
<td>ICC</td>
<td>$8,230,000 - $9,876,000</td>
<td>$1,447,565 - $1,389,662</td>
<td>$4.55 - $5.46</td>
<td>18% - 14%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$144,496,000 - $173,395,200</strong></td>
<td><strong>$63,500,000 - $60,960,000</strong></td>
<td></td>
<td><strong>44% - 35%</strong></td>
</tr>
</tbody>
</table>
Other Findings – Preliminary

- BRT system requires additional bus maintenance facilities and the modification of existing facilities to service articulated vehicles
- Requires approximately 430 buses to accommodate passenger demand
- Will require redeployment of Ride On and Metrobus fleets
Capital Costs – Preliminary

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Busway and Exclusive Lane Treatments</td>
<td>- includes 105 route miles of treatments</td>
</tr>
<tr>
<td>Intersection Treatments</td>
<td>- includes 175 intersections with TSP, 26 intersections with queue jumps, and 255 intersection widening treatments</td>
</tr>
<tr>
<td>Stations and Concrete Pads</td>
<td>- includes ticket vending, passenger information, and other station amenities (bike parking, etc.) at 150 locations; concrete pads for curb-lane stations only</td>
</tr>
<tr>
<td>430 Articulated Buses</td>
<td></td>
</tr>
<tr>
<td>Maintenance Facilities</td>
<td>- based on average cost per articulated bus</td>
</tr>
<tr>
<td>Add-ins</td>
<td>-25% of costs of lane treatments, intersection treatments, stations, and maintenance facility. Include PE, final design, construction management, insurance, and startup costs</td>
</tr>
<tr>
<td>40 % contingency for BRT treatments, stations, and maintenance facilities</td>
<td></td>
</tr>
<tr>
<td>Estimated System Cost*</td>
<td>$2.5 billion</td>
</tr>
</tbody>
</table>

* Excludes costs such as right-of-way, utility relocation, and stormwater management
Questions and Answers
Route 3: Veirs Mills Road
Route 3: Veirs Mill Road

Montgomery County BRT Study

Transitway and Intersection Options
Route 3 - MD 586/Veirs Mill Road

<table>
<thead>
<tr>
<th>Transit Treatments (Median, Side of Road, Etc.)</th>
<th>Intersection Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-way guided (15 ft)</td>
<td>Transit Signal</td>
</tr>
<tr>
<td>Two-way guided (24 ft)</td>
<td>Special Queue</td>
</tr>
<tr>
<td>One-way unguided (25 ft)</td>
<td>Transit Queue</td>
</tr>
<tr>
<td>Two-way unguided (36 ft)</td>
<td>Local Queue</td>
</tr>
<tr>
<td>Additional Lane (12 ft)</td>
<td>Accessory Queue</td>
</tr>
<tr>
<td>Peak-Hour Bus Lane, AM &amp; PM (12 ft)</td>
<td>BRT Corridor</td>
</tr>
<tr>
<td>Peak-Hour Bus Lane, AM (12 ft)</td>
<td>Proposed BRT Stations</td>
</tr>
<tr>
<td>Peak-Hour Bus Lane, PM (12 ft)</td>
<td></td>
</tr>
</tbody>
</table>

April 2011
Route 4a: Georgia Avenue North
Route 4a: Georgia Avenue North