Evaluation of Time-Based and Distance-Based Fare Policies

Operations Committee
September 16, 2010
Elements of Report

- Analysis of time-based and/or distance-based fare policies adopted by North American properties
- Analysis of current Metro fare media and technology for applicability to either practice
- Assessment of Metro organizational structure, personnel and other changes needed to implement either policy
- Literature review of academic journals since 2000 analyzing time-based and/or distance-based pricing
- At least 3 models for how to implement either practice on Metro including pros and cons
Definitions

- **Time-based fare collection**
  - Fare paid purchases time on the system
  - Rider receives unlimited access to system’s routes for a defined period of time (often 1 to 2 ½ hours)
  - Daily, weekly and monthly passes are time-based fare media

- **Distance-based fare collection**
  - Fare paid varies with length of trip
  - Rider is paying for a trip up to a specified length, or for access to a defined segment of a route
  - Price increments may be established based upon distance along each route, or based upon dividing the service area into fare zones
Analysis of Fare Policies Adopted by Others

- 32 of 244 properties use time-based pricing for single trips:
  - Mostly through free transfers using paper (17), magnetic stripe (6) or Smart Card media (9)
  - 11 allow 1 transfer within 1-2 hours
  - 2 allow 2 transfers within 55 minutes to 2 hours
  - 19 allow unlimited transfers within 1 to 2 ½ hours

- 7 of 244 properties use distance-based pricing for non-express bus services:
  - 4 have radial systems with 3 zones
  - Buffalo will discontinue distance-based fares in September 2010
  - 4 of 16 heavy rail systems use distance-based pricing, based upon distance increments
  - 4 of 31 light rail systems use distance based pricing: 2 with 4 fare zones, 2 with 3 fare zones
Analysis of Current Metro Fare Media

- **Time-based pricing**
  - Requires proof of time the trip started, or receipt showing expiration of validity
    - TAP card provides this
    - A vended receipt from a farebox could be issued (hardware required)
    - A transfer could be issued (media previously discontinued except for inter-operator transfers)

- **Distance-based pricing**
  - Requires proof of trip origin (and time) and validation and/or added payment at trip destination or each fare zone boundary
    - TAP card provides this if tapping out is enforced
    - Zone checks with boundary inspections could be used (requires labor and more running time for inspections)
    - Gated stations could enforce this together with TVM tickets
Assessment of Metro Organizational Structure

Current Organizational Structure

- Operations SBU
  - Fare Planning
  - Bus Fare Enforcement (partial)
- CEO SBU
  - Transit Security (Rail & partial Bus Fare Enforcement)
- Financial Services SBU
  - Treasury
- Communications SBU
  - TAP

Functions can be coordinated through current organizational structure
Generally, these studies found that price increments should be related to the marginal cost of serving longer trips.

**Optimizing Distance-Based Fares and Headway of an Intercity Transportation System with Elastic Demand and Trip Length Differentiation**
By Feng-Ming Tsai, Steven I-Jy Chien, and Lazar N. Spasovic

**Optimization of Fare Structure and Service Frequency for Maximum Profit of Transit Systems**
By I. -J. Y. Chien and Chuck F. M. Tsai

**The Relationship between Fare and Travel Distance**
By Finn Jorgensen and John Preston
Journal of Transport Economics and Policy

**Travel Distance and Optimal Transport Policy**
By Finn Jorgensen and John Preston

**On the optimal fare policies in urban transportation**
By Pål Andreas Pedersen

**Optimal Fare Structure for Transit Networks with Elastic Demand**
By W. H. K. Lam, and J. Zhou
## Three Models for Time-Based Pricing

<table>
<thead>
<tr>
<th>Example 1</th>
<th>Example 2</th>
<th>Example 3</th>
</tr>
</thead>
</table>
| - Base fare paid with TAP or TVM ticket – unlimited transfers up to 1 hour after initial transaction  
- Base fare paid in cash, no transfers  
- Passes allow unlimited boardings during period of validity | - Base fare paid with TAP or TVM ticket – unlimited transfers for up to 1 hour after initial transaction  
- Base fare paid in cash – issue receipt permitting unlimited transfers for up to 1 hour after initial transaction  
- Passes allow unlimited boardings during period of validity | - Base fare paid in cash – no transfers provided  
- Premium fare pays for 1 hour pass – unlimited transfers while valid  
- Passes allow unlimited boardings during period of validity |

**Pros:**  
- Uses existing hardware and fare media; Incentive to use TAP

**Pros:**  
- All users benefit from transfers included with base fare

**Pros:**  
- All users benefit from transfers included with base fare

**Cons:**  
- Higher base fare needed to offset revenue loss from free transfers  
- Cash riders must pay base fare for each boarding

**Cons:**  
- Higher base fare needed to offset revenue loss from free transfers  
- New hardware needed to vend transfer receipts for cash riders

**Cons:**  
- Higher base fare needed to offset revenue loss from free transfers  
- Additional fare required to obtain transfer privileges  
- New hardware needed to vend transfer receipts for premium riders
# Three Models for Distance-Based Pricing

<table>
<thead>
<tr>
<th>Example A</th>
<th>Example B</th>
<th>Example C</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Rapid &amp; Express bus only</td>
<td>▪ Heavy Rail only</td>
<td>▪ Rail only</td>
</tr>
<tr>
<td>▪ Fare zones defined by line based upon some increment of distance</td>
<td>▪ Fare zones defined by distance or number of stations traveled</td>
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</tr>
<tr>
<td><strong>Pros:</strong> Uses existing hardware and fare media</td>
<td><strong>Pros:</strong> Gates are installed simplifying enforcement</td>
<td><strong>Pros:</strong> Gates simplify enforcement for Heavy Rail</td>
</tr>
<tr>
<td><strong>Cons:</strong></td>
<td><strong>Cons:</strong></td>
<td><strong>Cons:</strong></td>
</tr>
<tr>
<td>▪ Zone checks issued to each rider, slowing boarding process</td>
<td>▪ Add fare machines needed within paid areas</td>
<td>▪ Add fare machines needed within paid areas</td>
</tr>
<tr>
<td>▪ Fare checks required at zone boundaries, adding running time</td>
<td>▪ TAP must be reprogrammed to handle Heavy Rail fare payment</td>
<td>▪ TAP must be reprogrammed to handle Rail fare payment</td>
</tr>
<tr>
<td>▪ Affordability concerns where Rapid &amp; Local coexist</td>
<td>▪ Affordability issues may require duplicative local bus service</td>
<td>▪ Some Light Rail stations not secure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Affordability concerns may require duplicative local bus service</td>
</tr>
</tbody>
</table>
Tradeoffs of Time & Distance-Based Models

- **Time-based**
  - Riders pay for increments of *time* on the system
    (more time spent on the system means added payments)
  - Incentives to use faster, higher capacity services, often most efficient for transit provider to operate
  - Cash & TAP purse riders pay higher base fare to fund free transfers
  - Implementation possible with current hardware and fare media

- **Distance-based**
  - Riders pay for increments of *distance* on the system
    (more distance traveled means added payments)
  - Less incentives to use faster, higher capacity (generally premium priced) services, requiring operator to provide lower priced parallel service
  - TAP reprogramming required for each applicable mode
  - Added hardware needed for rail
Next Steps

This report serves as a technical basis for further discussions on the applicability of time and distance-based fares for the Metro transit system. Staff will return to the Board in October/November 2010 with additional information on appropriate fare structures for Metro bus and rail services.

As part of the Board motion, the request for a timeline for implementation and necessary coordination with other agencies also will be addressed in October/November.