Bay Area System Plan for a Regional Express Bus Service

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Overview of Study

• Caltrans-funded – concern over congestion management, efficient use of state facilities
• Partners - transit operators, county congestion management agencies, county transportation sales tax agencies, MTC (oversight committee)

Researchers – UC Berkeley
Objectives of Study

- Identify ways to increase effectiveness and use of express bus system
- Build upon previous work on HOV lane use
- Develop a plan to address likely demand, improve facilities, services, secure financing – short term and 20-25 yrs.
- Recommend further studies as needed
Research Approach

- Develop agreement on a policy framework
- Build upon, complement previous work focusing on freeway HOV lanes
- Work with operators, users, stakeholders to identify key issues – iterative approach
- Conduct analyses on ways to improve performance; reach agreement on priorities
- Recommend short and longer term improvements to services and facilities
Policy Framework: Key Express Bus System Design Elements (Consensus List)

- Plan for door to door service, not just line haul speed – poor access, wait times, transfers can offset major capital investment benefits
- Address capital and operations needs on arterials as well as on freeways - most express buses operate on arterials part of the time
- Address user needs for safety, security, comfort, predictability as well as operator needs for priority treatment
Key Issues

- User concerns about services
- Crowded park and ride lots
- Feeder service needs and costs
- Delays on arterials
- Gaps in HOV lane network on freeways
Research Tasks

• On board surveys and observations
• Park and ride surveys and observations
• Focus groups – express bus users, park and ride users, car drivers in transit corridors
• Study of first and last mile shuttles
• Simulation of signal timing options, queue jumpers etc. on arterials
• HOV lane “gap analysis” and simulation of freeway HOV lane additions
Findings - Express Bus Users

- Many affluent workers, but low income in some corridors, midday (no “typical” user)
- Users’ key concerns: wait times, waiting conditions, transfer times, security and safety – in-vehicle time less in need of improvement
- Cuts in feeder buses increasing problem– need to investigate first and last mile options such as shuttles
- Lower income users are least likely to have employer commute benefits – social equity consideration
Findings – Park & Ride

- Problems include space availability, security, cleanliness, comfort – some users would pay for improvements ($1-3/day)
- Underutilized lots are poorly located (“wrong side” of the freeway or off main routes, would take hard sell to increase use
- Cost of park and ride space is considerable – $2 - $8 day not including land cost
- Land for expansion may not be available; costly
- Freeway stations feasible in some locations, but high cost, require attention to noise, vibration, emissions exposures.
Findings: First / Last Mile Services

• Transit operators have been cutting bus feeder services due to high costs, modest ridership
• Alternatives are park and ride or ???
• In some areas, shuttles - operated privately and as public-private partnerships offer a cost-effective choice
• Most are last-mile – of 800+ in Bay Area, only a handful operate from home end so far
• Could be an alternative to P&R expansion
Findings – New Investments

• Limited ability to add lanes, stations in medians—region already used this space for widening
• Will need to consider shoulder lanes in some locations
• Arterial improvements are equally important for express bus performance (1 min. delay at signals wipes out 1 mi. of HOV lane investment at $10M/mi.)
• Options are site-specific; simulation of arterial and freeway strategies can be used to determine best available options
On-Board Survey: Findings
Survey Design

• Surveyed 28 express routes – 40% of total
• Surveyed about half the runs on survey day
• 3354 Responses
• Overall Response Rate: 37%
Peak hour trips were almost all for work, mid-day trips were more varied.
No “typical” express bus user: Household incomes vary greatly
Walk access was much more common than expected – even to P&R lots.

The diagram shows the percentage of riders accessing various locations by different modes of transportation. The modes include:

- **Walk**
- **Drove**
- **Dropped off**
- **Bus**
- **BART**

The locations are labeled as follows:

- AC Transit-AM
- AC Transit-MD
- GGT-AM
- ST-AM
- ST-MD
- I-80-AM
- I-80-MD

The bars represent the percentage of riders for each mode at each location.
Share of Transit-Dependent Riders

- AC Transit-AM
- AC Transit-MD
- AC Transit-PM
- GGT-AM
- GGT-PM
- ST-AM
- ST-MD
- ST-PM
- I-80-AM
- I-80-MD
- I-80-PM
Full Cash Fare: Another Low-Income Issue
Transit/Transportation Benefits At Work

<table>
<thead>
<tr>
<th></th>
<th>I-80</th>
<th>US-101</th>
<th>East County</th>
<th>BART</th>
<th>San Francisco</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit Pass/Allowance</td>
<td>45%</td>
<td>40%</td>
<td>37%</td>
<td>48%</td>
<td>58%</td>
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<tr>
<td>Free Parking</td>
<td>14%</td>
<td>20%</td>
<td>5%</td>
<td>5%</td>
<td>11%</td>
</tr>
<tr>
<td>Access to Company Car</td>
<td>3%</td>
<td>4%</td>
<td>31%</td>
<td>17%</td>
<td>3%</td>
</tr>
<tr>
<td>Other</td>
<td>17%</td>
<td>9%</td>
<td>27%</td>
<td>7%</td>
<td>23%</td>
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<tr>
<td>None</td>
<td>27%</td>
<td>37%</td>
<td>27%</td>
<td>29%</td>
<td>9%</td>
</tr>
</tbody>
</table>
Rider Concerns (from comments)

- Lack of security, comfort at stops
- Buses running behind schedule / poor information
- Missed transfers
- Delays at major intersections due to traffic, poor signal timing, no priority to buses

NOT a big problem: on-board comfort, on-board speeds
Conclusions

• Express buses are serving both affluent and the less-so

• Access is a growing problem – need feeders, park and ride

• Equity issues uncovered – fares, number of transfers, lack of employee benefits for lowest earners
Findings From Park & Ride Surveys & Field Visits
Methodology

• Mail back surveys distributed to
  – all cars parked at 38 P&R lots (37% response)
  – 3 BART parking lots (Modified survey – 32% response)
  – 3 San Francisco commuter lots (Modified survey – 10% response)

• Objectives: Determine OD patterns, trip purposes, user characteristics, use of alt. lots, access modes; for BART – why drive rather than take bus? for SF lots – Why drive to the City?
Findings

• 97-99% of P&R patrons are going to work
• 90% use lot 4+ days/wk
• 90% park in same lot each day
• Over 80% live within 15 minutes of P&R that they use
• BART riders use different lot if primary lot full; others park in neighborhoods or drive to work
Park and Ride Customer Wish List

• Patrons
• Lighting
• Bathrooms
• Cleaning – trash, pigeons, etc.
• News stand/boxes
• Food vendors / beverage machine
• More parking!
Conditions At Park & Ride Lots

Bike Parking

Counts as a parking space
Recommendations

- Restripe existing lots to smaller spaces, separate SUVs & big trucks from cars
- Legalize use of driveway shoulder and organize spaces
- Rethink cuts in feeder buses since new P&R is as expensive on a daily basis
- Make more use of public private partnerships for first and last mile (800 programs already in region)
Findings: Shuttles for the First and Last Mile

- Over 800 shuttles in the Bay Area
- Three models:
  - Single employer shuttle
  - Multi-employer/shopper/hotel shuttle/circulator
  - Community shuttle
- First two mostly started as traffic management requirements (developer exactions), now seen as employee benefits / business support
- Third often grew out of 2d model
Shuttle Advantages

• Use a variety of vehicles matched to market – from used buses to vans
• Costs run $50-60/hr – about same as least expensive conventional bus provider in region, less than half the higher cost providers’ rates
• Drivers are unionized but work rules are flexible
• Services are “agile” – flexible, respond to market
• Relations with conventional transit often are positive
Recommendations

• Consider shuttles as environmentally friendly alternative to park and ride
• Evaluate shuttles as substitute for marginal feeder bus services
• Engage employers, local businesses, cities in funding shuttles
Focus Groups: Findings
Approach

• 13 focus groups: 7 with Transit Users, 2 with Carpoolers, 4 with Solo Commuters
• 140 participants
• Recruited on board, at park and ride, and from FastTrak (toll tag) data
• Objectives: understand reasons for people’s travel choices and views on possible improvements
Themes

• “I’m trying to do the right thing by taking transit. But they don’t make it easy to do the right thing.” (East Bay commuter to UCSF)

• “I’ve tried it all.” (Hercules Casual Carpooler)

• Considerable frustration, desire for improvements, willingness to pay for them

• Resentment against rising fares with diminishing services.
Findings

• Transit riders concerned about wait times, waiting conditions, missed transfers, safety, cleanliness.

• Lower priority: on-board travel time and bus characteristics (other than seat comfort).

• Findings are consistent with travel behavior research, but surprised Caltrans and MTC, who have been focusing on “missing link” capital projects.
Findings (continued)

• Many carpoolers were former transit users who gave up in frustration.
• Carpoolers also liked no-cost travel – many would take bus if free pass were available.
• Both transit users and carpoolers would pay one to three dollars per day for park and ride lot policing, cleaning, toilets, lighting, and shelters.
Findings (cont.)

• Middle-income commuters drive to San Francisco for three primary reasons:
  – Avoid multi-transfer transit trips
  – Avoid high out-of-pocket costs for transit
  – Have car available when working extra hours

• Most avoid high SF parking charges by moving car around residential zones, parking in parks, etc. (go to great lengths)
Specific areas needing improvement (all groups)

- Local access to express bus
- Park & Ride capacity
- Park & Ride security
- Intermodal transfers (bus to BART in particular)
- Cleanliness
- Communication with transit agencies (customer service)
- Rider Information
Capital Investments and HOV Gaps
HOV Lane Gap Identification

• HOV lanes and other priority treatments found throughout the Bay Area BUT
• Gaps persist, and some cause substantial delay, frustrations for HOVs
• Legislators have taken notice, have asked why network is not continuous
- Red indicates congested gap sections
- Green indicates uncongested gap sections

Legend:
- Coltrain
- BART
- VTA Light Rail
- ACE Train
- Existing HOV Lanes
- Programmed HOV Lanes
- Planned HOV Lanes
- Gap Without Congestion
- Congested Gap

Data Source: MTC 2002 HOV Lane Master Plan Update, March 2003
- Red indicates congested gap sections
- Green indicates uncongested gap sections

Data Source: MTC 2002 HOV Lane Master Plan Update, March 2003
Most Common Reason for Gaps: No Right of Way, High Costs

- Previous capacity expansions used freeway shoulders and medians - little room left for HOV lanes (14 gap sections – 120 route miles)
- Cost of new ROW high, funds not identified
Options for High-Cost Gaps

- Re-striping to create an additional lane in existing, paved right-of-way or shoulder lane operation – both would require engineering studies, policy changes
- Seek alternative routes for specific gap sections
- Reconsider conventional wisdom that taking a lane for HOVs is unacceptable
- HOT lanes where high costs are the problem
Second Most Common Reason for Gaps: Section Isn’t Congested (Yet)

• 13 gap sections, 110 route miles of freeway aren’t congested yet – HOV lanes wouldn’t provide any benefit
• Need to monitor these sections as growth patterns evolve
• Retain ROW for future needs
Remaining Gaps: Upstream or Downstream Bottlenecks

– 5 gap sections, 23 route miles
– Bottlenecks would have to be fixed before priority lanes would offer a significant advantage
– Few cost-effective options to fix these
– Possible future study: ITS alternatives?
Simulation: I-580 and San Pablo Avenue
Objectives

• Consider two important issues: fitting HOV lane into existing right of way, and improving priority treatment on arterials carrying express buses
• Show through case studies how various strategies could improve performance
I-580 Simulation
I-580 Simulation HOV Lanes

Median HOV Lane

Barrier Separated Median HOV Lane

Shoulder HOV Lane
San Pablo Avenue Simulation

Hilltop

Downtown Oakland
Travel Times for Alternative HOV Lane Designs

- Existing
- Median
- Barrier
- Shoulder
San Pablo Avenue Simulation

• Express Bus Improvement
  – Transyt-7F
    • Time signals for transit (person hours of delay)
    • Weight transit vehicle more than cars
  – Paramics
    • Add queue jumpers
    • Change intersection and bus stop geometry
Results (1)

- Transyt-7F - compare “ordinary” signal timing to bus-weighted timing

<table>
<thead>
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<th>Existing</th>
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<th>Weighted</th>
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<tbody>
<tr>
<td></td>
<td>Bus</td>
<td>Total</td>
<td>Bus</td>
<td>Total</td>
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<tr>
<td>Delay (veh-hr/hr)</td>
<td>10</td>
<td>1364</td>
<td>8</td>
<td>1459</td>
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<tr>
<td>Total Stops (veh/hr)</td>
<td>6836</td>
<td>114885</td>
<td>3762</td>
<td>84514</td>
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</tbody>
</table>
Results (2)

- Paramics (signal priority and queue jumpers)
  - Significant improvements to travel time of express buses
  - More significant improvement to reliability (reduced variance)
Conclusion

- Simulation software provides opportunities to easily explore a multitude of alternatives
- Can quantify the effect of geometric and operational changes to REB performance
- Gives ability to simulate future scenarios and growth
- Allows us to evaluate new techniques for delay calculation considering buses
Short and Long Term Projects

Findings and Recommendations
# Capital Projects Summary

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<tr>
<th>Type of Improvement</th>
<th>Timeline</th>
<th>Number of Proposals</th>
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<tbody>
<tr>
<td>Traffic signals - New, adjust, priority</td>
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</tr>
<tr>
<td>Metering lights - New, adjust</td>
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<td>6</td>
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<tr>
<td>Research or study for solutions</td>
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<td>4</td>
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<tr>
<td>Park &amp; Ride lots and Transit Center Expansion</td>
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<tr>
<td>Pavement markings - crosswalks, turn lanes, etc.</td>
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<td>Rolling stock purchase</td>
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<tr>
<td>Bus stops - New, refabricate</td>
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<td>14</td>
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<td>Queue jump lanes - New</td>
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<tr>
<td>New Park &amp; Ride lots and Transit Centers</td>
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<td>14</td>
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<tr>
<td>HOV lanes - New, extend, adjust</td>
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<tr>
<td>Ramps and connectors - New, realign</td>
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</table>
Project Evaluation Approach

• Transit operators provided lists of proposed projects
• We evaluated them based on cost per rider now and in the future (net present value)
• Costs based on Bay Area data (Caltrans worksheets)
• Ridership based on MTC forecasts
Conclusions

• Express buses serve both affluent and not-so-affluent commuters in the Bay Area
• Services could be greatly improved by more attention to user needs: better management of access, wait, transfer conditions
• In-vehicle travel time improvements are important, but are overwhelmed when access, wait, transfer conditions are poor
Conclusions (cont.)

• Operations improvements such as signal timing and small capital improvements such as queue-jumpers are highly cost-effective
• Some capital projects are not (too few buses would use them, too few hours of the day)
• Parking expansion likely to be major cost ($25K+/space) – feeder services cost-competitive
• “Color of money” problem – easier to get capital projects than operational improvements
Further Reading

• TRB papers are forthcoming on park and ride, Paramics simulation
• Additional publications will be forthcoming this summer