



*****Reports from the 2002 TRB Annual Meeting, January 2002.*****

(Report on session W24, Prepared by Session Presenter, Peter J.V. Koonce, P.E., Kittelson & Associates, Inc., Portland, Oregon)

TRB Transit Signal Priority Workshop

Within the area of Bus Rapid Transit, a significant amount of attention has been given to expediting transit flow through various preferential treatments. The inset describes several of the treatments identified in the Transit Capacity and Quality of Service Manual. Such treatments are aimed at improving segment, route, and system performance. Transit Signal Priority (traffic signal priority or signal control priority) has been effectively implemented in several cities. A recent workshop (the workshop was co-sponsored by the Traffic Signal Systems and Bus Transit Systems Committees) at the 2002 Transportation Research Board Meeting (Session W24- Sunday, 9:00am-4:00pm) included several speakers that provided an insight to the issues associated with the implementation of signal priority. The workshop was specially designed to bring speakers with a variety of perspectives and experiences together to share lessons learned from both the transit and traffic perspective.

Transit Agency Perspective

Speakers from transit service providers summarized their experiences as a transit agency involved in the development and implementation of a transit signal priority program. Agencies invited included Tri-met (Portland, OR), Centre Area Transportation Authority (State College, PA), and Metro (Los Angeles, CA). The transit service provider presentations highlighted the system features and resulting impacts to transit service resulting from implementation of their respective systems. Each speaker shared their experience in terms of vehicle performance, which provided the traffic engineers in attendance with an opportunity to appreciate the detailed transit analyses that bridge the gap between transit and traffic operations. Key points summarized from the presentations included:

- Signal priority provides an opportunity to reduce transit travel time and running time variability
- Incorporating the benefits into the scheduling process is an iterative and interactive process

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Report from Committee AIE01 Chairman John Dockendorf

On behalf of our Committee, and the University of South Florida's Center for Urban Transportation Research (CUTR), I am pleased to provide our Committee's third annual newsletter. This special issue is dedicated to covering news and developments primarily related to the national Bus Rapid Transit (BRT) Initiative. It covers two BRT-related conference sessions, and two paper sessions that were either sponsored, or co-sponsored by our Committee at January's Annual TRB Meeting

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TRB Transit Signal Priority—continued
Traffic Engineering Perspective

The traffic engineering presentations provided details regarding signal timing and technology that are a part of transit signal priority. There are numerous ways to accomplish transit signal priority, but the elements of field implementation addressed in the workshop included the following:

- Initiating a vehicle (bus) call;
- Detecting the bus (communication between the bus and the traffic signal); and
- Implementing traffic signal controller intelligence (signal timing that changes the intersection timing, thus providing priority).

One of the primary issues raised in the workshop was the importance of recognizing that signal priority is not preemption, which is reserved for emergency vehicles. Preemption alters the normal operation of the signal, while priority is a less disruptive change for traffic signals and more amenable for the traffic engineering community. One of the obstacles to implementation of signal priority is older traffic signal controllers, which, in some cases, may not distinguish between a priority call from a bus and a preemption call from an emergency vehicle. They also may not have control algorithms to properly service them if they could make that distinction. On the other hand, the transit vehicle may not distinguish between whether the transit vehicle actually needs priority.



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Committee chairman report—continued

in Washington, DC. Also, it includes a summary of the six topical BRT sessions presented at last summer's national TRB Bus Rapid Transit Conference last August in Pittsburgh, PA.

We hope you find these articles interesting and informative. The Committee plans to continue to play a lead role in TRB's involvement in the Bus Rapid Transit Initiative and will have more to report later. Although we will not be sponsoring a Summer BRT Session, like last year, we do plan to co-sponsor a BRT Conference session with FTA at TRB's Annual Meeting in January. In addition, we expect to sponsor two paper sessions which will inevitably include some BRT-related papers. If at all possible, we encourage you to attend these sessions so you can hear these presentations first hand. However, if this is not possible, we plan to include a summary of these sessions in our next newsletter next year.

In conclusion, I want to personally thank all of our contributing authors for taking the time to both serve as a moderator, presenter, or both, at these various Committee-sponsored sessions, and for taking the time to prepare the enclosed articles summarizing the highlights of their respective sessions. Also, I want to personally thank Dennis Hinebaugh and his staff at CUTR for all their help in preparing, publishing, and distributing our Committee newsletter.

Thanks to all our Committee Members and Friends for a very productive year!



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Transportation Perspective

The focus of the remaining sessions in the workshop was introducing and educating those attending the workshop in emerging issues associated with transit signal priority. The speakers during the third session highlighted the need for intense coordination between transit and traffic officials to coordinate activities and compromise on solutions from a transportation perspective. Both Bill Kloos (City of Portland, OR) and Les Kelman (Toronto, Ontario, CANADA) have been involved in transit priority evaluation and implementation for over ten years and have unique perspectives related to transportation issues and consideration of transit and traffic as a system. The primary area of commonality with respect to the institutional issues that both have faced is that, on many levels, transit and traffic have conflicting objectives, divergent goals, and different vocabularies. As both Bill and Les shared in their presentation, it is for these reasons that additional coordination between transit and traffic is necessary.

Standards and Future Research

Following the summaries from practitioners, the workshop concluded with a fourth session that summarized the ongoing research TCRP A-16 and the NTCIP standards development process for Signal Control Priority. TCRP A-16 is a research effort that has developed conceptual signal priority algorithms to facilitate improved functionality within field devices (signal controllers). The communication standards between devices that are under development will facilitate the passing of information between the bus, the traffic signal, and the systems that support these objects in the field.

Summary

A significant amount of delay to transit vehicles in urban areas is caused by traffic signals. The implementation of signal priority has the potential to reduce control delay caused by traffic signals. The implementation of these systems requires engineering studies that address both transit and traffic signal operations. Implementation of signal priority requires coordination between the transit agency and the transportation or traffic department to address the needs of both agencies and more importantly consider how TSP fits into the system. This workshop provided an opportunity to address the issues concerning the various perspectives. The primary lesson learned at the workshop is that there exists a need for more coordination between transit and signal operations staff, working together to solve transportation challenges. Transit signal priority is a promising measure to improve the transportation system by improving the efficiency of transit and increasing the mobility of the system. ♦

(Report of TRB Session 398, prepared by Session Presenter John Dockendorf, Pennsylvania DOT, Harrisburg, PA).

What's New in Bus Rapid Transit

This year's BRT session was the third consecutive annual BRT conference session jointly sponsored by the Federal Transit Administration and our Committee. As before, this was a very popular session having a total attendance of 200 individuals.

FTA's Chief of Service Innovation Division, Bert Arrillaga, served as both the moderator and initial presenter. Highlights of his presentation, "FTA BRT Program Update" included the following:

- Five of the Federal BRT demonstration projects have already attained significant ridership increases and travel time reductions.
- Seven of the Federal BRT Demonstration projects are in the Preliminary Engineering phase and are expected to

commence soon.

- Two BRT workshops are proposed in year 2002: "System Integration" in Los Angeles in this winter; and a "Fare Collection Workshop" in Milwaukee this summer. An international BRT conference is proposed for November, site to be determined.
- TCRP has initiated Project A 24 to develop a "Tool kit for POP Systems".
- The Center for Urban Transportation Research (CUTR) at the University of South Florida and Partners for Advance Transit and Highways (PATH) at the University of California, Berkeley have collaborated to form the National BRT Institute (NBRTI).
- FTA has initiated an Intelligent Vehicle (IV) Demonstration Program to promote this BRT option.
- FTA and selected US and French

vendors and systems are conducting vehicle experiments to track and test available BRT rubber-tired vehicles on the market such as CIVIS, Translohr and TVR.

Next, Mr. Samuel Zimmerman, Principal for Transportation Planning, DMJM reported on TCRP Project A-23; Implementation Guidelines for Bus Rapid Transit Demonstration Program. He indicated the project's initial product, a BRT brochure, was completed and distributed last August; and, that its other planned product, "Implementation Guidelines for BRT Projects" is expected to be available this spring. Sam's presentation included detailed information on Brisbane, Australia's new Busway; Bogotá, Columbia's new "TransMilenio" project; Rouen, France's new "TEOR" project and Los Angeles' Metro Rapid project. Among the lessons learned from these, and other BRT projects were the following: *continued on next page...*

What's New in Bus Rapid Transit con't

- Take advantage of BRT's flexibility.
- Stress BRT's relatively modest costs.
- Promote BRT "Brand Identity" by using special vehicles if at all possible.
- Stress problem solving, not solution advocacy, during planning.

The third speaker, Dennis Albrecht, BRT Project Manager, Greater Cleveland Regional Transit Authority (GCRTA) made a presentation on Cleveland's Euclid Avenue BRT Project. GCRTA plans to implement one of the more sophisticated federal BRT Demonstration projects utilizing an exclusive lane with special stations and "pop" fare payment. To minimize both vehicle operating and dwell time, the Authority plans to utilize low-floor, articulated buses with doors on both sides. In addition, the Authority plans to utilize ITS technology to increase operating speed and AVL technology to improve vehicle reliability.

The fourth speaker, Roderick Diaz, consultant, Booz-Allen & Hamilton, Inc, and

member of our Committee, made a presentation on "Making BRT Happen: Overcoming Barriers; Creating Opportunities." Mr. Diaz identified the following five key barriers that most communities will need to overcome to implement a successful BRT project; physical constraints; regulatory compliance; market acceptance; technical capacity; and institutional/organizational issues. The local focus on traffic impacts and congestion mitigation often limits the ability to convert and re-allocate roadway space. Providing separate rights-of-way to help overcome this problem are costly and may greatly reduce the cost advantage BRT has versus rail alternatives. Other constraints occur in finding a suitable vehicle available to meet BRT requirements; obtaining public and political acceptance of any bus option given the historical perception of buses as an inferior mode; and obtaining the necessary local cooperation between city traffic engineering departments and local transit authorities. Roderick then pointed out how the Los Angeles BRT project overcame these barriers largely by promoting their initiative as an extraordinary, innovative project having national and international attention. This synergy resulted in a "band-wagon" effect that helped motivate many agencies and individuals to cooperate to expedite the implementation of the project.

Finally, I briefly reported on last August's national BRT conference in Pittsburgh; and, then distributed a matrix summarizing which of the sixteen federal BRT Demonstration projects planned to utilize one, or more, of eight different general BRT strategies to promote ridership, reduce travel time and enhance customer awareness and convenience. A review of this information indicated that virtually all of the FTA demonstration projects plan to utilize a number of different BRT strategies to reduce trip time, reduce vehicle dwell time and improve vehicle reliability to increase ridership. Also almost all these systems plan rider enhancements and marketing initiatives to improve passenger awareness, convenience and comfort. However, many of the more dynamic and innovative, BRT strategies will not be implemented until the later phases of most of these BRT projects.

In conclusion, the BRT continues to be a very interesting and popular topic and will probably continue to be so in the foreseeable future. Most of the current federal BRT projects have not even started yet, and FTA is considering adding nine more candidate BRT projects to the consortium. Therefore, there should be a wealth of BRT project data and findings to foster research, national conferences and TRB annual meeting sessions for the remainder of this decade. ♦

(Report of TRB Session 435, prepared by Session Moderator, Frank Spielberg, SG Associates, Inc., Annandale, VA)

Bus Operating Strategies

This session included a diverse mix of papers covering applications throughout the world of a wide range of bus operating strategies. The first paper by Lee Rogers reported on the O-Bahn, the guided busway in Adelaide. Lee presented a historical review of the factors that led to the implementation of the O-Bahn and why the system has not seen broader implementation in other cities or other corridors in Adelaide. Although a political dispute led to governmental policy which encouraged non-rail transit applications, broader application of the O-Bahn has been hindered, in part, by patent issues. The O-Bahn continues to serve Adelaide.

Work by Joel Rey and Dennis Hinebaugh was presented in a paper reporting the findings of a Florida study of bus safety issues and bus crash findings related to operator training and operating policies. Lew Fulton, representing Lee Schipper, both of The International Energy Association, headquartered in Paris, presented a paper reporting on staff travel to cities in the Midwest and on the Indian subcontinent to determine the effectiveness of buses in these environments. The final paper, presented by Kari Watkins, reported on the design station for the proposed the

busway in Hartford, Connecticut. Since the busway will operate in a low volume two-lane road the designers saw



no need to provide full grade separation for pedestrian crossings. However, to promote pedestrian safety in station areas, the designers have proposed a number of treatments to minimize crossing distances and to maximize pedestrian awareness of approaching traffic. ♦

(Report of TRB Session 465, prepared by Session Moderator,
Dave Sampson, Urbitran Associates, Inc., New Haven, CT)

Bus Operations

Session 465 was held on Tuesday evening, January 15th. Despite the evening time slot, the session featured a lively discussion of on-time performance issues and the use of technology to affect travel time reliability, spurred by the excellent presentations of papers regarding bus holding control strategies and traffic signal pre-emption.

The first presentation was entitled “On Design and Implementation of Bus Holding Control Strategies Under Real Time Information”, by Liping Fu and Xuhui Yang of the University of Waterloo, Canada. The paper investigated two holding control models aimed at keeping bus headways even on a given route. In one case, the model was based upon holding times solely dependent on the spacing to the previous bus, while in the second case the modeling was based solely on the spacing between both the preceding and succeeding buses. A simulation was conducted using operating parameters from a route in Waterloo, aimed at determining which of the two methods worked more effectively, how many control points, where they should be along a route, and how strong the controlling paradigm should be. From the findings, the researchers concluded that bus holding control is an effective method for stabilizing operations, improving reliability, and reducing passenger wait times. The general conclusions were that the control point should be near the middle of the route and at a high boarding/alighting location, that ideally there should be two such points at the high demand stop, and also at the terminal but additional stops were not



needed. Additionally, it was concluded that real-time information is most beneficial to passengers when used in conjunction with such a program.

The second paper was entitled “A Modeling Approach for Transit Signal Preemption”, and was present by Bhuwan Bhaskar Agrawal of Northwestern University. This paper described a simulation/assignment based approach for evaluating the region-wide impact of signal pre-emption strategies for bus transit operations. The model addresses both the impact on bus operations as well as the impact on traffic and the routing behavior of drivers in response to introduced pre-emption controls. A simulation was conducted for services on the Cermak Road corridor in Chicago to test the applicability of the approach. The study assessed several forms of priority—passive priority, semi-active priority, and active priority. These forms of priority were assessed looking at further subsets regarding green extension, red truncation, red interruption, and red extension. A modeling system was developed

and the simulation conducted for each combination. As expected, vehicles changed routes due to signal pre-emption, and therefore the model has to take into account the impact of signal alternation beyond the isolated region of change. Signal preemption was found to help reduce bus travel times, but did not necessarily improve total system travel times; as traffic conditions change and may worsen under certain conditions. Finally, the number of buses affected is an important ingredient in determining the type of action taken and the projected impacts. The next step for the authors will be to extend the project to a larger, area-wide network to assess more fully the interrelated impacts on buses and other vehicular traffic. ♦

The preceding article concludes the articles summarizing presentations made at the 2002 TRB Annual Meeting, held in January 2002. The following pages contain articles summarizing presentations made at the TRB Bus Rapid Transit Conference in August 2001.

The BRT Option as a Part of Alternatives Analysis

(Report of the TRB BRT conference, prepared by Session Moderator, Edward Fleishman, Director, Office of Oversight, FTA)

The first general presentation session at the August 12-14, 2001 Transportation Research Board Conference on Bus Rapid Transit was entitled “The BRT Option as a Part of Alternatives Analysis”. The session was a prelude to roundtable discussions on the same topic that were conducted the next day.

COMPARISON OF BUS SEMI-RAPID TRANSIT WITH LIGHT RAIL TRANSIT AND OTHER MODES

Dr. Vukan V. Vuchic, Professor of Transportation Engineering, University of Pennsylvania

The first speaker was Professor Vukan R. Vuchic of the University of Pennsylvania whose presentation was entitled: “Bus Semirapid Transit as an Option in Alternatives Analysis.” He stressed that the selection of transit modes is an important and usually complex task. To perform it efficiently, a thorough understanding of different modes and their characteristics, based on experiences from different cities, is needed. He felt that it is particularly important that technical facts and data are used, rather than emotional arguments and promotions of individual modes. Impeding the upgrading of bus services is that many traffic engineers still base decisions on the number of vehicles rather than persons.

Professor Vuchic presented the family and classification of transit modes. He then discussed some misconceptions about transit services, which were prevalent in the 1950-1970 era. This was followed by an analytical comparison of bus rapid transit with regular bus and light rail transit. He concluded by stating that despite the potential for bus rapid transit implementation, there are serious obstacles to it. Planners must be aware of these problems, anticipate them, and prepare how to overcome them.

BRT- THE BETTER WAY FOR THE CAPITAL REGION

Michael Sanders, Transit Administrator, Connecticut Department of Transportation

Michael provided an overview of the State of Connecticut transit planning efforts. The State’s public transportation strategic objectives included maintaining existing systems to a state of good repair and expanding bus and rail services to capture a greater share of existing markets and to capture new markets. A major public transportation challenge is that capital funding levels are insufficient. In response, the New Britain-Hartford Bus Rapid Transit Project was developed. This project moved through the planning process as a lower cost solution to the problem of providing increased mobility in that corridor.



BRT AS AN OPTION: OPPORTUNITIES, LIMITATIONS, & ISSUES IN CHARLOTTE, NC

Garet Walsh, AICP, Senior Planner, Charlotte-Mecklenburg Planning Commission, and Catondra Noye, Project Manager, Charlotte Area Transit System (CATS)

The authors started with an overview of the Charlotte area. They then discussed the process of how Charlotte decided to implement rapid transit. A 2025 Plan that was developed called for expanding existing transit services, focusing development in identified centers and corridors, developing regional transit in five corridors, and promoting more compact, pedestrian-friendly, mixed use development. Then a sales tax referendum was passed that provided increased funding. Major Investment Studies are underway where both BRT and LRT are under consideration. They discussed the fact that in Charlotte, the concept of Bus Rapid Transit is foreign, while LRT is thought of as “cool”.



ROUNDTABLE DISCUSSION

The next day of the conference included the roundtable discussion which provided an opportunity for attendees to discuss “The BRT Option as a Part of Alternatives Analysis” in greater detail. Three problems confronting BRT are that many people are reluctant to take a bus trip since they are not quite sure of the route of the bus, some transportation planners don’t know the full capabilities of BRT, and existing transportation models don’t model BRT very well. Therefore the roundtable discussion group recommended that 1) a tool kit be developed for planners to help them better understand the BRT option and its advantages; 2) improved modeling tools be developed to enable planners to see the effect of various BRT options; and 3) scanning trips be encouraged so that more planners can see successful BRT projects.◆

BRT Project Vehicle Selection Session

(Report of TRB BRT conference, prepared by Session Moderator, Kevin St. Jacques, P.E., P.T.O.E., Wilbur Smith Associates, Dallas, TX)

ADVANCED BUS TECHNOLOGY

Douglas Skorupski, Booz-Allen & Hamilton

As an introduction to the subject of BRT vehicle selection, Doug Skorupski presented an overview of bus technologies for BRT. He began with a discussion of articulated buses, their history in application, and proven successes. However, sales in the US have been limited due to the lack of need for high capacity buses. The advent of BRT systems has fostered an increased interest in articulated buses. A summary was presented of the advanced technology buses available from North American manufacturers, including New Flyer, NABI (North American Bus Industries) Neoplan USA, Gilig, NovaBus (Volvo), and Orion Bus Industries (Daimler Chrysler). These buses were compared to those available from European Bus manufacturers including Irisbus. The US bus models have proven service, lower capital and maintenance costs, better equipment access, conventional appearance, interior steps and no fourth door option. The European bus models have an attractive rail-like appearance, are true low floor buses, have an available fourth door, and electric wheel motors that support larger 85-foot double articulated buses; however, they have higher capital and maintenance costs, but have unproven structural design (in the US) and unproven propulsion system design (in the US). Also presented was information on European light rail vehicle manufacturers, such as Bombardier and Lohr, which have developed rubber tire models of their LRT vehicles to serve the BRT market. The presentation then moved on to advanced propulsion systems, including ICE with electric drive system, ICE electric hybrid system, Dual mode with electric drive system, and fuel cells. The presentation on advanced bus technology concluded with a discussion of European technology procurement considerations, including: federal regulations of FMVSS, EPA, ADA, bus testing, Buy America; design issues; service requirements; infrastructure requirements; and communication between planning and procurement groups.

SELECTING A SLEEK, GREEN, ATTRACTIVE VEHICLE

Graham Carey, P.E., AICP, Lane Transit District, Eugene, OR

Lane Transit District's BRT Project Engineer described their process for identifying desired attributes of the vehicle for use in their BRT corridor. First, they identified what they wanted in a vehicle – low floor, multiple doors, more environmentally friendly fuel system, and distinctive styling (rail-like appearance). They also evaluated the desirability and trade-offs of extra-wide doors, three doors on non-articulated buses, and doors on both sides of the bus, considering passenger capacity, structural integrity and other factors. They evaluated the desirability of alternative fuels, electric or hybrid buses. They considered wheelchair accommodations and securement, bicycle storage, seated passengers versus standees, luggage storage, fare collection, guidance systems and vehicle performance. Considering the European vehicles, they had to consider the useful life of the vehicle, history of the manufacturer, parts and service availability and warranty, and other factors.

BOSTON'S BRT VEHICLE SELECTION – AN OVERVIEW OF TECHNOLOGY, POLITICS AND THE REGULATORY PROCESS

Michael Mulhern, Deputy General Manager, Massachusetts Bay Transportation Authority (MBTA)

After a brief introduction of why BRT was selected for the Silver Line project (flexibility, capacity, convenience, incremental growth, cost effective), the two phases of the project were described and the need for considerations of two BRT vehicles: CNG articulated low-floor buses and dual mode articulated low-floor buses. Several key lessons learned from the vehicle selection process were discussed. Be realistic in your approach and your budget involving municipal, state and federal agencies in the process. Maximize buying power by partnering with other transit agencies, sharing information, and leveraging multiple procurements to attain economies of scale. Do your homework - allowing plenty of lead-time to conduct industry reviews, visit manufacturers, and talk to the engineers and other agencies. Understand the state of the industry including low emission technology, low floor buses, comfort features, smart bus technologies (vehicles and stations), modern maintenance facilities, and advanced service management techniques. Finally, embrace public dialogue, conduct public outreach early and often, understand the concerns of anti-bus lobbies, give elected officials and community leaders a stake in the project, and importantly document your efforts.



PRECISION DOCKING AND WHEELCHAIR ACCOMMODATIONS FOR BRT SYSTEMS

Rolland King, Consultant

The experience of some European cities with bus level boarding was described, in which mechanical, optical and electromagnetic guidance systems were utilized. Issues of horizontal gap and vertical misalignment tolerances and performance were discussed. Also, ADA wheelchair requirements were discussed, including alternatives to current wheelchair accommodations for BRT systems. Wheelchair accommodations on buses in Europe and Canada were presented for comparison including the three-sided compartment, the padded bulkhead for backrest, and the rearward facing traveling position.

In summary, discussion with a panel of conference attendees suggested that the following lessons were learned:

1. Use available technologies to enhance performance and image as upgraded service.
2. Promote the image of BRT. In addition to vehicle appearance, include low floor vehicles, walk on/walk off mobility at stations, and quiet-running non-polluting vehicles.
3. BRT needs to be conceived and developed as an integrated system, just as LRT is, with vehicles and passageway and stations developed together.

The panel of conference attendees also identified the following research needs:

1. What attributes of BRT have most attributed to ridership increases?
2. Information on emissions reductions and life of articulated buses.
3. Limitations of vehicles by service type and conditions.
4. Reliability of guidance technologies.
5. Alternative for precision docking.
6. Passenger response to interior and exterior design.
7. Capacity of BRT: breakpoint as a precursor to LRT. ♦



ITS Applications for Selected BRT Projects

(Report of the TRB BRT conference, prepared by Session Moderator, Dr. Brendon Hemily, Consultant, Toronto, Ontario, Canada)

Intelligent Transportation Systems (ITS) includes an array of technologies including Automatic Vehicle Location (AVL) using GPS, Transit Signal Priority (TSP), Customer Information Systems with bus stop displays of bus departures and on-board stop announcements, Advanced Fare Collection Systems using smart cards, etc. The conference found that ITS is playing an increasingly important role in the design and implementation of BRT projects, and this session, moderated by Brendon Hemily, provided some perspective on some of ITS developments in three transit systems related to BRT.

PRESENTATION ONE

Peter J.V. Koonce, P.E., Senior Engineer, Kittelson & Associates, Inc., Portland, OR & Bill Kloos, Signal System Manager for the City of Portland, OR.

The first presentation focused on the experience of Portland Oregon. The City of Portland and the Tri-County Metropolitan Transportation District of Oregon (Tri-Met) have been involved since the early 1990's in a cooperative comprehensive program to implement transit signal priority (TSP) in a way that addresses the needs of both agencies and users. Initial experiments were held in 1993-1996, and based on the experience gained from these experiments, a first phase of a comprehensive TSP project has been implemented on two routes (Routes 4 and 104). Bus detection is done using the 3M Opticom system, and provides selective priority when the bus meets the following conditions: the bus is on route, in service, its doors are closed, and is running over 90 seconds late (based on assessment of the on-board AVL system calculation). Priority requests that are accepted result in green extension (up to 40 seconds), or red truncation, within certain constraints of fitting within overall cycle length, and minimum pedestrian and vehicle green time. The system has been implemented at 58 intersections, and preliminary results indicate that improvements to bus travel time typically range from 5 to 8 percent, with maximum reduction attaining 24 percent under certain conditions. Implementation will continue, with relocation of stops to far-side locations, and increased use of the AVL system to refine priority strategies.

PRESENTATION TWO

Sean Skehan, Transit Engineer, Los Angeles Department of Transportation, Los Angeles, CA.

The Metro Rapid Bus concept has been implemented along two major corridors in L.A. ITS technology has played a significant role in the system design and success. TSP is provided at most intersections along the corridors using the inductive loops placed in the roadway that recognize the on-board low frequency transponders. All signals are connected to the City's central urban Traffic Control System with once-per-second real-time communications.

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BRT Project Land Use/Economic Development Impacts

(Report of the TRB BRT conference, prepared by Session Moderator, Dennis Hinebaugh, Director, National Bus Rapid Transit Institute, Tampa, FL)

CURRENT VIEWS ON BRT AND LAND USE IMPACTS

David R. Miller, Ph. D., AICP, Assistant Vice President, Parsons Brinckerhoff (Philadelphia, PA)

The presentation summarized recent views about BRT impacts on transportation and land use – a survey of conventional wisdom. Findings were:

- Some good news – BRT can have positive impacts. An FTA consultant studied the New Starts submittals and the FTA ratings, and focused on the factors affecting a project’s overall rating on the issue of land use. No strong correlations between overall project ratings for transit-supportive land use and the projects’ various distinguishing characteristics such as project mode were found. To quote:

Experience with busways in Pittsburgh and with an exclusive bus tunnel in Seattle, however, suggests that transit-supportive busway development is a realistic possibility. These experiences further indicate that strong planning and promotional efforts by local agencies can have a significant effect on development adjacent to busways, just as they can for rail stations.

Most of the BRT projects aren’t very far along in the project development process yet, and examples of TOD are still relatively scarce. Nonetheless, the analysis concluded that there is no reason new busways can’t have the same sort of positive TOD effects as new rail systems. However, it’s more challenging to achieve positive land-use impacts with BRT than with rail.

- Other literature reviews generally concur on the following lessons:
 1. Transit redistributes rather than creates growth, and a healthy regional economy is a prerequisite.
 2. Land-use impacts are greatest when transit investments occur just prior to an upswing in regional growth.
 3. Although transit can spur central-city redevelopment under the right conditions, still, regional transit investments generally reinforce decentralization trends.
 4. Pro-active planning is necessary if decentralized growth is to end up in subcenters.
 5. Other pro-development measures must often accompany transit investments if land-use changes are to occur.
 6. Concentrated growth and subcentering does translate into land value gains.
- Even with the likelihood of a positive eventual outcome, there are some significant differences between rail rapid transit and BRT in terms of what can realistically be expected. Part of the challenge with buses versus rail for TOD is focus and emphasis. An advantage of bus service is that it is ubiquitous - buses cover an entire community. A successful bus or rail TOD strategy will need to be strategically focused on a few key sites.

Operationally, one of the great attractions of BRT is that (except where the system uses dedicated vehicles that operate only on the busways) many more riders can be provided with a one-seat ride than with rail, which requires a change of mode for most riders except in the highest-density settings. But the very fact that there aren’t large groups of transferring riders changing modes at terminal complexes means that one of the big incentives to develop a sub-center – lots of foot traffic – isn’t there with BRT to nearly the same extent that it is in rail-based systems. The challenge is to convince citizens, planning and zoning officials, and developers that concentrating growth in sub-centers is A Good Thing, and to work to make sub-centers viable in carefully selected nodes. In a new and growing metropolitan area, it takes strong local leadership to bring about realization of the potential land-use advantages of BRT. Except in those cities with substantial terrain constraints, there is little to help guide development into logical sub-centers. The unconstrained workings of the urban land market won’t do it.

Evidence exists that BRT can help focus new growth in desirable land-use patterns. It’s still a little early to tell what will ultimately develop along the South Miami busway or the Pittsburgh Airport busway, despite the fact that initial segments of both have been in operation for several years, let alone what might happen in the other cities in the BRT demonstration program. It’s reassuring to note that among the “insiders” there seems to be a very good understanding of what it takes to bring about the desired changes, but discouraging to note that the pace of change is slow. But on balance, we need to observe what happens as more of the demonstrations come on line. It is simply premature to judge. So far, there is scant evidence to prove or disprove a strong connection between BRT and land use changes in U. S. experience.

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BRT Project Land Use continued

BRT- CONNECTING PEOPLE TO LIFE

Bruce W. Ahern, Assistant General Manager, Business Development, Port Authority of Allegheny County

The Port Authority of Allegheny County has been a leader in planning and construction of BRT systems, having completed 3 Busways since 1977. The BRT system in Allegheny County is the oldest continuously operating system in the United States. Busways offer many service advantages over conventional bus transit service, including: 1) safer operation, police patrolled; 2) improved reliability of service; 3) reduced peak period travel time; 4) improved fleet productivity; 5) reduced wear and tear on vehicles; and 6) buses spend less time in the garage.

Given all these advantages for Busway Rapid Transit versus conventional bus transit service, it's understandable that the Port Authority of Allegheny County would desire to expand and improve their Busway services. A critically important ingredient to this expansion is the early community dialogue to establish need and common ground for the project. Both the community and the transit agency must agree that their partnership in the project is a good situation for all parties involved. In addition, once the scale of the project is known and agreed to, the developers must be included to allow the creativity of the marketplace to refine development concepts while meeting the needs of the transit agency and the community. It's all about creating destinations, fun places to be, and offering a high quality of service to the sites or stations.

Finally, it is critically important to know the market and get involved at the planning stage in terms of creating station area development and weaving parking needs into the community. Our transit agency wants to develop a high quality system of transportation, not just singular, disjointed projects. Pittsburgh's West Busway, opened in September 2000, is an excellent example of the current state of the art in BRT systems. A variety of project types have been tested in Pittsburgh, including urban new development, integrated town centers, suburban transfer centers, and urban redevelopment sites as well.



INTEGRATING LAND USE & TRANSIT PLANNING IN THE DULLES CORRIDOR

Leo J. Bevon, Director, Virginia Department of Rail and Public Transportation

Dulles Corridor, Washington's High-Tech Corridor, includes the major regional activity centers of Tysons Corner, Reston/Herndon, Dulles Airport and Eastern Loudoun County. The Dulles Corridor Rapid Transit Project is a four-phase rail development program involving a 23.5-mile extension of the Metro rapid transit system in the form of a Bus Rapid Transit system. The BRT will use the existing infrastructure of the Dulles Airport Access Road and the West Falls Church Metrorail Station as an Intermodal Terminus. The Dulles Corridor BRT will feature median stations, off-line stops, and a vehicle fleet of 60-foot low-floor articulated buses, level boarding at station platforms and stops, and prepaid fare collection. Amongst the technology enhancements of the Dulles Corridor BRT will be electronic fare collection, real-time schedule information, and precision docking at stations.

Some of the challenges facing the development of the Dulles Corridor BRT are encouraging transit-oriented development in a suburban highway corridor and developing land use policies and plans to match phased implementation of rapid transit. In Fairfax County, land use planning efforts have moved forward concurrently with transit project development processes. Specifically, Tysons Corner BRT station land use plans will allow certain land use changes when "rapid rail" is constructed: mixed-use development within ¼ mile of transit stations, density bonuses near stations and additional office and residential development. The Reston/Herndon BRT station plans involve: Development that is concentrated within ¼ mile of stations, mixed-use and higher intensity development, density increases with BRT and again with Metrorail, and design guidelines for transit-oriented development. At the Dulles Airport BRT station, special land use plans will involve: compatibility with the airport's master plan, use of airport property for transit facilities, coordination with ongoing capital improvements, and integrating the transit station with the airport terminal. Finally, the Loudoun County BRT land use plan involves: Rapidly urbanizing this outer suburb, a comprehensive plan to address growth issues, and the use of vacant land which provides the opportunity to make all station area development transit-oriented. The Dulles Corridor BRT is being constructed to address the projected growth in population and employment within the Dulles Corridor. It is projected that without additional rapid public transit in this area that traffic conditions will rapidly deteriorate. ♦

BRT Project Intermodal Interfaces/ Pedestrian Access

(Report of the TRB BRT conference, prepared by Session Moderator, Frank Spielberg, President, SG Associates, Inc., Annandale, VA)

Pedestrian access and egress is an essential element of all public transit services. Many proposed or existing bus rapid transit projects rely on on-street operation or use of a right-of-way at-grade adjacent to an existing roadway. Achieving safe and effective pedestrian connections are key to successful design of BRT stations. The presentations at this session illustrated varied real-world approaches used in a diverse set of cities to serve the needs of pedestrian access to busway operations in varied environments.

BRT PRESENTATION

Dr. Jack M. Reilly, Deputy Director, Capital District Transportation Authority, Albany, NY.

Dr. Jack M. Reilly reported on the planning for a BRT corridor connecting Albany and Schenectady via the NY 5, Central Avenue and State Street Corridor. The many goals for the project included not only stimulating and attracting transit ridership but also making the communities served pedestrian and transit friendly. Dr. Reilly illustrated the range of actions proposed including bulb-out bus stop areas that provide adequate space for passenger facilities while shortening the distance of street crossings, developing special bus lanes, constructing and repairing sidewalks both along and perpendicular to the corridor and provision of facilities to enhance the overall pedestrian environment. He described the planning process that had been undertaken to develop the concept plan featuring an active public participation process to introduce the concept of BRT and to solicit community guidance in identifying needed improvements for the Route 5 corridor. The varied nature of the corridor, ranging from older, dense downtown locations, through typical suburban development to essentially rural reserves, mandated that the facilities for both bus operations and pedestrians reflect the nature of the surrounding environment. Illustrations of the varied design concepts were presented.



INTERMODAL TRANSFER FACILITIES ON FOUR BRT SYSTEMS

Mark C. Walker, Professional Associate, Parsons Brinckerhoff, New York, NY

Mark C. Walker reported on the Intermodal transfer facilities in use at four existing BRT type systems – Curitiba, São Paulo, Quito, and Ottawa. He reported that the Ottawa system combines both on-street lanes and operation on special bus-only rights-of-way. Where special rights-of-way are used, Busway stations, comparable in design and scale to rail transit stations, have been constructed. The stations provide enclosed, climate protected, waiting areas. With few exceptions grade-separated pedestrian crossings of the busway are provided and crossing of the busway by pedestrians at-grade are actively discouraged. In Quito the buses operate in the center of a large arterial roadway. The typical station is high platform with a glass enclosure with in-station fare collection. Pedestrian access provisions across the mixed-traffic outer lanes vary. Where space is limited, access is via marked crosswalks but in other locations pedestrian overpasses have been provided. The BRT services in São Paulo and Curitiba also operates in the center of a major arterial. In São Paulo, center platform stations are served by buses with left-side doors. Access to the loading platforms is via marked crosswalks. For Curitiba's BRT operations right side loading platforms are provided. Pedestrian access and egress is across the adjacent mixed traffic lanes.



INTERMODAL INTERFACES ON THE SOUTH MIAMI-DADE BUSWAY

David R. Fialkoff, Chief, Service Planning and Scheduling, Miami-Dade Transit Agency, Miami, FL

David R. Fialkoff described intermodal interfaces on the South Miami-Dade Busway. The busway facility extends south from the Dadeland South rail terminal station and parallels US Route 1. The busway crosses intersecting streets at-grade with signalized intersections. The Busway development program included an increase in the level-of-bus service and the number of routes operating in the corridor. To accommodate the additional routes and the new services, the operating patterns at the South Dadeland Station had to be modified. The busway routes now loop the station boarding area providing loading and unloading bays on either side of the station entrance/exit plaza. The former kiss-ride area was incorporated in the bus circulation system. Kiss-ride activity was relocated across Dadeland Boulevard to the station parking area. This configuration provided direct pedestrian connections between rail and bus without any crossing of a roadway. ♦

Marketing and Fare Policy

(Report of the TRB BRT conference, prepared by Session Moderator, Roderick B. Diaz, Associate, Booz-Allen & Hamilton, Inc., Los Angeles, CA)

The Marketing and Fare Policy session reviewed general trends in marketing and fare policy across agencies planning Bus Rapid Transit systems. Two speakers presented specific strategies on marketing and fare policy and general bus rapid transit system planning at two agencies.

AN OVERVIEW OF BRT FARES AND USER INFORMATION

Janet E. Krause, Vice President, Mundle & Associates, Inc., Philadelphia, PA.

Janet Krause began the session with a summary of an informal survey she conducted on how agencies planning bus rapid transit are addressing fare policy, fare collection technology, branding and marketing, and the presentation of user information. Her investigation focused on whether or not BRT acted as a catalyst for innovation in these areas.

Ms. Krause cited several examples of projects. She described how the Metro Rapid program in Los Angeles presented several unique features which tie into a “branding” program – unique brand name, distinctive look, distinct vehicle with a dedicated fleet and separate bus stops. The program, in fact, was marketed with the tag line “Faster Service, Same Fare” and promoted extensively in conjunction with the Red Line subway system. Overall, integration of technology and alternative fare systems is proposed in future phases of the Metro Rapid program including variable message signs for bus information at stops and advanced fare technology.

Other projects are similarly at prospective stages of their planning. Boston is planning its “Silver Line” similar to its rail system, with the same fare, and off-vehicle fare collection at some locations (including the subway stations and some high-traffic surface stations). Kiosks with real-time bus information may also be installed. Lane Transit District in Eugene, OR is proposing Proof-of-Payment fare policies with inspectors combined with installation of Ticket Vending Machines at platforms. Miami-Dade Transit Agency in Miami is planning no significant changes to its marketing or fare policy. Aside from the separate right-of-way and a free transfer at the southern end of the MetroRail line, there is no separate identity, fare policy, or fare or passenger information technology. AC Transit (Oakland) envisions the same fare structure as the rest of its bus system. Proof-of-payment fare collection with multiple-door boarding and a unique bus color scheme are possible strategies. Finally, the Rio Hondo Connector in San Juan, Puerto Rico is planned to be part of the Tren Urbano system with the same magnetic fare card as the train, same graphics, and same fare technology (with TVMs at stations).

Overall, there is still limited innovation in marketing and fare policy, especially given the early stages of much of the planning for various bus rapid transit systems. Branding is not universal. Many agencies are retaining similar fare structures and fare technologies as the rest of the bus system. Where innovations are introduced, they are usually tied to system-wide programs such as “next bus” information systems and new fare cards.

BRT FARE COLLECTION/USER INFORMATION

Joseph A. Calabrese, Chief Executive Officer, Greater Cleveland Regional Transit

Joseph Calabrese provided a general overview of the Euclid Corridor Transportation Project and described several initiatives that the RTA is undertaking to support the project. The Euclid Corridor Transportation Project includes a combination of bus lanes both adjacent to the median and adjacent to the curb. Each application includes a specific design treatment. Specific prototype urban designs have been developed to visually integrate the various elements of stations including planters, street trees, lighting, public information signs, ticket vending machines, and pedestrian safety measures. All of these elements together grant the project a distinct design identity.

On a larger scale, the Greater Cleveland RTA is also supporting several initiatives to move the industries to support better vehicles for BRT. Specifically, the RTA is encouraging American manufacturers to produce vehicles that address the new market for advanced buses. RTA is also supporting common test standards for BRT to allow standardization in testing vehicles.

BRT USER INFORMATION-- HAWAIIAN STYLE

Paul Steffens, Chief, Public Transit Division, Hawaii Department of Transportation

Paul Steffens focused on user information on a different level, specifically on community outreach regarding the planned regional BRT systems in Honolulu, which are nearing completion of a Final Environmental Impact Statement. Mr. Steffens focused on three major ideas – Consensus, Communicate, and Celebrate.

Reaching consensus regarding Honolulu’s BRT projects involved several activities. First, local planners started with other plans to identify how livable community plans

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Innovative BRT Project Fare Collection continued

already included elements on transit. This investigation provided a foundation for subsequent activities. Local planners undertook surveys both of riders on board buses and at transit hubs and interviewed non-riders to gauge public opinion. Planners also conducted interactive workshops with fun activities to engage community stakeholders.

The Department of Transportation Services also undertook a multi-pronged approach in its communications strategy. Among its tools were a bilingual staff of “Ask Me” people who were available in the field when service changes were implemented. Other channels include bilingual literature,

banner announcements throughout the community, graphic animations to convey obscure transit concepts, clear maps and flyers, and implementation of real-time bus information signs at major stops.

The last major aspect of the community outreach for Honolulu’s BRT systems was a strategy to “Celebrate Transit.” This strategy acknowledged Honolulu’s and Hawaii’s local culture. Activities to “celebrate transit” included food and festive decorations at meetings, participation in parades, and luaus. All of these activities served to engage a broad cross-section of people. ◆

ITS Application for Selected BRT Projects continued

Priority is provided to late buses only, only at intersections with far-side bus stop locations, and under conditions that do not violate minimum times. Accepted priority requests can result in either an “early green” (red truncation), a “green extension”, or a “phase hold”. The last strategy holds the phase until the bus arrives and is typically used for left turns for buses. Green extension and early green is generally limited to 10% of current cycle length. Displays at the traffic control center show the status of each intersection using color coding so traffic engineers can monitor system operation. A headway maintenance load-balancing algorithm seeks to minimize bus bunching. Overall the Metro Rapid Bus system has achieved a 25% reduction in total travel time, and the TSP alone contributed to 30% of the total time savings. Bus delays at intersections were reduced by 33-39% with minimal impacts to cross street traffic.

In addition to TSP, the Metro Rapid Bus system provides a passenger Information System that records bus arrival time at each detector, and calculates arrival times for all downstream bus stops, and communicates this information to bus stops using CDPD system and LED real-time displays at stops.

PRESENTATION THREE

James Lightboy, Manager, Planning & Programming, Santa Clara Valley Transportation Authority, Santa Clara County, CA

The third presentation focused on the Line 22 Corridor Bus Rapid Transit project that is under development. Line 22 is the trunk line on this 27 mile corridor, providing 24 hour service and carrying 28,000 riders daily (18% of total system ridership). The BRT project will incorporate a number of ITS applications, including an Advanced Communication System incorporating AVL/AVI and an enhanced operations management center, transit signal priority (TSP), dynamic real-time passenger information, enhanced passenger security through CCTV on buses and at stations and direct emergency communications at stations, and enhanced fare collection system through proximity cards and off-vehicle fare media vending machines. The TSP system is being coordinated with CalTrans and will use existing traffic control loops to provide red truncation or green extension by an average of 10 seconds. An initial six mile test segment for the TSP system will be implemented in the Summer of 2002.

The three examples illustrate the key role being played by ITS technologies in recent Bus Rapid Transit systems. These projects are using advanced communications, automatic vehicle location, transit signal priority, customer information systems, etc. to both dramatically improve travel times for the buses, as well as enhance the customer experience on the system. ◆



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