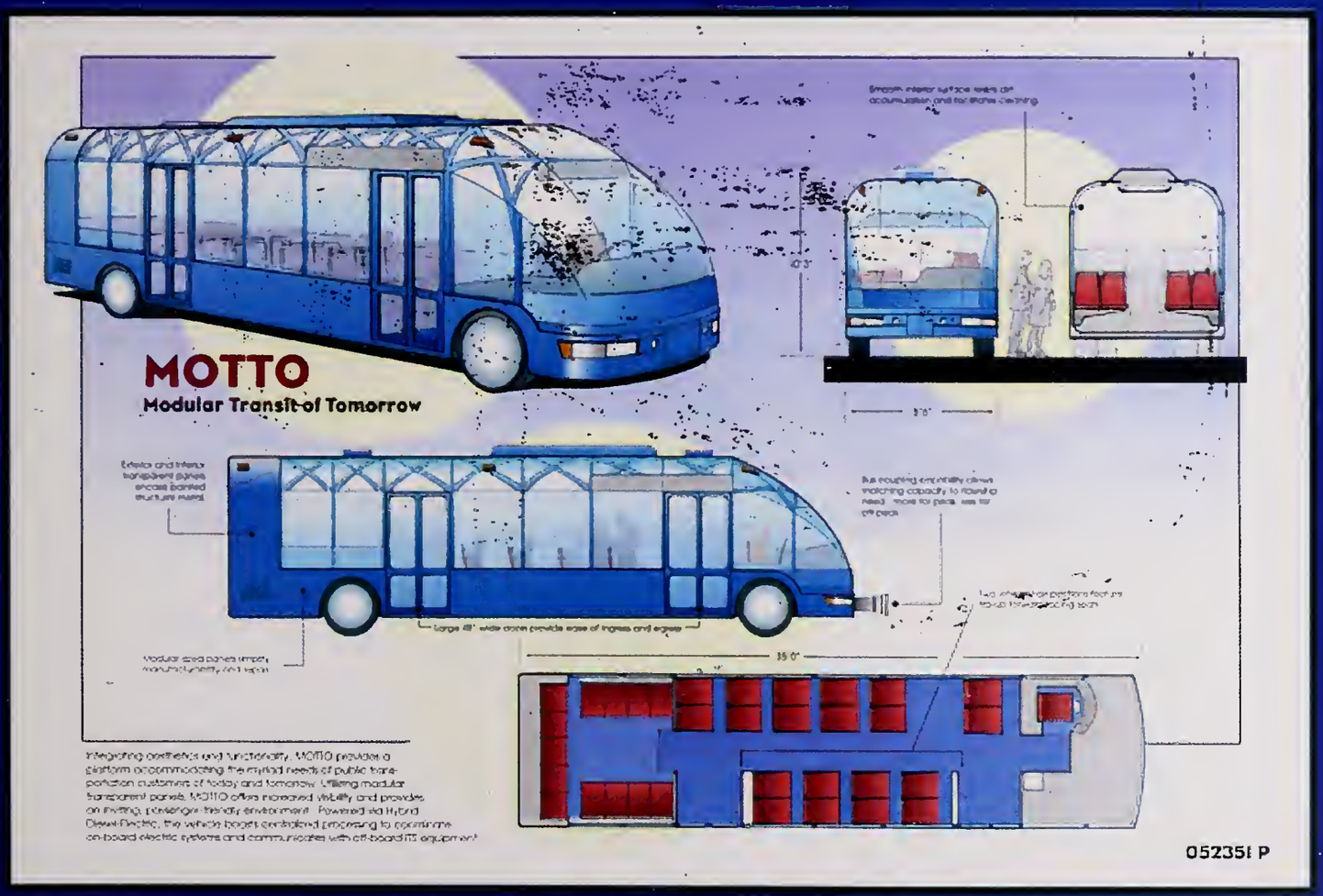
U.S. Department of Transportation

FTA

Proceedings of the

Bus Rapid Transit Vehicle Design Meeting



Washington D.C.
February 9, 2001

BRT BUS RAPID TRANSIT

PREFACE

This document was prepared for the Office of Research, Demonstration and Innovation of the Federal Transit Administration (FTA). The Bus Rapid Transit (BRT) Vehicle Design Meeting was held at the FTA offices in Washington, DC. Representatives of the BRT Consortium cities and industry representatives were gathered to discuss the vehicle design issues facing the projects and the manufacturers as these projects continue towards implementation. This summary was prepared by Eric Randall, Sue Mason, Donald Schneck and Douglas Skorupski, representing the Bus Rapid Transit Program support team of Booz·Allen & Hamilton Inc. This effort was funded under a Bus Rapid Transit Program assistance task of the Omnibus Contract with the Federal Transit Administration. Cover illustration is provided by Calstart/Weststart

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INTRODUCTION

The Federal Transit Administration's (FTA) Bus Rapid Transit (BRT) Program held a meeting on BRT Vehicle Design on February 9, 2001, at its headquarters in Washington, DC.

The purpose of the meeting was to discuss BRT vehicle issues with transit agencies and transit manufacturers/suppliers in an effort to promote cooperation. The meeting opened with a review of the FTA's overall BRT vehicle design and deployment strategy. This was followed by a discussion of the BRT vehicle strategy. Reviews of ongoing FTA activities were provided as background, with presentations on the European Scanning Tour, the Vehicle Design Competition, and a draft of the BRT Vehicle White Paper. An open forum on BRT vehicle design was then held, concentrating on cooperation among stakeholders and the support of technological deployment in BRT vehicles.

A list of attendees is included.

INTRODUCTION TO VEHICLE DESIGN/DEPLOYMENT STRATEGY

OPENING REMARKS

Mr. Edward Thomas, Deputy Administrator for the Office of Research, Demonstration and Innovation, Federal Transit Administration, opened the meeting with a review of two major program initiatives of the Bus Rapid Transit Deployment Program: Vehicle Design and Project Deployment. With the number of ongoing activities and issues in the BRT vehicle subject arena, FTA wants to ensure that these issues are openly discussed with transit agencies and transit manufacturers/suppliers. The intent is to avoid potential design and procurement difficulties that could emerge with the number of procurements for so few vehicles and with more unique characteristics than the typical bus procurements for the main bus fleet. By hosting this vehicle design meeting, FTA hopes to answer the question: "how do we work together in terms of a partnership?"

FTA has undertaken several projects and other activities to facilitate these objectives:

- The European Scanning Tour provided participants a review of BRT vehicle technology overseas, along with an emphasis on cities working together to introduce new, cost-effective transit services.
- The Vehicle Design Competition being conducted by Calstart/Weststart is another initiative. The FTA is not attempting to produce new vehicle designs but is rather working with cities to help formulate vehicle designs and to focus on the vehicle issues the cities are dealing with.
- The BRT Vehicle White Paper being prepared is a framework for the issues of procurement and funding as they relate to the introduction of new products to the industry (e.g. propulsion, other new technologies).

While funding for vehicle procurement is more available than it was in the 1980s and early 90s, the implementation of new products and technology is still a costly matter. Deployment of these vehicle designs and systems also requires more time to be spent on the newer transit

innovations. Learning curve impacts from the developmental phases of specification development, inspection, acceptance testing, operations and maintenance are all requiring increased attention to facilitate these challenges.

UNDERSTANDING THE BRT PROGRAM AND BRT CONCEPT

The environment for the U.S. bus industry is different today than it was at the bus summits in 1991 and 1993. At those meetings the critical issues were a lack of definition of the market and the unpredictability of customer related issues. Since the 1993 bus summit, FTA has undertaken several tasks to improve the procurement and design issues of buses in the U.S.

Funding – Since 1991, Federal funding for transit has doubled. A similar trend has taken place in local political environments too. In 2000, FTA obligated $7.3 billion: $6.3 billion federal transit program funding and $1 billion of highway funding. Part of this funding was a $173 million investment in R&D for the good of the industry - technology and developments in: energy storage systems, advanced electrical systems, lightweight materials, ITS and advanced propulsion systems. The theme of the new Secretary of Transportation, Mr. Norman Mineta, is to improve productivity: figure out what we have and how to use it. The focus is on cutting costs, reducing emissions, and improving energy management. The measure of success is an outcome in which the transit industry becomes more effective and efficient.

What is BRT? – There are several different definitions of BRT by local agencies and the federal government. According to DOT and as cited in the Federal Register, BRT is an integrated form of bus rapid transit that incorporates features of rail (e.g. rapid boarding, track, stations, customer service, cameras, and seamless transfer with other services – auto/bus/rail) and that can be incrementally implemented (i.e. some things can be done quickly and the system can operate in mixed traffic). Basically, BRT is an integrated bus system.

Understanding the BRT Concept – Studies by the architectural guild in California produced the following: a 40-foot bus without a lot of ancillary services can easily and quickly be implemented that can operate in mixed traffic but provide an improved, higher level of service

(e.g. Los Angeles or Honolulu). As BRT progresses, a standard 40-foot bus can operate on a devoted, exclusive right-of-way, doubling capacity. Articulated (60-foot) buses on a dedicated right-of-way can further increase capacity to 2.5 times that of a standard bus. Finally, additional elements, such as pre-paid fare, bus preference traffic control systems, ease of boarding and articulated buses, can increase capacity to 3.8 times. An additional step considered by FTA is envisioning and designing BRT as a stepping stone for future conversion to light or heavy rail (i.e. Dulles).

Examples of BRT range from the simple investments to enhance existing services to much more complex grade separated alignments. At the basic end, an example is the New York City Madison Avenue reserved bus lane. This was a community-inspired program, which improved traffic flow for all vehicles. The community had to be convinced that reconfiguring streets to make the buses more efficient would have good overall traffic congestion impact and not create problems for taxis or cars. More complex examples include: the Orlando Downtown Circulator, an exclusive bus lane; the Denver 16th Street Transit Mall, an exclusive facility with low floor vehicles providing seamless flow into and out of the vehicles; Pittsburgh with its dedicated busways; and bus lines on HOV lanes such as in Houston and Los Angeles or the I-95 corridor in Washington, DC.

BRT Development Program - FTA has sponsored the BRT Development Program to foster the development of BRT in the United States. The kickoff meeting of the BRT Consortium in August, 1999, included a survey of major issues in the cities: vehicles, traffic engineering issues, access to facilities, urban design and street furniture, land use, new technology and ITS, propulsion, and institutional and operational issues. The BRT Consortium currently includes 17 cities, 11 of which are already proposed for federal funding.

FTA is now concentrating on moving these systems further through the project development process. A two-part deployment strategy of vehicles and related technology allows incremental implementation. This allows BRT systems to demonstrate that they are having an impact and are improving service with new systems amenities such as automatic vehicle location (AVL) and signal priority systems improvements.

FTA is working with cities through the Offices of Planning and Program Management to include them in the discretionary funding programs, rate the various projects, and make recommendations to Congress about support of BRT efforts. Nine of the 11 cities proposing federal funding are in the FTA Planning Office New Starts Program. In addition, FTA recognizes that technical capacity may not be available in these communities and is providing limited technical assistance to cities in competing for New Starts funding.

Vehicle Deployment – FTA is fostering vehicle deployment through a number of efforts, including: the Vehicle White Paper, the Vehicle Design Competition (currently looking at proposals submitted), scanning tours, specific workshops, technical workshops, and other opportunities to deal with issues of vehicles. BRT could become a platform for deploying recent technology advancements - custom service-related systems, etc. - as is done in Europe.

The goal of this BRT vehicle design meeting is to produce a framework and an agreement for a vehicle strategy by which all agency and supplier stakeholders can work together. Cooperation is the only way to advance transportation projects in light of what is quickly becoming a worldwide phenomenon of constrained opportunities. The recent article in Metro Magazine highlighted that the many proposals for light rail heavy rail, commuter rail, and monorail in cities across the country can not even come close to being completely funded. Not all cities will get funding for new starts; they could be waiting decades for full funding to become available. To meet transportation demands in the near term, cities need to be prepared to make incremental improvements in bus transit service now - through the BRT program. "What can we do and how do we work together?"

BRT VEHICLE DESIGN STRATEGY

INTRODUCTORY REMARKS

William Siegel (FTA) introduced the vehicle strategy by emphasizing that the objective of this informal meeting was to get opinions and ideas about BRT activities and the application of BRT programs to vehicle issues. By brainstorming and organizing ideas and concepts, FTA hopes to move towards the development of a new modal alternative – something in between more traditional bus and rail services – with new types of vehicles, systems and operations.

A subset of the BRT Consortium, those planning to introduce a new vehicle design as part of their project, has been established. FTA is in the early stages of conceptualization with this vehicle consortium group – 6 to 8 agencies – in the process of vehicle design. The long-range program is to move these concepts to implementation – operation of BRT vehicles by transit authorities. Transit authorities need to provide details on the types of vehicles needed and when. Given identified needs and timelines, FTA can ideally coordinate with these agencies a joint procurement with a larger volume that will attract manufacturers into the BRT arena. This will in turn allow FTA to approach manufacturers and collect information from them on what they need and when they must start the vehicle design process – test and evaluation programs for the new technologies - to allow a final evaluation and implementation.

What is the process? FTA wants to involve all stakeholders in figuring out needs, details and concepts. BRT also needs to get ideas from the public and the transit industry. These ideas can then be assembled and consolidated, and narrowed down into a workable set. Technologies and specifications can then be evaluated - pieces and parts on a test bed basis - and then combined into a joint RFP for the transit authorities. Bus manufacturers have been invited to get involved from the beginning; FTA doesn't want to just involve a small group from the transit agencies.

OPEN DISCUSSION

Walt Kulyk (FTA) – The BRT Vehicle Design strategy is a work in progress. The design competition will lead into requirements analysis – the product will be guidelines or something similar (like the trucking industry), not an actual specification. The focus will be on the needs and requirements of building a class of buses that will meet BRT objectives. FTA is carrying out a number of efforts to get input: scanning tours, surveys, workshops, and an analysis of the costs of U.S. vehicles vs. European vehicles (why are they less in Europe?). From these projects and the input from stakeholders, maybe the industry can get a better handle on requirements and information needs. For example, the wheelchair tie-down regulations are different for rail and bus; maybe these should be made more similar to make travel more seamless for the disabled community. These concerns can then form the basis for a series of demonstrations – 2 or 3 in separate cities – maybe with 2 or 3 different vehicles.

Another concern is financing: how can BRT be paid for? Current discussion is to emphasize the deployment of BRT systems that are in a lower cost range, yet still able to meet city transportation needs. Can vehicles be made to address BRT needs that with minor modifications could be used for regular bus service, thereby increasing the market for manufacturers?

Bert Arrillaga (FTA) – The Curitiba Scanning Tour allowed participants to observe the multiple types of vehicles in use in that system. For instance, the bi-articulated buses introduced in 1992 provide capacity for the highest volume trunk line services while the smaller buses offer circulator and connecting services into the neighborhoods. Different platforms are needed to meet different needs. To improve BRT visibility in the U.S., perhaps FTA should sponsor a marketing consortium with a national campaign to improve the image of the bus industry. FTA is also sponsoring this meeting with manufacturers to get inputs on vehicles: tell us your thoughts about BRT efforts. The European bus industry is ahead of the United States in demonstrating certain elements of vehicles and we want your input. Manufacturers: what can we do in the future?

Ed Thomas (FTA) – Secretary Mineta believes that transportation should have a "brand name." Critical to this is the development of an open-system common platform that can be used for vehicles of all kinds. FTA's concept is a "Plug and Play" bus that could accommodate using advanced electronics and electric systems with plug-in features to meet different needs (i.e., fare collection, propulsion, etc.). The flexibility of the platform would provide manufacturers the capability to service customers based on needs and technical capability. This concept, linked as it is to procurement and system architecture, will be increasing in importance. Possibly an overly ambitious undertaking, but an opportunity to move the industry ahead unlike any other opportunity out there. The "brand name" concept could be as important as hybrid-electric propulsion.

Jim McLaughlin (LAMTA) – These are good ideas. It would be helpful to have this information from the bus industry before the APTA Annual Meeting. Get the manufacturers to participate and let us know what their capabilities are; match the two together. Input from transit properties can then be developed into a requirements platform.

Bill Siegel (FTA) – Taking the "Plug and Play" concept and coupling it with about a hundred other ideas is the objective of the process that we're trying to work through here. This process needs to be inclusive to succeed.

Jim Gleich (AC Transit) – Oakland needs to buy vehicles for a BRT project now, and we have next week to settle on a vehicle design internally. While deciding on the design now will help us in the long term, through the Scanning Tour we have seen things in Europe that we're intrigued with. Our intention is to procure the first group of vehicles with non-federal money, and we are considering several of the European offerings. In the future, though, federal money will be needed for procurement. Has there been any consideration of waiving the Buy America requirement for the BRT Program? If advanced vehicle designs start showing up in America and prove successful, it will stimulate industry here to produce buses that customers want to ride in.

Bill Siegel (FTA) – Reviewing the Buy America requirement is under consideration. This will not be accomplished in the near-term, but perhaps for procurements six months from now. Any waiver process will not impact most procurements. However, if there is a longer term need with advanced requirements or features that can not be found now, that is a possibility. Innovative technologies or designs can be tried; hopefully this will stimulate transit authorities and manufacturers to invest in such features earlier.

Dale Hill (TransTeq) – There is no grant money for our company, a small electric-hybrid manufacturer in Denver, even though historically more innovations come from smaller companies. We don't have the clout to get financial assistance. On the flip side, smaller companies can also take the money but not accomplish anything. In Europe, most technologies are funded by large companies. Bus manufacturers are larger there than in the U.S., and also interact more with their customers. What is needed is a grant program from FTA or another agency that will make funding available for those with proven track records in getting the job done. In North America, by virtue of the market, bus manufacturers are unlikely to have an R&D background. They have to turn to suppliers (e.g. Allison for drive trains) to produce what customers want.

Ed Thomas (FTA) – One proposal is the establishment of a joint partnership program for deployment of innovation. A 50-50 cost sharing agreement was suggested by which the public and private sectors can come together. In the past, there hasn't been the need to foster this relationship; now that innovative buses are needed, perhaps there is an opportunity to use joint partnership. Nor will this be limited to the United States; the international community is available too. Transit agencies interested in foreign products do have to deal with Buy America, which is a legal requirement, but will have opportunities to cooperate with foreign businesses. This is a policy architecture that will require cooperation, however, and stakeholders must be prepared to use the authority they have to do this.

This cooperation is a challenge to all stakeholders to pull it together. A proposal based on an innovative technology deployment or BRT deployment is under consideration for FTA's budget proposals. However, FTA doesn't want it to be undercut by the industry. FTA needs

information on whether consensus is possible and whether cities and manufacturers would support such a proposal. Or, would everyone go to Congress and do their own deals. The objective is that any proposal helps us as an industry. Joint partnership authority could be used in some select cases to deal with some of the issues of the small manufacturers. In addition, an international program could be developed with trade missions both from and to the United States. There is still a lot of work to be done on this however.

Jim Gleich (AC Transit) – Is such a joint partnership program funded?

Ed Thomas (FTA) – Not yet, though $173 million has been obligated for technology as a capital item. There is a possibility that joint partnership authority could be used in context with this appropriation.

Bert Arrillaga (FTA) – This program would be designed especially to do what you're saying, but there is no funding as yet and FTA can not go to Congress without having a consensus. FTA has been trying to get groups and consortia to get together to join in a partnership that's beneficial to everyone. Transit agencies would carry out research and development and have proprietary rights. Without funding, though, cooperation with the manufacturers must be pursued. FTA is looking both inside and outside for ideas and support on how to get stakeholders together to craft a request for funds.

Walt Kulyk (FTA) – There are a number of alternative ways to go about getting funding. One option is to request a Congressional appropriation during reauthorization for a demonstration program for which industry would set the parameters. Secondly, a pooled fund could be established. Stakeholders could contribute a small amount of capital money - $1 or $2 million - to the pool fund to do development work that benefits them directly. That money would then come back as a project that would benefit that site/city, if cities are willing to work with that kind of idea. A third option would be a variation of this, seeking planning and capital dollars. There is authority to do that in existing programs, but cities have not been using it. Perhaps FTA could help coordinate the development of a demonstration/deployment program that

could have parallel tracks. Instead of a generic vehicle, develop 2 or 3 varieties that would benefit BRT cities directly.

Jeri Chaiken (GCRTA) – What if a bus manufacturer came and wanted to participate in such an R&D program, and a technology or vehicle was produced, but then someone else took the idea and used it?

Rich Hitchcock (AVS) – There are several differences between these proposed joint partnerships and the DARPA process referred to earlier. One issue is determination of what types of rights industry retains; this needs to be addressed. It should be noted that typically a manufacturer's timeframe wouldn't accommodate 3 or 4 years of development.

There is a temptation to look to Europe, which has some very advanced physical aspects of vehicle design that are more applicable to BRT, for instance the interface with station/boarding. But in the U.S., drivetrain technology is more advanced. [**Dale Hill** (TransTeq) – The turbine TransTeq uses for on-board power generation is further advanced than in Europe. There is also a very advanced design in New Zealand.] This drivetrain technology is of interest to everyone, with an advanced plug-and-play concept offering greater design flexibility and with an integrated connection to the electronics/propulsion system. This technology offers an opportunity to tie-in other control systems (HVAC, power steering), all electrically operated and tied together, producing a more efficient and flexible platform. These same components can be used in both small and large buses, attempting to standardize across platforms. This is a more advanced system than is available in Europe.

If the United States is to continue to have a successful industry, Buy America is important and should be continued, but manufacturers should pursue taking the best of European designs and technical advances in the U.S. and combine them. The challenge for U.S. manufacturers is to change the current competitive focus from the standard 40-foot diesel coach to the implementation of innovative concepts. If there is a sufficient market, manufactures can take these concepts or reconfigure and repackage to accommodate different needs.

Jim Gleich (AC Transit) – An agency like ours isn't ready to take a leap in power plant technology. Though Oakland is committed to zero emission technology and has funding to implement it, that is not what we're buying here, which is diesels with proven power trains. Oakland is looking for a vehicle like the European vehicles, which are more appealing and serviceable.

Rich Hitchcock (AVS) – Based on our experience in the deployment of electric buses, one of the things we found was that the reasons customers ride are usually convenience and frequency, but that non-tangibles like quietness and non-polluting are two items at the top of list. Even a clean diesel with a nice interior still sacrifices those two features.

Jim Gleich (AC Transit) – Though diesel buses are certainly much cleaner and don't smell like they used to, public perception is more interested in something like the trolley buses. An electric or full size battery powered bus is wonderful, people like them.

Dharm Guruswamt (Inter-American Bank) – Ecuador uses electric trolleys, but cannot justify the economics of electric trolleys anymore and is now expanding its transit system with diesels because of money. Everyone loves them but the economics don't work. While features like an advanced drivetrain are important for the environment and efficiency, image is very important. The only thing that differentiates the Los Angeles Metro Rapid buses is that they have a different color. In Curitiba, there are buses that look different, unlike a typical bus. From the user perspective the system is configured like rail, with the interior appearance and the means of boarding/alighting very important. The current purchasing system in the U.S. doesn't address such elements, which should not be ignored.

Bill Siegel (FTA) – These are excellent ideas. Stakeholders need to pull these ideas together and pursue funding.

Jim McLaughlin (LAMTA) – As a priority, funding for a Joint Partnership needs to come first; this has been a long wait.

Bert Arrillaga (FTA) – Agree, but we need to convince stakeholders to in turn convince Congress. Cooperation is needed for this to happen.

Dale Hill (TransTeq) – Cooperation is definitely needed, everyone needs to get together. In reference to Oakland's comments, the issue is that so much of this technology is unproven. In the course of the European Scanning Tour, we visited a large number of transit agencies and looked at new technology. We would like to be able to offer it to our customers, but we also have to have buses roll out each morning. There is no track record for implementation of all these innovations. Where is there money available to assist cities that want to be leaders and will pay for this technology?

Bert Arrillaga (FTA) – In Curitiba, the average income is $500/month while the articulated buses cost $250,000. If we could spend as much money in a relative way, we would be rich. The problem is competition; we develop a competitive strategy to compete but don't have the manufacturers. Is there something we could do with manufacturers? Is this logical?

Dale Hill (TransTeq) – This is a North American problem. With only 5,000 – 6,000 buses purchased each year - which is not many - manufacturers are driven by availability of funds. All energy is put in to plants to sell and cover buses they've sold at a no-profit margin. When the market drops off, the industry suffers. There is no infrastructure to motivate current manufacturers to go anywhere in terms of producing new technologies. That is why current drivetrains are from the auto industry or airlines.

Rich Hitchcock (AVS) – Economies of scale affect costs; that's why developing countries are deploying buses that cost $65,000. That is what new technologies have to compete with in other countries. Technology is the other issue that drives costs. The challenge that new bus technology faces is standardization to lower costs. The way to standardize across different platforms is "Plug and Play".

Mike Gage (Calstart/Weststart) – The other opportunity is the private sector. The latest Federal Express RFI for a next generation vehicle is an opportunity for new vehicle technology

deployment. Both UPS and Federal Express are evaluating hybrid electric vehicles; when the private sector starts pushing hybrid systems into their fleets there will be real opportunities. Bus manufacturers will need to be alert to these opportunities or they will miss the next wave of technology, which is coming very quickly.

EUROPEAN SCANNING TOUR

INTRODUCTORY REMARKS

Walt Kulyk (FTA) – The European Scanning Tour allowed a small group of transportation engineers to visit some of the latest developments of bus technology in Europe, concentrating on vehicle designs, propulsion types, guidance, and deployment. The focus of the European Scanning Tour was on vehicle design and operations, along with integration with the environment.

PRESENTATION

- Trieste – The first city of the scanning tour was Trieste, Italy. Trieste is constructing a BRT system using the in-street electricity-supplying STREAM system to power Neoplan dual-mode buses. The entire project is being done by Breda. The STREAM BRT is designed for the market in between light rail/tram and standard bus, with a 1500 - 4000 passenger per peak hour capacity. The STREAM system has no catenary overhead wires, yet is environmentally friendly. The life cycle costs are also in between those of other modes such as tramway and guided bus, creating a market niche. During the tour, participants saw actual installation of the system, though it is not yet in operation. STREAM has contact lines and a 600 vdc cable encased along ground. Power is fed through a magnetic contact to supply the bus. Sophisticated and elegant, it is a straight forward solution. A magnet is the only connection to the actual line; there is no chance of interference or accidental connection. The bus can divert and then return to connection without problem. There is a snow/ice provision, though delegation members would like to have a better test of these features.

- Lausanne – Lausanne, Switzerland is acquiring a Neoplan vehicle similar to what Boston is buying. In Europe the model has less seats and more standing room

(butt rests). It is very heavy, 40,000 lbs., and expensive. The model has been in operation for over a year. Europeans look at bus design in a whole different way; their buses have a wonderful ride with independent suspension (none in U.S.). Participants got to visit the Neoplan facility. Lausanne is very hilly; the bus system is using a 60 foot articulated bus, a dual mode electric trolley with overhead catenary. The bus has impressive acceleration and power - though with a bit of a hum to the motors - as well as anti-lock brakes and excellent traction. A superb bus, with engineering that is some of the most impressive one will ever see. Other special features include the mechanism for door operation, which allows quicker boarding/alighting by moving to the side. In addition, the operator has a standardized compartment. Overall, the bus has the look and feel of a rail vehicle.

- Lyon – The tour of Lyon, France, emphasized that image is very important, a lesson that is important to consider in the Calstart/Weststart design competition. The vehicles in Lyon can also leave the busway for mixed right-of-way operation, adding flexibility to the BRT system. The tour of Lyon also included a visit to the Irisbus engineering facility, where the Civis and Crystalis models are being produced. The Civis bus has an extremely light rail type of feel, with sleek features and large windows and skylights; this is the vehicle chosen by Las Vegas. The Civis bus uses an optical guidance system; no other system in the world is as advanced. Matra developed this system. A camera, looking from 2 to 45 feet ahead, focuses on lines in the pavement. This system is $50,000 as an option, but the roadway technology is cheap. The guidance system enables accurate stopping and improves rider comfort. The driver is still there and can take over at any time, but the guidance system provides better operation that a human can.

- Rouen – Rouen, France, was the most striking. The BRT system is still under development in Rouen; when completed, the vehicles will be married with an on-street guideway, dedicated stations, and the Matra optical system. Rouen

will be a true BRT system with numerous features, and the system will have a running time comparable to light rail. The BRT system was developed as a less-expensive alternative to light rail. The projected cost is $11M/mile, for a total of $65M for the dedicated operation. The system will look and feel like light rail but for significantly less cost. Residents didn't complain over the choice; BRT will improve the look of community. On the street, the bus lane will be red and have a 1-inch high curb. This will allow limited access for cars and emergency vehicles if necessary. The deployed system will be a combination of dedicated and mixed right of ways, with signal priorities along the middle of street. This provides a very flexible system, a combination of many BRT attributes, that once operational will be very interesting.

- Essen – The city of Essen, Germany, has a BRT system with separate guideways and low-tech, mechanical guidance. The system is very effective with good ride quality. The guideway is precast before installation; this provides a smoother ride than if cast in place.

- London – The city of London, England, provided an example of a pilot BRT system from which many lessons are to be learned. Innovations of the London Millennium Dome system included a separate guideway, with electronic operation for precision docking. However, the system erred in design and the radius of the curve going into stations – the back end of bus stuck out. No electronics now. Another innovation was the use of magnetic guidance. The advantage of magnetic guidance is that the system concept could be used in all climates; magnetics can go through snow. The guidance system requires that cables be buried in the pavement; a frequency generator modulates the system to provide guidance and the bus picks up the signal. The lesson learned from this trial was that the camber of road made it difficult to line up the bus. In addition, there were several other small mistakes. One feature was that the guideway was built of pavers as an architectural effort to improve appearance; unfortunately ride quality was terrible. The system was set up to learn from.

- As part of the tour of London, Transport *for* London hosted a discussion of several technical projects under way. The most impressive of these was the project for real time bus information, available at about a 1/4 of stops and coordinated with signal priority and dedicated lanes. London is somewhat behind other systems on smartcards, but is catching up. The plan is to change out the fare systems on the entire rail network. Another innovation is the enforcement of a lane priority system by putting cameras in the front of buses to catch cars violating the lane restrictions.

- Leeds – The tour of the city of Leeds, England, was hosted by the private operator, First Leeds. All the transit systems in the UK are private now except London Rail and London Bus. First Leeds has experienced significant ridership increases in recent years on its BRT system. Similar to Essen in operation, the BRT uses reserved guideway in only a few critical areas, generally just prior to major intersections. Buses jump the queue by getting on the guideways, and then receive priority at the intersections.

CONCLUSIONS/OBSERVATIONS

- In Europe, BRT is being used as a systems solution. It is not simply buses on streets, but rather an integrated design from the beginning.

- BRT is an alternative to light rail.

- BRT can be successfully implemented in mixed right of ways.

- Advanced technological features such as electronic guidance and precision docking can improve operation. While these systems are still in the testing stages in the U.S., the Europeans are already in deployment.

- Vehicle costs are lower in Europe than in the U.S. FTA is commissioning a study to examine why.

- Europe has a different philosophy on wheelchair restraints that provide better/faster boarding time. There may be lessons to be learned from this philosophy; in the U.S. it may be time to reconsider ADA.

- Advances in vehicle design in Europe are impressive. The Irisbus Civis model has a light-rail appearance and design that is sharply different from traditional buses.

- There is a definite trend in Europe towards electric-based propulsion - more environmentally friendly. The STREAM propulsion system in Trieste is one example of this, though weather is an issue that still needs to be examined and tested.

- Mechanical guidance in certain applications is as effective as high-tech at a greatly reduced cost. (Cleveland is considering this.)

- Signal priority and other operating enhancements are city-wide in Europe; use of these enhancements is just starting in the U.S.

Jim McLaughlin (LAMTA) - The partnerships being formed in Europe go farther in breaking down some of the barriers in the industry. For example, the private operator in Trieste is partnering with the public operator in Paris. This participation of the private operator leads to a DBOM type of working relationship. How do we combine the private sector with what we're trying to accomplish in the public sector?

Fred Silver (Calstart/Weststart) – One example of improved cooperation is the development of a common cockpit architecture. This standard allows for driver training to be the same for all the systems, with modular components for some variations.

Doug Skorupski (Booz·Allen) – The steering in the common cockpit is set up the same on every dashboard; the basics are identical.

Rene Allen (Volvo) – The common cockpit is mandatory in Germany and doesn't come cheap.

Walt Kulyk (FTA) – Also in Germany, all fare payment is done on the honor system. There is a unit that checks payment, but the honor system simplifies operation.

Doug Skorupski (Booz·Allen) – In Leeds it is different, all fare payment is done at the single door at the front of bus. It is a nice BRT system, with different passenger loading times.

Jerry Trotter (APTA) – In Trieste, snow on the STREAM system is a concern. So is snow on an optical system; the driver can't see the white stripes. As far as other guidance technologies, the Essen mechanical guideway is sort of dead in the water, not being advanced. The mechanical guidance system in Leeds is still evolving.

Rich Hitchcock (AVS) – Cost comparisons will be crucial for new technologies, particularly for hybrid technology as well as the traditional diesels.

Marcel Belanger (FTA) – From a customer's point of view, what matters most is that the bus arrive now and a minute from now, and make a trip without a lot of stops. Frequent rapid service is best provided by 2 or 3 inexpensive buses rather than a single, high-capacity multi-articulated bus.

VEHICLE DESIGN COMPETITION

INTRODUCTORY REMARKS

Fred Silver (Calstart/Weststart) reviewed the BRT Vehicle Design Competition being conducted by Calstart/Weststart under the auspices of FTA.

- Background – The Vehicle Design Competition started in the summer of 2000. Calstart/Weststart developed a curriculum piece for universities and held a workshop in September.

- The product of the competition is the bus of the future, linking new transportation options to communities. A Metro Magazine article has been written, and there will be follow up exhibits.

- Goals/objectives – The competition seeks to create new vehicle designs and promote integration of bus design with transit systems, looking at land use and the transit network of links and hubs.

- The competition is designed to foster multi-disciplinary cooperation and promote BRT among universities, urban planners, OEMs, transit agencies, workshops, and communities. Outreach has been successful; the competition is high profile among policy and decision makers. Federal funding may be made available.

- The audience of the competition is widespread, with some 10,000 pieces of mailed information and posters.

- Participants in the competition represent several stakeholders, including transit authorities and manufacturers.

DESIGN COMPETITION

The design competition is in two parts. Part One consists of a "charette" style of competition focused on vehicle design. Part One closes at the end of February, 2001. Technical experts will review the submitted designs on March 3-4. All teams will benefit from suggestions.

Submission Requirements

- Part One – Each team must submit a sketch design of their vehicle - establishing an initial concept.

- Part Two – Teams will incorporate expert panel feedback and then submit improved BRT bus concept and details, integrating the vehicles into the transportation network stations and roadways, other transit systems, and transit enhancing services.

- Eligibility – The rules of the competition are very serious about design eligibility. Each team must consist of a design person, a planner, and an engineering person (architectural side – off-board side).

- Industrial contestants or teams of students who are studying these subjects must be together for a team. Skill sets are placed on a website for review.

- Workshops were held in Boston, Cleveland, and Tampa. These were a great opportunity to improve the quality of submissions and see what BRT is from each city's perspective.

- The competition has two tracks, one academic and one industrial. Universities will compete against other universities and industrial contestants against other industrial contestants for a $30,000 prize for Part One. This keeps the playing

field level and promotes the best offerings in both tracks. To assist in guiding the projects, a Technical Advisory Committee meets on March 5-6.

- Part Two – In Part Two the teams have to declare a community they will use - as real and evolutionary as possible. The entries for Part Two will have to be realistic, with financial estimates and an emphasis on practicality. For the final bus concept and community systems entries there are $25,000 in pool awards. There will also be a best overall design. The final review for Part Two will be held on June 6-7, 2001.

- The jury deliberation will be held on June 14-15, 2001. Presentations will be made in Washington, DC.

- There are 65 paid registrations to date; about 50% will probably submit (35). Participants are: 19 universities, 46 industrial, and 5 international.

- Long term outcome – The long term objective of the competition is for BRT consortium members to adopt some of the new concepts or designs. This will in turn hopefully involve community planners in adopting aspects of Part Two of the competition. The competition will also hopefully get new communities involved in BRT and contribute to increasing administration and congressional support for BRT. Enhancing the image of transit, with BRT as a new platform for how a bus is perceived, is the end goal.

- Short term outcome – The competition hopes to foster the funding and execution of limited demonstration projects. With a legislative strategy, high profile awards, and a follow-up competition with a traveling community exhibit, the results of the initial competition can be used as a basis for further outreach.

QUESTIONS/DISCUSSIONS

Ed Thomas (FTA) – From the competition, we hope to learn how to incorporate and integrate what we're doing and what the cities are doing. How do we wrap the results of the design competition into local cities? How does it affect the local community? How do we integrate? One alternative is to get an independent but related arbitrator, such as the American Institute of Architects, to get experts that have no "bones to pick" with the issues and who can facilitate bringing communities together. In this fashion, information can be gotten out to the local decision making process. Such a step may be controversial, but we need to integrate and work together. This is the type of recommendation that FTA really wants to follow through on.

Fred Silver (Calstart/Weststart) – The competition is intended to be a voice for the community. There was great value in the workshops, and the transit agencies have been very helpful.

Jeri Chaiken (GCRTA) – We held a very successful workshop, integrated with planning and the community.

Fred Silver (Calstart/Weststart) – Other monies come into BRT from roadway sources. It may be important to work with land development revitalization agencies such as HUD in the future. A BRT system bringing a more friendly nature to the transit system can revitalize a whole corridor.

Jim McLaughlin (LAMTA) – Though there are seventeen cities in the BRT Consortium and other cities also pursuing BRT, implementation is slow. The need is to get city engineering types and the broader community planning people involved in seeing concepts and hearing the message from others that transit might make transportation and development easier. Transit first policies need to be adopted, even if not necessarily adhered to or enforced.

BRT VEHICLE WHITE PAPER
[AND VEHICLE DEPLOYMENT STRATEGY DISCUSSIONS]

INTRODUCTORY REMARKS

Christine Gikakis (FTA) – The purpose of the BRT White Paper is to "get a handle" on BRT vehicle issues, though there is not really one BRT system that fits all of the vehicle concerns. The scope of the paper concentrates on understanding the vehicle, though some characteristics to define attributes - features and designs - of BRT are included, based on existing and planned BRT systems. The White Paper is a "living document." Information for the White Paper was developed in cooperation with manufacturers.

DETAILED DISCUSSION OF THE BRT WHITE PAPER

The BRT White Paper will include the following elements:

- Overview
- BRT Characteristics
- Summary of Information on BRT projects in the U.S.
- Potential BRT vendors
- Appendices

Some of the BRT System Goals include:

- Shorter trip times
- Short wait times
- Integrated
- Accessible
- Distinctive
- Easy to use
- Welcoming/friendly

Characteristics of BRT include:

- Operations
  - Dedicated lanes
  - Semi-dedicated lanes
  - Expressway operations
  - Mixed traffic streets
- Management
  - Central tracking of vehicles
  - Central security tracking
  - Articulateds (more capacity)
  - Passenger counters
  - Dependable service
  - Flexible service
- Characteristics
  - Rapid loading and unloading
  - Wider bus doors
  - More doors
  - Stations with platforms
  - Curb entry
- Rapid fare collection
  - Vehicle-based – passes
  - Station based

- System image

  - More rail-like operation
  - Dependable
  - Less frequent stops
  - More frequent service
  - Distinctive look
  - Modern

- Low environmental impact

  - Lighter chassis
  - Alternative fuels
  - Electric drive technologies

- Implications for BRT Vehicles:

  - High capacity – larger, articulateds, bi-articulateds
  - Easy accessible boarding – low floor, more doors, large doors, precision docking to raised platform
  - Distinctive and modern looking – new designs, wrap treatments, special paint
  - Smoother operation – advanced control, advanced suspension
  - Passenger information
  - ITS technologies for fleet management – AVL, loop detectors
  - Fare collection technologies – automated, smart cards
  - Comfortable quiet interior – layout redesign, low noise
  - Low emissions – clean fuels and propulsion technology
  - Dependable and reliable – proven technologies

- Types of BRT – each has implications for vehicle design and characteristics:

  - Express BRT system – geared toward rapid rail-type service
  - Urban shuttle BRT services – geared toward operation in heavily congested areas
  - Local collector/distributor BRT – provides access to transportation for riders in dispersed areas

CHARACTERISTICS OF SURVEYED BRT AGENCIES

Matt Hardy (Mitretek) - As part of the Vehicle White Paper, a survey of nine agencies that have BRT was performed, not including Hawaii, Miami, or Puerto Rico. A snapshot of July and August 2000 found:

- 8 – express
- 6 – express continuing on a downtown street or local neighborhood
- 2 – local collector distributor

Some commonalties among agencies:

- Primary goal – shorter trip times but different ways to achieve that goal
- Short wait between vehicles – road design, operations
- Integrated and accessible – parking lots or connecting with distributor
- Distinctive – all but one through unique paints, busways or stops
- Easy to use – all will use at least one feature (signs, low floor, platforms)
- Low environmental impact – CNG, clean diesel, 3 electric-powered, catenary. Some agencies knew they wanted to do something but hadn't decided on a particular fuel.

An additional survey of vendors was also conducted. These interviews were very limited, with only four companies interviewed; they were meant to get a flavor of what's going on – a reality

check. In the future, another survey may be conducted to expand the scope and incorporate more information. The vehicle paper does not identify who the vendors are in order to prevent bias towards one or another.

Themes from the vendors:

- More standardization means lower cost – this applies to all types of transit vehicles. Having numerous varieties with only a small number of each being purchased is a concern.

- Vendors can respond quickly to procurements with common components due to established vendor relationships. Establishing a new relationship is more cumbersome and increases the costs associated with adding new technologies.

DISCUSSION

Dale Hill (TransTeq) – Bus manufacturers want to take a standard bus and modify it for hybrid-electric. Yet, hybrid-electric technology allows you to produce a ground up design. No offense to standard bus manufacturers, but the standards were designed around diesel propulsion. This means that purchasers can't take advantage of hybrid-electric advances without driving up the cost of the vehicle. With all the new technologies going into vehicles, it becomes extremely costly and difficult to put in new technology without a redesign. In the long term, the cost of redesign might be less. The life cycle cost of a redesigned bus may be less than one with the current technology.

Rene Allen (Volvo) – Bus manufacturers can offer some very unique features. The difference between here and Europe is that while the Europeans modify, they don't certify. North American manufacturers have to recertify at Altoona, making bus modifications more difficult in the U.S.

Rich Hitchcock (AVS) – It's a matter of economics.

Rene Allen (Volvo) – For instance, if a customer asks for doors on the left hand side of a vehicle, we have to redesign it, then certify it to Volvo, and then go through the tests at Altoona. This is all expensive.

Mike Gage (Calstart/Weststart) – What are the primary reasons for maintaining the existing Altoona requirements and the concurrent high costs of meeting them? Is there a way to downscope the changes that require Altoona approval?

Ed Thomas (FTA) – This is a legitimate issue. Here we have seventeen cities with self-contained demonstration programs; that may give us enough leverage to look at different procedures for Altoona. Maybe it's time to revisit the legislation and regulations. For instance, perhaps we can make more use of simulation testing. What makes sense to the manufacturers and the transit agencies? Are we prepared to look at this issue? Look at ways to upgrade computer modeling capability. There is no reason why we have to physically test every model if we have computer aided systems. Maybe there's a class to test through simulation or a phased type system. We want to make it simpler and easier as much for the manufacturers as for FTA. As a customer, you need to be more proactive. FTA [Marcel Belanger] needs to hear about this from you in regards to bus testing. That is the only way we'll be able to make the process proactive and discover new ways to get at issues.

Dale Hill (TransTeq)– To add to what was said earlier, in regards to dedicating the cost of a bus to testing, everyone wants something in the next 12 months; yet 6 months must be spent at Altoona because of the time it takes to work everyone through. In addition to this cost – time is money – the need to expedite program testing and shorten the time frame is also an issue.

Rich Hitchcock (AVS) – We recognize their limitations at Altoona, but this is a real issue and is adding significant time to schedule, adding to cost. Time for testing is six months at a minimum.

Dale Hill (TransTeq) – In addition, if one part beaks then the whole vehicle has to go to the back of the line again. We are not being critical; this is simply something FTA and transit agencies need to be aware of.

Ed Thomas (FTA) – This sounds like we need a workshop on bus testing.

Fred Silver (Calstart/Weststart) – Are there procedures for testing hybrid-electrics at Altoona?

Dale Hill (TransTeq) – No, but there is a test protocol.

Doug Skorupski (Booz·Allen) – A charge sustaining hybrid-electric can be tested like a diesel bus, and there have been some new procedures developed for electric buses. For a vehicle like AVS' recent bus - a hybrid with a turbine battery pack (non-charge sustaining) - they may need to develop new procedures.

Dale Hill (TransTeq) – This is a real issue, particularly with money out there.

Doug Skorupski (Booz·Allen) – This is a trade off. There are good intentions to the tests to protect buyers, and they do these very well.

Jim Gleich (AC Transit) – As a cautionary note, we don't want to lower the standards that protect public money.

Rich Hitchcock (AVS) – The issue of standards and the time they take to test is not doing away with the program. It is more a question of streamlining. Do Finite Element Analysis (FEA) tests with computer data and simulations, and focus actual testing on questionable issues.

Mike Gage (Calstart/Weststart) – What if manufacturers could self-certify like the auto manufacturers do?

Rich Hitchcock (AVS) – They do self certify for FMVSS (Federal Motor Vehicle Safety Standards).

Mike Gage (Calstart/Weststart) – As to other specifications, Altoona will test you. But you as the manufacturer will be responsible for warranty that you meet the standards whether you've been tested or not.

Rich Hitchcock (AVS) – It is not really a standard; you have to understand Altoona testing. It is not a pass/fail test or a matter of testing components in a certain way. Some subsets of tests are like that, but these are minor.

Bill Siegel (FTA) – This is a very emotional issue, but we don't want to take up too much time. FTA is on the hook to do a workshop with the manufacturers on bus testing. FTA has also been after Altoona to do new things. Let's move on and postpone those discussions for bus testing workshops.

Christine Gikakis (FTA) – Bus testing is an issue for BRT vehicles too. There are still essential elements to be resolved on how BRTs will fit into the program. For instance, Buy America provisions came up as an issue in vendor discussion. How should they be addressed?

Rene Allen (Volvo) – There is a lot of confusion on what exceptions there are. This is a limited arena that people don't often deal with, they want a better understanding.

Christine Gikakis (FTA) – Buy America is a legal requirement. There is a section on the FTA website on Buy America provisions.

SUMMARY OF ISSUES

Issues that need to be addressed include:

- Procurement strategies

- Specialized vs. standardized platforms
- Integration of multiple technologies
- Testing requirements
- Availability of technology

Outlook for BRT:

- Can be a platform for innovative technologies
- Can be a vehicle based on a common platform but able to accommodate new technologies as required
- BRT system can be an effective transportation solution

QUESTIONS OR OTHER ISSUES

Dale Hill (TransTeq) – When will a copy of the Vehicle White Paper be available?

Christine Gikakis (FTA) – It's in draft form currently. Perhaps within the next several months when comments are incorporated.

Bert Arrillaga (FTA) – There are still a lot of issues not covered. We need to decide whether we expand the White Paper to cover these additional issues.

Ed Thomas (FTA) – FTA started the effort on the White Paper because of considerable interest in vehicles from the seventeen BRT Consortium cities. Several working groups for BRT were set up, of which the vehicle group is the most active. They have weekly or biweekly conference calls, and there is frequent communication. The White Paper has come together from their input, and FTA decided to publish the paper based on their interest. One of reasons we are discussing the White Paper today is so that everyone hears about it; we don't want surprises, rather we want you to provide some input. FTA is here to serve you by dealing with some of these issues if we have lots of input. Many of these issues are also issues for the entire bus industry; BRT is a vehicle for the purpose of surfacing wider concerns to resolve some of these.

Please provide feed back after you read it. We want to deal with the broader issues and then work our way closer.

Rich Hitchcock (AVS) – You've identified the different types of BRT operations - feeder and express - and the vehicles which will provide higher capacity and rail-like service, but these vehicles may not work as well for other applications. From a personal viewpoint, the use of the term proven technology, whether it means proven to be reliable or it means something that's been around forever, needs to be clarified in the White Paper.

Christine Gikakis (FTA) – Eight of nine project cities are looking at express service as one platform. The urban type applications have different needs.

Dale Hill (TransTeq) – There are different ways to provide higher capacity; faster doesn't necessarily translate into higher capacity.

Christine Gikakis (FTA) – BRT can serve as a transportation solution in the national parks. In the Grand Canyon, for instance, there was a study on light rail; they have now gone back to reevaluating bus service because of cost and the new ways to provide bus service in new and appealing - image - ways.

Mike Gage (Calstart/Weststart) – The comments on the White Paper are very valuable. What wasn't picked up in the generic discussion but did show up in Mr. Thomas' opening presentation was the evolution of BRT. The LA Metro Rapid bus operates without dedicated lanes but dramatically improved travel times and service. The success of the service is helping another plan by convincing merchants about the usefulness of dedicated lanes. Metro Rapid is one step in the evolution process where eventually they plan to have dedicated guideways. There is another opportunity for evolution in White Paper. In the Federal Express RFI that I read, one of the specifications was to maximize the use of recyclable materials. This is not a known quantity, but looking at proposals it seems likely that an environmental piece could be added with low cost.

Rich Hitchcock (AVS) – Vehicle acquisitions by FedEx and others offer an economy of scale issue. If the drivetrain these vehicles use can be similar in structure for a bus, there is a considerable potential for savings from economy of scale. One of the issues when you talk about cost – it will be an issue – is that standardizing components across different platforms should be a key strategy. One of the challenges in the electric propulsion industry is that there's no Cummins or DDA that can spit out electric engines.

Fred Silver (Calstart/Weststart) – Another comment. When you mentioned "wrap" on the vehicles, were your referring to advertising or for a different look?

Marcel Belanger (FTA) – On wrapped buses the load bearing structure is hidden; this makes the bus look different at fairly low cost. Another thing we noticed on European buses is that their wheelwells really intrude into the passenger area.

Fred Silver (Calstart/Weststart) – The drive system intruded more on the Neoplan low floor. Iris, not as far ahead as Neoplan, had to go to extra wide wheels.

Marcel Belanger (FTA) – The issue is important for fast loading/alighting. Especially for disabled the issue is level boarding rather than low floor. Platforms are needed to get people on and off quickly.

Rene Allen (Volvo) – In Curitiba, the bus height had to be changed. The door opening is on the level of the first step in a high floor bus. The bus has to be modified, for instance, raising the roof, which is structurally difficult.

Marcel Belanger (FTA) – One solution is to replace stairs with a lower ramp; instead of focusing on low floor, raise the platform.

Dale Hill (TransTeq) – Once you make these modifications, you have a bus that's totally dedicated to that BRT route and can't interchange with the buses on other routes. You need

buses that can do both. A better solution may be low profile tires to lower the wheelwell and put seats over it, until you have a 14-inch floor off the ground.

Jim Gleich (AC Transit) – That is a partial solution. Ramps are a big issue too. Even if they meet standards, they are frequently too steep.

FINAL DISCUSSIONS

SUMMARY OF FINAL DISCUSSION

Ed Thomas (FTA) – The points covered today were:

- Overall strategy – what are the advantages with coming up with a vehicle deployment strategy for agencies and manufacturers as well? If you have some additional thoughts on strategy to share, please do. Ideas on how to continue with the strategy are open to discussion.

- A certain level of cooperation is required. Each agency can't charge off independently; there must be some level of cooperation with other stakeholders.

COMMENTS AND GENERAL DISCUSSION

Jim McLaughlin (LAMTA) – FTA should be congratulated for its time and effort in this arena. What's missing from the industry side is an effort to provide the same level of consistency back to you. More stakeholders must be engaged on industry basis; the same issues get raised by different parties at different times. There has to be some way to winnow out on the vehicle side. There is generally strong concurrence on BRT issues, which the projects are trying to address. There is less consistency as it relates to the vehicle side. Everything that's a minor detail on the vehicle side can be a make or break for a small firm, as can inconsistencies between projects, or time delays. All of these can cause difficulties.

There was a TRB session on BRT - lots of interest at the session on the capacity of BRT and whether this is a mode. Interest was raised about how BRT fits in; its potential to fit in as a mode to carry a lot of people. BRT stakeholders need to come to some collective conclusion about where we're going. In the short term, we need to take what exists today and then ramp up with FTA and APTA, get additional R&D funding, and increase interest from others. We

also need to develop a consistent strategy on the vehicle side and have some agencies sign off on it. And we must get more people from industry engaged on a regular basis.

Ed Thomas (FTA) – Appreciate the compliment, and will pass it on to Walt Kulyk and Bill Siegel who took the lead in getting you together today. We were also hoping to see some subsystem suppliers here today. Examples of auto technology, for instance drive by wire, need to be considered. We also need to think about how to do this on a business level. In the future, software developers are likely to be the manufacturers, and current manufacturers will become assemblers. The brains and heart and soul of vehicles will be electronics. The auto industry is aware of this and is planning what they will do about this trend. The concept of a parallel effort more attuned to the manufacturers is a great idea; we will have to look at how we can make it happen. Obviously we need to continue this effort with our direct customers, but it would be useful to reach out and expand industry participation and numbers.

Walt Kulyk (FTA) – How can the federal government help? Industry needs to get behind itself as well, but is there a focus role for the federal government?

Jim McLaughlin (LAMTA) – What gets people's attention is money. There needs to be some way to talk about how to get to the next step for potential funding, and how to build partnerships and have FTA help with less traditional approaches to the current way of doing things. In Europe, we talked to people with multiple ideas about priorities for vehicles. The concern is that, instead of building consensus, as the vehicles become more complex we may need to winnow ideas.

Walt Kulyk (FTA) – There appear to be two courses to take. One is to try and develop consensus on a new vehicle and how it's different from the old ones. This is the White Book kind of approach – don't think that's the way to go. The White Paper lists the positive characteristics for BRT vehicles, which are also good and positive for other buses: ease of ingress, ease of fare collection, uniqueness, look, attractive, not same old bus, etc. All those characteristics can be successfully applied and help transit authorities to attract ridership.

The other course is that there are a series of characteristics, desirables, and goals for buses. A facilitator is needed to get industry to use their purchasing power to move manufacturers toward improved vehicles. We want these features. We do not want to set up a series of specifications in the White Book approach that are mandatory and don't permit each stakeholder to use its creativity to meet the functional goal. Hopefully, FTA invested technologies can be used in more creative ways. If a White Book specification is for 300 vehicles, the vehicles will be very expensive and there will not be much competition. Ideally, you want to have 3 or 4 manufacturers able to split development costs and willing to put money into a technology you want.

Eck Chaiboonma (LAMTA) – We need to get manufacturers to sit down at pre-bid conferences. Maybe have groups at pre-bid during which we express what we want and listen to what the manufacturers have to offer. Unfortunately, most can't afford to come to this kind of meeting.

Rich Hitchcock (AVS) – Maybe you need to have manufacturers do a show-and-tell and let them show how they're meeting these goals.

Bert Arrillaga (FTA) – From the manufacturing and operating points of view, we are slow in dragging some innovations in. For example, buses don't have toll passes in Virginia, but autos do. There can be large planning audits that come up with suggestions, but how can we get basic technology implemented? What can we do to apply these innovations? Do we have to spend big bucks before we can get these technologies? For example, self-service fare has worked in bus and rail systems; so many more could use it. Maybe the solution is to form partnerships or get together more often.

Fred Silver (Calstart/Weststart) – Is this a BRT issue or a transit issue in general?

Ed Thomas (FTA) – We're raising the question of leadership. Goals and objectives for BRT have been identified that are also transit goals: safe, quick, and reliable. What do we have to do to lead the industry towards innovation? What on the federal side and what on the local side? If we gave you more money would we see more AVL or signal priority or is there something else

you want? There are other demands on each agency's system; worries about maintenance and operations are likely to be more pressing. This conference raises the question: how do we get innovation into the industry? How do we get manufacturers and transit agencies to move forward together?

Jim McLaughlin (LAMTA) – We have already accomplished this to some degree, and have identified attributes that make it work better. A seamless fare system with its emphasis on getting people in and out is one. Maybe we have to look at our culture too. How can we get attributes out there and reinforce them a little broader than with only BRT? Additional customer feedback and testing in the customer market is needed.

Fred Silver (Calstart/Weststart) – We need to make BRT lingo easier, guidelines to at least help you explain or articulate your goals for BRT - what you have and what you want. Don't make it difficult for newcomers - all these guidelines, standards, long-term goals. Need to define some of the nomenclature. Getting the word out is important and will help people understand what we have and don't have in BRT.

Bert Arrillaga (FTA) – Again we are back to the issue of leadership. The federal role may be too bureaucratic. How do we form a partnership to do these things and be leaders? Our industry is so big. How can we form the leadership to implement these concepts and ideas from the manufacturers? This is a role that FTA needs to define and be more effective in accomplishing.

Jeri Chaiken (GCRTA) – There are other decision-makers that come into play after we agree on this; GAO is doing a study on BRT too. Do we need to bring them in? We need to bring them into the loop, or have one-on-one meetings, so that ultimately we get more money. This will enable us to use those other influences that normally we wouldn't be able to.

Ed Thomas (FTA) – That's a good point. We talk a lot but don't get down to the nitty-gritty; we should be more organized in how we engage them (i.e., the GAO study). More importantly, do we in fact know who's in the game and may have some say in where BRT will go? For instance, a Congressman may raise a question about a study effort, and likely have some specific interest.

Also need to know what partnerships are possible. Typically, FTA's been thinking in areas where there are issues of intellectual profiting, where it's difficult to sort out ownership and rights issues. We took what was a program that DoD had developed through DARPA to expedite R&D projects where intellectual profiting is an issue. It's a big issue in lots of areas of the federal government. DoD really took advantage of the "other transaction" category. Instead of grants or cooperative agreements or contracts for R&D, DoD called them "other" transactions or agreements.

We had some experience in train control in San Francisco and decided to incorporate it in our legislative proposal. Our side calls it an "Other Agreement." One possibility is to negotiate between a transit agency as the primary party and a private party that has a system to sell but that needs improvements before it can come commercially practicable.

What are some other opportunities? We have the wherewithal to create these partnerships. In Tokyo, FTA was involved in a safety based IVS program. We were surprised at the relationship between auto manufacturers and the government through institutes and research institutes: all part of a third circle, work together very well, very impressive. There is a lot of technology that we are still experimenting with in the United States while they are moving ahead in incorporating in buses and trucks. The partnership they have between government and private industry allows them to work together. We are not there yet. It appears that partnerships are the way to go and offer opportunities for BRT, for instance ITS applications related to drivers. Also such technologies as incorporating hybrid engines or other propulsion systems. To revisit the issue, where could we go with a concept that will get agencies what they need and let manufacturers work out issues on products that they are close to commercialization on but not quite ready for a proven label?

Mike Gage (Calstart/Weststart) – At Calstart, we have done this on the automotive side. We've worked under "other transactions" with some more restrictive conditions and under FTA section 26 grants; AVP other transactions weren't as easy as the DARPA program. Overall, these partnerships are a good way to go, but not all are successful. Some groups do better than

others. Opportunities for partnerships need to be reviewed in house. A partnership if you're having trouble - teaming with a transit agency - is an option.

Rich Hitchcock (AVS) – DARPA, under the electric vehicle program, actually deployed vehicles with new technologies in Chattanooga. All the stakeholders involved in deploying a vehicle with something added on or in building a vehicle want to incorporate new technologies. Transit authority, manufacturer and institute need to work together to do a project; this would be a positive approach for BRT. If a manufacturer has an idea to change a vehicle to meet BRT goals or a transit agency has identified a goal, then it reduces risk to transit agencies. There needs to be a mechanism that reduces risk to transit authorities; they are very risk aversive institutions. Buses need to be 100% reliable; these are public agencies where failures are not tolerated in dealing with public money. For all these reasons, there needs to be a different procedure put in place that doesn't promote risk avoidance and that bypasses the institutional and bureaucratic barriers raised to protect public money. If there was a pot of money that FTA could make available to bus manufacturers, this would give us a mechanism for deploying vehicles with new technologies. A cooperative arrangement among the 17 cities is needed to demonstrate how ideas work that would benefit all.

Walt Kulyk (FTA) – The heart of the issue is the funding. One proposal would be to take some of the bus money in the future, which will ultimately be put in BRT, from agencies that have common needs. Why couldn't we do phased deployment? Deploy vehicles as needed and then take 2 or 3 vehicles out of the deployment, add new technologies and do a test in a real city environment. The results of the test would then be used in the phase two buy - Rouen is doing this. I think it takes commitment by industry, as agencies may have to give up a number of vehicles for a given amount of time to do demonstration testing. Phase two would then be able to meet more of the objectives of BRT.

Rich Hitchcock (AVS) – This would be a very good strategy, allowing the use of procurement dollars.

Ed Thomas (FTA) – As a first step, we could probably do this if the number of projects, costs, and vehicles could be calculated.

Rich Hitchcock (AVS) – You need more than one vehicle for each prototype.

Eck Chaiboonma (LAMTA) – This is basically what we're doing now. The plan is to procure six buses from two firms and do deployment demonstrations. After their vehicles pass the tests, they will get an order. These are 40-foot low floor buses. In another program, the plan is to issue an RFP for high capacity low floor and buy 30 buses and do the same thing - a deployment so that we can be sure the vehicles and technologies are working correctly. Then we can bring the results back and share them.

Fred Silver (Calstart/Weststart) – Why can't we piggyback on and buy more vehicles for demonstration projects?

Rich Hitchcock (AVS) – There are other approaches to push technology, as manufacturers will be risk aversive too. What needs to happen is a cooperative operation; buy three of a type and work cooperatively with the manufacturer to make it better and see if it works. This is what the industry should be moving towards - increased cooperation with the manufacturers. Stakeholders can either meet this challenge aggressively and share the risk or give up and do 50% less. Take a less risky approach; cooperation will allow you to figure out how far to push and how to limit financial risk.

Bill Siegel (FTA) – One of the major reasons you were invited here is to build support for just that very thing. FTA would like to be a facilitator to try and put ideas together and allow things to happen; this would also help with the risk. While the budget is determined by Congress, we should be able to assist small projects. If we're really talking about accomplishing all these things we need to think about them as a group. At FTA, we need to present ourselves as a definable program with a progressive path, identifiable milestones and an output - that's how we have to be to sell programs. If you have ideas and would like to help out in testing some technologies, maybe not entire vehicles, there may be some ways to spread out the risk.

Overall, support is needed for a common plan - then we can go to Congress and say we've got a plan and we've got the country behind us. If FTA presents a plan we've all worked out then we'll get support for it. If we're not together then it won't fly.

Dale Hill (TransTeq) – One comment is that if FTA could use some of their clout with purse strings to control the program, we would support FTA.

Ed Thomas (FTA) – One issue that we have not really discussed in that context is having an overriding goal. That's what we really have to come up with: is there a goal? Leveraging the money or reducing and improving the energy management of vehicle to lower operating costs – whatever it is - we're going to have to form around some tangible achievable goal. This is an industry issue, not just BRT but also the entire bus industry. We could elevate the visibility of the bus industry, which is maybe where we want to go.

Rene Allen (Volvo) – The goal of transporting more people faster, with alternative propulsion systems to reduce noise/pollution, energy, and image - raising the image is very important - that is the real goal we're trying to achieve. In Curitiba, solutions were simple. If you want to carry people more simply you need simple solutions to implement: level boarding, dedicated priority way, high capacity. If you implement these [simple solutions], the bus can be anything. As for the other goals mentioned, we need to separate them out and determine how they will be met. LA wants buses now and can implement BRT solutions, but if we confuse them we'll still be talking in 5 years.

Bert Arrillaga (FTA) – Speaking of demonstration programs, they are unlikely to be really innovative and successful unless the risk is really shared. But because FTA is the driver of technology we have to lead. The goal of this is not just testing but implementation however. Because if you have a system that makes people say 'wow', then everyone will benefits from it. What we saw in France demonstrated and illustrated what can be done with new buses. There are multiple opportunities for a really expanded federal role in testing, learning and showing. A real partnership is what we have to think about.

Mike Gage (Calstart/Weststart) – When the goals of the nine agencies in the White Paper were presented, there were some pretty common goals. As was mentioned, many of these goals are common for the bus manufacturing industry as well, particularly moving people faster. Travel time, energy efficiency, and safety are important too. These are the key components of goals that we need to get cooperation on. Then we can move ahead with both some technologies that are not quite there as well as technologies that can go on the street today. Money should be put into this program too, some money to go to partnership development and some portion to technology demonstration.

Bert Arrillaga (FTA) – So we need a dedicated tax to get BRT cooperation going? Combine funds from consortium members and industry to have a program to illustrate and test new technologies?

Jeri Chaiken (GCRTA) – The other side of this is that you should have the entire bus industry involved; get the transit authorities together. As a suggestion for FTA, why not funnel some grants through the regions to get them on the same page? Dayton piggybacked on Cleveland and Boston. If regions are involved, this also gets transit authorities in the states where there are BRT demonstration programs on the same page. It would also help in coordinating the transit authorities on other projects too.

Dale Hill (TransTeq) – As a proposed plan, say FTA determines we're going to support four parallel projects to meet the same goal. You come up with a performance-based specification and FTA accepts - for the sake of discussion. FTA goes to the cities and says put up $1M and then FTA will double match, so you get 50% from the FTA, 25% from the cities, and 25% from the manufacturers. With four competing vehicles that will ultimately get you where you want to be faster and with more dollars to develop; three vehicles may also make a lot of sense. The danger is that the small players may be disadvantaged and not have the necessary financial clout. But this would be a plan that could be implemented in the near future.

Rich Hitchcock (AVS) – That would certainly be one way to structure it, though it is important to have transit authorities buy in to the concept from day one. Instead of taking a specification

to a city, the cities should work together to help define their requirements because there are differences between the various BRT systems. There would be less risk for manufacturers and transit authorities with FTA being the facilitator.

Dale Hill (TransTeq) – That will work if FTA takes the leadership role and everyone else has enough participation to take ownership. The way transit agencies are set up now, if they want a hybrid-electric bus they have to stick own neck out. The New York government went to bat for $20M for an electric-hybrid bus.

Bill Siegel (FTA) – Another comment that was made - is there any opinion that FTA should design this bus?

Participants – No, no.

Bill Siegel (FTA) – We're to be just a facilitator then.

Dale Hill (TransTeq) – Someone does have to take the lead, and since you have the purse to control capital acquisitions, it should be you.

Ed Thomas (FTA) – That is a sensitivity due to past issues. But from the comments and observations that are being made there are at least five things to do.

Jim McLaughlin (LAMTA) – The issue is that if FTA proposes some type of BRT program, how would the industry respond? Has APTA taken a position on having BRT as a separately funded category? If we could set that up in reauthorization, then other things would flow. If we don't set it up then we have a different issue. Where are we taking the money?

Ed Thomas (FTA) – This is an issue that is being evaluated. On the rail side there is a lot of technology available: signals controls, communication, etc. Some of these communication technologies could be used in BRT. Expanding core systems means a third category of rail, besides new starts and modernization, that is being discussed. How do we expand the capacity

of Metro without expanding the platforms and building more tunnels and using technology for that purpose? To rephrase an earlier point, is there a comparable situation on the bus side? Or is bus included in expanding the core system, using some way of accomplishing the objective without a major infusion of capital funds? Rail is using communications-based train control to expand. Having a separate BRT category may not be possible, but it is something we should look at.

Jeri Chaiken (GCTRA) – We need to determine if we need to ally with rail to see if we're all in this together. Is BRT part of RT?

Dale Hill (TransTeq) – BRT is an amorphization and will force the two together.

Marcel Belanger (FTA) – There is a continuum of different ways of providing transportation, with different levels of integration and service.

Bert Arrillaga (FTA) – There is an ongoing TCRP research project on ideas to support the deployment of technology to transit. APTA caught on to it during brainstorming in legislation workshops. They have been very supportive and strong in helping to develop programs. However, they are not able to do a lot because they only have so much money.

Ed Thomas (FTA) – APTA just conducted a strategy session on research and technology, examining their role. Deployment was one area raised by APTA membership. Moving on to an issue that we can all buy into: how do we do it?

Bert Arrillaga (FTA) – Agencies are certainly much more aware of it. There are lots of questions being put forward on how much is being deployed.

Ed Thomas (FTA) – I would say that there needs to be all kinds of money. The way this conversation is going, we're not talking about small dollars available through R&D programs; we're talking about trying to mainstream opportunities through capital funding. None of these ideas will get very far if it's limited to R&D funding. We need to elevate this discussion and

work with industry to fit demonstration projects in with capital programs where they will have more impact and require less strain.

Jim McLaughlin (LAMTA) – We need a bigger umbrella for funding some of these smaller dollar projects so that we can get innovation, while also taking advantage of things that can be mainstreamed.

Jerry Trotter (APTA) – Most of these issues aren't BRT only but bus industry-wide issues. BRT has the visibility to get these things done that will benefit the whole industry. A program like this would be a good way to increase technology funding and deployment.

Ed Thomas (FTA) – There is one other area to discuss and that's the international field. There is a lot going on out there. FTA is involved in some of it. There is a mission scheduled for Southeast Asia in June to take an international tour; we are working with the Department of Commerce to put a trade mission together. There will be a technology transfer workshop on design/build, as well as other opportunities for information exchange. We are also working with UITP, and a group from a partnership between UITP and the French and German governments will be participating. We will be working the international program intensively. Walt Kulyk mentioned that RATP and other European stakeholders have come together to talk about these same BRT issues. The question is: how do we work with them? Because we need to and we are. Exchanging information on BRT should be part of our international agenda as well as a domestic one.

Dale Hill (TransTeq) – We have been contacted by representatives on all continents; internationalism is an issue. If we had a developed vehicle then it would be marketable worldwide either as a vehicle or as technology. The biggest area of interest is from the Pacific Rim because of emissions. This is becoming a worldwide issue, and if the U.S. had an available marketable technology it could sell worldwide.

Rich Hitchcock (AVS) – AVS has some experience in the international market. There's a limit in how much you can export. Typically, you are more frequently talking about components.

Dale Hill (TransTeq) – There are global World Bank funds available for the worst polluted cities.

Walt Kulyk (FTA) – One lesson we learned from overseas. We met with RATP; they're the transit operator in Paris. They have an R&D arm like London Transport used to have. Their technologies will influence development in their country, and they have funding too. They have been able to forge a partnership with 20+ entities: French bus manufacturers (Civis), Bombardier, suppliers, all the cities looking at Civis vehicles, as well as entities outside France such as STREAM in Italy. They have taken one line outside of Paris and undertaken testing of vehicles from which they are all learning about the newest technologies. We don't know details about data rights, etc., but it's a perfect model that we can do. Though the way we address it with funding may be different.

Bert Arrillaga (FTA) – What is needed is a partnership with cities and countries.

Walt Kulyk (FTA) – Everyone is contributing something, cash or in-kind; it is a wonderful partnership. The projects we saw in Rouen included a visual based technology based on RATP developments. We need to learn from and bring this type of partnership up as a case study.

Jim McLaughlin (LAMTA) – We were really struck by Transport *for* London: standardizing these same attributes, their Prestige smart card program, and the integration with the city structure. There would be a tremendous opportunity to partner on a number of these projects; there are a lot of good examples.

Bert Arrillaga (FTA) – The French partnership had Las Vegas involved in it because of Civis. Their partnership is with European countries and with FTA.

Ed Thomas (FTA) – That concludes the session. In the near future, FTA is scheduled to meet with GMs and other policy makers soon, which will provide the opportunity to revisit some of these issues. We will consider inviting the private sector and will talk it over with agency staff.

Participants – We appreciate the time you've spent putting this together. Thank you for hosting.

APPENDIX A

WORKSHOP PARTICIPANTS

Name	Organization
Marcel Belanger	Federal Transit Administration
Irving Chambers	Federal Transit Administration
Lewis Clapton	Federal Transit Administration
Christina Gikakis	Federal Transit Administration
Althea Goodine	Federal Transit Administration
Walter Kulyk	Federal Transit Administration
William Siegel	Federal Transit Administration
Edward Thomas	Federal Transit Administration
Joel Washington	Federal Transit Administration
Rene Allen	Volvo
Eck Chaiboonma	Los Angeles MTA
Jeri Chaiken	Greater Cleveland RTA
Mike Gage	Calstart/Weststart
Jim Gleich	AC Transit
Dharm Gurusant	Interamerican Development Bank
Matt Hardy	Mitretek
Dale Hill	TransTeq
Rich Himes	North American Bus Industries (NABI)
Rich Hitchcock	AVS
Sue Mason	Booz·Allen & Hamilton
Jim McLaughlin	Los Angeles MTA
Fred Silver	Calstart/Weststart
Doug Skorupski	Booz·Allen & Hamilton
Jerry Trotter	APTA
Steve Warren	Connecticut Transit