LRT news

TRANSPORTATION RESEARCH BOARD

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LRT News is published intermittently by the Transportation Research Board to disseminate information on new developments in light rail transit planning, technology, and operations. The newsletter also reports on new studies, completed research, and current literature. The publication of *LRT News* is made possible through funding under the Technical Assistance Program of the Federal Transit Administration. Donald O. Eisele, editor. John W. Schumann, Chairman, TRB Committee on Light Rail Transit. Peter L. Shaw, TRB staff. Submit news items to *LRT News*, Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001, telephone 202-334-2966. ISSN 0162-8429.

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OF THE NATIONAL ACADEMIES

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The Return of the Streetcar

THE FALL AND RISE OF THE NEW ORLEANS STREETCAR SYSTEM

Background

New Orleans is one of seven U.S. cities that have enjoyed electric street railway service without interruption from the time service was first instituted. The other six cities are Boston, Cleveland, Newark, Philadelphia, Pittsburgh, and San Francisco.

Street railways, by their nature, are influenced strongly by the street networks on which they operate. There are two characteristics of the New Orleans street system that have particular relevance to this account of the city's streetcar system: the unusual pattern and the configuration of specific streets.

The major portion of New Orleans is situated on flatland south of Lake Pontchartrain and north of the Mississippi River. In this area, the river deviates from its general north-to-south course and flows from west to east on a serpentine path. As the city grew from the early settlements, it expanded in all directions but more rapidly along the river's left bank.

As the street pattern developed, it did not follow a strict grid pattern with 90-degree intersections. The streets were laid out generally parallel or perpendicular to the meandering river. Thus, the streets that parallel the course of the river do not have a consistent bearing, but instead have a crescent-shaped pattern that contributed to the Crescent City pseudonym. Most of the streets that are perpendicular to the river have a constant bearing individually but are not parallel to each other. Near the center of the crescent, the perpendicular streets are close to a north-south axis but deviate by about 45 degrees at the edges. Consequently, for the perpendicular streets the custom is not to describe travel direction as northbound and southbound, but rather as lakebound and riverbound. For the parallel streets, the direction is described as downriver and upriver, or downstream and upstream, rather than east and west.

The principal perpendicular street is Canal Street. It is a multilane thoroughfare with a wide median. The street forms the upriver boundary of the French Quarter, once occupied almost

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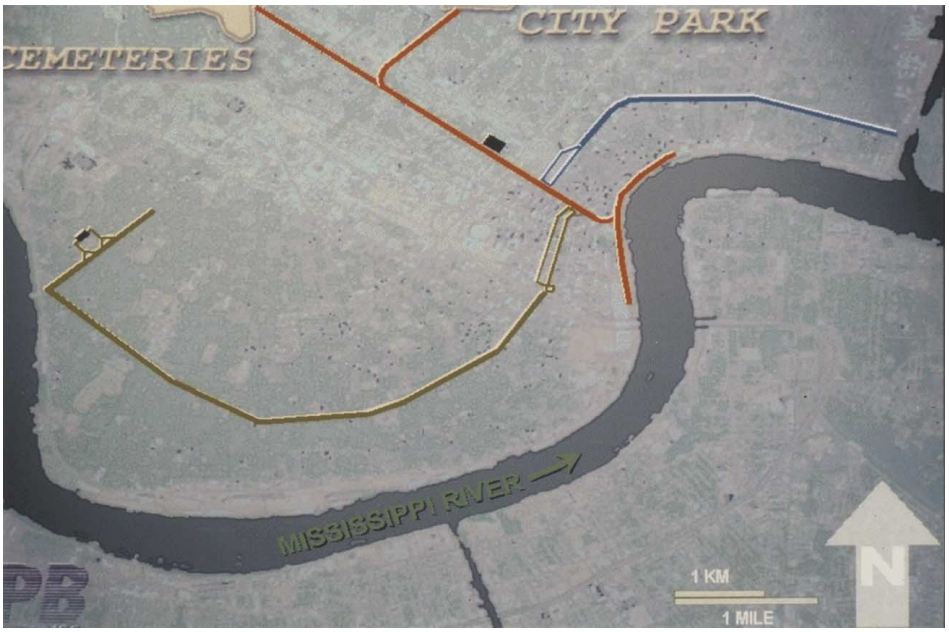

Mississippi River and principal street alignments, New Orleans.

exclusively by the city's Creole society. In the early 19th century, tensions between that society and newer arrivals to the city living on the upriver side of Canal Street became so intense that the median of the street served as neutral ground between the two communities. After relations improved, the term remained in use and is applied to the grassed medians throughout New Orleans.

The presence of these medians on many principal streets is the other characteristic of the roadway network that has relevance to the streetcar system. The neutral ground along a number of streets became the right-of-way for the tracks installed by the various pioneer street railway companies.

In New Orleans, the streetcar era began on February 1, 1893, when electric cars replaced mule cars on the St. Charles line. The mules were supplanted by electric traction throughout the city within the next seven years, after which the new mode continued to grow and prosper. By 1922, there were 30 electric streetcar routes and 362 kilometers [225 miles] of track.

From that zenith, the system dwindled over the following 42 years as buses replaced the streetcars on one line after another. Even the Desire line, immortalized by the Tennessee Williams play, was not exempt. It was converted to bus operation in 1948. By the end of 1964 only a single line remained.

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This last line was the one that had been the first line—St. Charles. It remained as the lone surviving line for more than three decades. Now, it is alone no more, but is part of a new and growing streetcar system.

The St. Charles Line—The Last of the Old Is the First of the New

The operation on the downtown portion of the line is classic city streetcar. The middle and outer sections of the line are semi-suburban in character.

The downtown terminus of the St. Charles streetcar line is in the neutral ground of Canal Street. Inbound cars arrive via Carondelet Street, cross the riverbound traffic lanes, turn right onto the neutral ground, travel for one block, and then turn right again onto St. Charles Avenue to begin their outbound journey.

Between Canal Street and Lee Circle at Howard Avenue, a distance of 1.2 kilometers [.7 miles], Carondelet Street and St. Charles Avenue operate as a one-way pair, downriver and upriver, respectively. The streetcars follow that pattern and run in a regular traffic lane on each street, as well as around Lee Circle.

Upriver from Lee Circle, St. Charles Avenue takes on a different character. There, it is a two-way divided roadway, and the streetcar tracks are located in the neutral ground, not in the traffic lanes. A little more that 5.5 kilometers [3.5 miles] from Lee Circle, the tracks depart from St. Charles Avenue and turn 90 degrees away from the river onto Carrollton Avenue. From that intersection, they continue another 2 kilometers [1.2 miles] in the neutral ground of that street to a stub-end terminus at Claiborne Avenue.

The line is operated with a fleet of 35 well-maintained, double-ended streetcars originally built 1923–1924 by the Perley-Thomas Company in North Carolina. Over the years, they have undergone several major overhauls, but today, as they approach the age of 80 (nominally, five or six bus lifetimes), they are not materially different from their original state.

They are not air-conditioned, and they have bare wooden seats. However, the windows can be opened and the seats are reversible, so that the passengers can face the breeze created by the cars' motion.

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The St. Charles line streetcars are dispatched from the Carrollton station, which is situated about one kilometer [.6 miles] short of the outer terminus of the line. This is not a passenger station in the traditional sense of that word. In fact, it is two blocks removed from the operating line on Carrollton Avenue. However, it fulfills the functions of a traditional "carbarn" in that it services, inspects, and stores the cars. Notably, the station also has the capability of assembling new streetcars. This element of the Carrollton station is playing a major role in the restoration of the city's streetcar system.

The Riverfront Line—The Reversal of the Trend

In 1983, ownership and management of the transit system was transferred from New Orleans Public Service, Inc., to the Regional Transit Authority (RTA), a public agency. In 1985, less than a quarter-century after the streetcar system had been reduced to a single line, the planning of a new line began. The seeds were planted for a new upsizing trend.

New Orleans, like a number of other American cities with a navigable waterfront, addressed the decline of riverfront industrial activity and the exodus of businesses that were no longer dependent upon water transportation by acquiring some of the vacated land and redeveloping it as an entertainment district. As part of this redevelopment, a segment of a riverfront railroad track, which had become redundant as the industrial role of the waterfront diminished, was acquired from the railroad for reuse as a streetcar line.

The track was severed from the railroad system, modestly realigned, and electrified. Using this track, a new 2.5-kilometer [1.5-mile], single-track streetcar operation, named the Riverfront line, was initiated to link the French Quarter with the Morial Convention Center and various new tourist attractions along the river. It included a short passing siding at the midpoint and a small storage yard, which was constructed on some adjoining property that was left over from the 1984 World's Fair.

The Riverfront line opened on August 14, 1988, using four cars. Two cars were repurchased New Orleans streetcars that had been sold years earlier after becoming surplus as a result of the conversions to bus operation. The other two cars were retired tramcars from Melbourne, Australia.

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The new service became popular instantly, so much so that a single-track line and four cars could not handle the demand. Furthermore, there was a market for service beyond the ends of the original line.

The line was extended and the car fleet was expanded by 50 percent through the reacquisition of one additional former New Orleans streetcar and the purchase of a third Melbourne car. By August 31, 1990, a second track had been laid, electrified, and placed into service, thereby eliminating the single-track operation.

With the advent of the Riverfront line, New Orleans once again had a multiline streetcar system. However, it was a system in name only. The venerable St. Charles line and the new Riverfront line were two physically separate and operationally incompatible streetcar routes that were located in the same city.

Being a new rail facility, the Riverfront line was designed to conform to the requirements of the Americans with Disabilities Act (ADA). The Melbourne cars assigned to the line were made ADA compliant through the provision of short, raised platforms set at the height of the car floors and located at one end of the regular platform. The raised platforms allowed level boarding similar to that of a subway train.

The St. Charles line is not ADA compliant. All passengers must negotiate steps in order to board and alight. Not only were the cars and the infrastructure of this line built long before the ADA was enacted, but its placement on the National Register of Historic Landmarks in August 1973 essentially precludes modifications that would result in the line becoming inconsistent with its historical nature.

However, this disparity of the laws and regulations applicable to the two lines is not what precluded melding them into one system. There were two far more significant issues: they did not intersect each other, and their tracks were of different gauges. The track gauge of the St. Charles line is 1,587 millimeters [62.5 inches], while the new Riverfront Line had used vestigial railroad track, which was standard 1,435-millimeter [56.5-inch] gauge.

To address these issues the RTA initiated the Riverfront Streetcar Line Regauging and Connector Project. The principal goal of the project was to give the cars serving the Riverfront

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Riverfront line.

line access to the Carrollton station and to retire the separate storage and maintenance facilities that had been set up to service the Riverfront line. In order to make the Carrollton station facilities accessible to the Riverfront cars, the two lines obviously had to be physically connected, and they had to have the same track gauge.

Ironically, the St. Charles line was originally built and spent its first 94 years as a standard-gauge line. It was constructed by the New Orleans and Carrollton Railroad Company, which adopted standard gauge for all of its lines. However, most of the other pioneer street railways in the area adopted the wider 1,587-millimeter [62.5-inch] gauge. As the various independent lines were melded into a comprehensive metropolitan streetcar system, the lack of a common track gauge caused increasing operating difficulties and inefficiencies. By that time the majority of track was of the wider gauge, and so the easier and less costly method of achieving uniformity was to widen the standard gauge tracks. This was done line-by-line over a period of four years. The St. Charles line was converted from standard gauge to wide-gauge during the weekend of October 2–3, 1929.

A half-century later, the second era of dual streetcar track gauge, which began when the Riverfront line opened in 1988,

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lasted for only nine years. In 1997, history repeated itself when the Regauging and Connector Project was implemented, and the Riverfront line's standard-gauge tracks were reconstructed to the wider gauge.

The other element of the project was the creation of a physical connection; both lines touched Canal Street. The Riverfront line passes the foot of the street at the Mississippi waterfront and 800 meters [.5 mile] inland, the St. Charles line uses the Canal Street neutral ground in the block between Carondelet Street and St. Charles Avenue as its downtown terminus. Consequently, the neutral ground of Canal Street offered an ideal right-of-way to connect the two lines.

The connection was accomplished by constructing a new branch of the Riverfront line. The branch comprises

- A double-track junction at the foot of Canal Street oriented toward the downriver end of the line,
- A pair of tracks situated in the neutral ground of Canal Street between the junction and Baronne Street, which is one block beyond Carondelet Street, and
- Track switches connecting with the St. Charles line.

Construction work on the project was initiated on February 24, 1997, beginning with the Canal Street connection element. The standard-gauge line continued to run until September 6, at which time the work on the regauging element began. Both elements were completed, and integrated operation of the wide-gauge Riverfront line and the St. Charles line commenced on December 13.

The regauging element of this project was limited to the infrastructure. It did not include the regauging of the six standard gauge cars. When the Riverfront line was shut down the standard-gauge cars were taken out of service. The three Melbourne cars were sold to Memphis for service on the expanding streetcar system. One of the three repurchased New Orleans cars was later loaned to San Francisco; the other two remain in storage.

The plans for developing the Riverfront line called for the acquisition of new wide-gauge cars, and the Carrollton station was mobilized to assemble them. The new streetcars were designed to resemble the historical Perley Thomas cars to the extent that is practicable. The significant differences are that they are fitted with contemporary electrical control equipment—European trucks that

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have resilient wheels and quiet gears and additional doors in the middle of the body that provide level boarding at floor-level platforms to comply with the ADA.

Completion of the Regauging and Connector Project made it possible to provide more flexible service. Although a majority of trips on the reconstructed Riverfront line run from one end of the line to the other, a few selected trips operate between the downriver end of that line and the inner end of the St. Charles line via the Canal Street branch. At present, only one specific car is assigned to this route.

These trips facilitate a transfer of passengers between the two lines, but no through service is operated between origins on one line and destinations on the other. An agreement with the Louisiana State Historical Preservation Officer stipulates that in order to maintain historic integrity, only authentic St. Charles streetcars can operate in revenue service on the St. Charles line. As a result, when the Riverfront line cars are traveling on the St. Charles line en route to or from the Carrollton station, they are out of service and carry no passengers.

The Canal Line—A Major Expansion

The next streetcar project that was undertaken by RTA was the development of a third line—the Canal line—which, when completed, will be a restoration of much of the pre-1964 line that bore the same name.

Extending the recently constructed Riverfront line branch on Canal Street outward from its current end at Baronne Street will form the new Canal line. The Canal line will comprise a trunk line and a spur. The trunk of this new line will extend from Baronne Street for a distance of 6 kilometers [3.7 miles] to the cemeteries in Mid-City. The spur will diverge from Canal Street at Carrollton Avenue and will extend about 1.25 kilometers [.75 miles] downriver from Canal Street to a terminus at the City Park. On the trunk, the tracks will be situated entirely in the neutral ground of Canal Street. The tracks of the spur will be installed in the left-hand, general traffic lanes that abut the neutral ground of Carrollton Avenue.

There is an existing RTA bus storage and maintenance facility on the downriver side of Canal Street between White

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Street and Gayoso Street. The facility occupies the site of the Canal station of the earlier streetcar system, which was dismantled and replaced by a garage when the original Canal line was converted to bus operation in 1964. This bus facility will be modified to accommodate a streetcar service and inspection and storage facility, which will be used as an operating base for the Canal line.

The new cars that will service this line are being manufactured at the Carrollton station. They are essentially the same as those built for the wide-gauge Riverfront line, but they will include air-conditioning. To camouflage the roof-mounted components of the air-conditioning system a roof monitor reminiscent of those used on many early 20th century streetcars will be added.

Construction of the trunk-line infrastructure commenced in September 2001, and work on the spur occurred in 2002. The entire Canal line, including the new service and inspection and storage facility is scheduled for completion in 2004.

The Desire Line—The Growth Continues

A fourth line, the Desire line, is now being developed and will serve the same section of the city as the earlier Desire line that was converted to bus operation in 1948. However, the new line will follow a different, but parallel routing—one that more closely approximates that of the St Claude line, which became a bus route in 1949.

The outbound track of the new Desire line will branch off of the Canal Street line at Basin Street, which is about 500 meters [1,640 feet] beyond the St. Charles line junction at Carondelet Street. The inbound track will connect with the Canal Street tracks at Rampart Street, only 350 meters [1,150 feet] from Carondelet Street.

The line will extend downriver from Canal Street to Poland Avenue—a distance of 4.5 kilometers [2.8 miles]. All but one of the streets that the line will follow are divided roadways with a neutral ground, but only a portion of the track will make use of those median reservations. Along the outer half of the line (i.e., the segment downriver from Elysian Fields Avenue), both tracks will be situated in the neutral ground of St. Claude Avenue.

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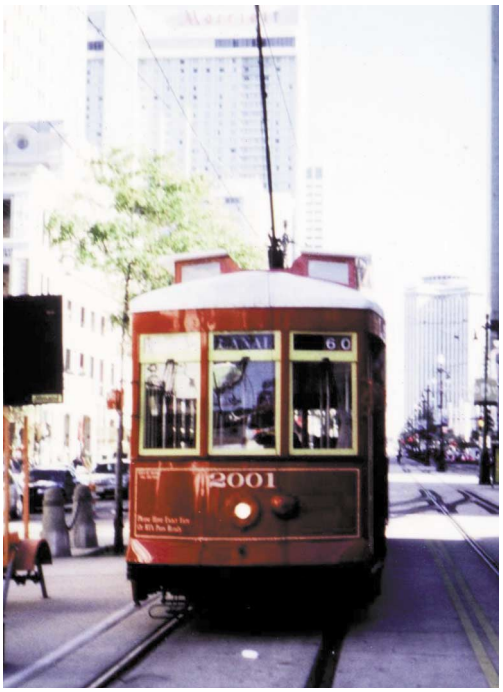

Desire line.

This reservation is just under 11 meters [36 feet] in width, which is sufficient to accommodate both tracks, a pole line to support the overhead trolley wire, and a station platform. One of these stations will be at the intersection of St. Claude Avenue and Desire Street.

Upriver from Elysian Fields Avenue, the neutral ground along the several streets that will host the Desire line tracks was narrowed some years ago to widen the roadways on each side.

The widths of the surviving neutral ground along these streets range from 7 to 7.5 meters [23 to 24.5 feet], which is not sufficient to accommodate two tracks. Track along the section of Rampart Street upriver from Toulouse Street, which will host only the inbound track, will be situated in the neutral ground. Between Toulouse Street and Elysian Fields Avenue, at least one track will be installed in the general traffic lane closest to the neutral ground.

About 1.5 kilometers [.93 miles] upriver from Poland Avenue, St. Claude Avenue crosses tracks of the Norfolk Southern Railway at grade. The crossing configuration of the railroad and the streetcar line has yet to be determined. An underpass for the streetcars and an at-grade crossing are being considered.

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Conclusion

As was done by the other six U.S. street railway networks that have remained in continuous service for more than a century, the New Orleans system has adopted many of the characteristics of LRT systems that have been built anew over the past 20 years. However, while the other six have modernized their streetcar-type lines with contemporary cars, track structures, and overhead wiring, New Orleans has upgraded more selectively.

On the St. Charles line, the infrastructure and cars have been rejuvenated. This was done with full respect for its honor as a National Historic Place. All of the other lines are completely new and have been designed with many of the criteria used by the nation's late 20th century LRT systems. On the Canal and Desire lines, the cars will be air-conditioned, as are the buses that they will replace, and they will be ADA compliant. At the same time, they still will provide much of the ambiance of the streetcars of the 1920s.

On all lines, the overhead contact system is fed from modern, solid-state traction power substations but delivered to the car through traditional, single-strand trolley wires rather than more visually intrusive catenary. The track components are all new, but they are installed in street paving and grassed reservations in keeping with New Orleans custom.

In New Orleans, the streetcar version of LRT has been preserved. Now it is growing and has a bright future!

—Jack W. Boorse, Parsons Brinckerhoff

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Point of View

BUS RAPID TRANSIT SHOWS PROMISE: COMMENTARY ON THE REPORT

EDITOR'S NOTE: In a September 2001 report, *Bus Rapid Transit Shows Promise*, the General Accounting Office (GAO) purported to illustrate some of the alleged advantages of the emerging bus rapid transit mode. However, there are people who believe GAO did not provide accurate comparisons of bus rapid transit and other modes, particularly light rail transit. The following commentary by E. L. Tennyson, P.E., is based on his many years of experience as a public transit engineer and administrator. Your comments and opinions are invited.
Click here to read the report: http://www.gao.gov/new.items/d01984.pdf

Bus Rapid Transit Shows Promise, a General Accounting Office (GAO) report released September 2001, was prepared for Republican Congressmen Tom DeLay, Tom Tarcredo, Tom Petri, and Don Young. At the time, Congressman DeLay opposed the use of federal funds to construct light rail transit (LRT) in Houston. Consequently, Harris County Transit Authority undertook the $320 million project using all local funds. Despite subsequent voter approval of the project by a two-to-one margin, federal funds have not been released.

The GAO bus rapid transit (BRT) report contains much that might be discussed. It is stated clearly in the report that transit systems should follow Federal Transit Administration's (FTA's) advice to "think rail, use bus"—so much for modal neutrality.

The report observes that buses are not popular with the public, "particularly when compared to rail service," and found that "transit officials repeatedly noted that buses have a poor public image," yet offers no explanation on why that might be.

Capital Cost Issues

While the report promotes BRT for its alleged economy, it says, "Two BRT projects have received (federal) funding commitments

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from the New Starts program totaling approximately $831 million." The projects are not identified, but if they include Boston's Silver Line, Pittsburgh's West Busway, or the Los Angeles Harbor Freeway Busway, the cost per mile without buses may be from $55 to $80 million per route mile, double or triple typical current LRT construction costs, which include rolling stock and shops.

GAO looked at Pittsburgh's West Busway (but did not include it in busway costs) and stated that an LRT alternative would have "cost two to three times as much to construct and equip for operation without attracting any significant added patronage." This is a correct quote, but it is taken from the project's Alternatives Analysis, based on comparing an underground subway in Buffalo with an at-grade busway on a vacant railroad grade in Pittsburgh. As it turned out, the ill-fated busway was 59 percent over estimate for construction cost and 84 percent below estimate for ridership. To reduce actual construction costs, the downtown end of the busway was not built; this will lead to future traffic snarls as heavy bridge repair is undertaken. As built, the busway cost $64 million per mile. LRT lines built at the same time in Denver, Saint Louis, and Salt Lake City cost only $24 million per mile, including rolling stock and shops. GAO did not mention this in the report, but it could and should have.

It should be noted that GAO did not look at successful LRT operations in Baltimore, Portland, Sacramento, or Saint Louis. Also, the costly Seattle downtown bus subway was omitted.

Operating Cost Issues

Despite the required reporting of passenger-mile data since at least 1982, the GAO report states, "We also attempted to determine operating costs per passenger mile as a measure of comparison, however we could not obtain sufficient data for such an analysis." The data are clear and obvious. In 2000, the LRT cost per passenger-mile was reported by the American Public Transportation Association (APTA) and FTA to be 45 cents, and bus cost was 55 cents—22 percent higher than the LRT cost—despite many low-wage systems in smaller cities that do not have LRT.

To avoid the wage disparity, LRT produced 199,056 annual passenger-miles per employee, but buses produced only

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103,855—little more than half as many. Even with 50 percent heavier loading on busier routes, BRT falls far short of LRT productivity, according to APTA and FTA, the sources GAO cite for much of the data.

According to GAO, the cost per LRT car-hour, was $161.48, but bus cost was only $84.72 per bus-hour. With the 110 passengers GAO assigned to a light rail vehicle, the cost per passenger is $1.47. GAO assigned 50 passengers per bus, for a cost of $1.69 per passenger, 15 percent more than LRT in comparable systems. However, with busways, there is a maintenance problem for drain cleaning, pavement patching, stop and right-of-way cleaning, and snow and ice removal that is not included in typical city bus costs. This may add 12 percent to busway costs, increasing the cost per passenger to $1.89, 28.5 percent higher than LRT costs. Assuming an average typical passenger trip of 4.5 miles, the LRT cost per passenger-mile will be 33 cents, but busway costs will be 42 cents per passenger-mile, both less than national averages because of favorable assumptions on patronage (load factor). LRT systems in Buffalo, New Orleans, and Philadelphia do not use large articulated cars, so these do not reflect optimal LRT efficiency when included in the national average. However, there may be excellent reasons for the use of smaller cars in these cities.

Ridership Comparisons

The GAO report states, “the largest ridership on BRT and LRT is quite similar. Busways . . . average about 15,000 riders per (week) day” but “LRT system ridership . . . averages about 29,000 per (week) day.” There is no similarity. The report is in error to use the word “system” in this case. The correct word is “route.” As a specific example, the Los Angeles Blue LRT route averages over 60,000 weekday passengers, but the parallel Harbor Freeway Busway averages only 3,500, despite a promise of 63,000. In Pittsburgh, the LRT system carried 36,000 weekday passengers before being truncated for partial reconstruction. The parallel South Busway, which shared some of the rail right-of-way, carries only 14,500, including those diverted from the truncated rail line. The busway serves a much larger service area, but does not generate the passengers.

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Data Inconsistencies

The report contains many data inconsistencies. For example, Dallas bus trips are reported to cost only 31 cents, but FTA and APTA data say the cost is $3.19 local and $3.68 express. At 31 cents, why would the fare be a dollar? The GAO report says Los Angeles County Metropolitan Transportation Authority bus costs are $56 per hour, but APTA and FTA say $93.72. The GAO report says LRT costs $434 per car hour in Los Angeles, but official records say $253.94. By coincidence, the then-unfinished Red Line subway did cost $434 per car-hour. The cost per bus-mile in Dallas was reported as $1.74, but official records say $7.24 local and $3.48 express. The GAO's report of $1.74 could be correct if limited to the nonstop segment of a trip on a freeway high-occupancy vehicle lane, but this would provide no passengers.

—E. L. Tennyson, Consultant

Please read the report, form your own opinion, and let us know what you think.

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From Mexico to Minneapolis

BOLD HIAWATHA LINE CARS READY FOR TRACK TESTING

LRT News readers stumbling into Bombardier's Sahagun plant in Mexico might think that a new light rail line is being constructed south of the border. Then again, the reader may remember the dramatic illustration of the Hiawatha line that appeared at the top of page 2 of the Fall 2001 issue of *LRT News*. (The *LRT News* editor was expecting comments from readers who believed that the artist might have taken too much liberty.) Take a long look at the mock-up of the new cars now under construction—maybe the artist was not bold enough!

About one-third of the 11.6-mile Hiawatha line connecting downtown Minneapolis, Minnesota, with the Minneapolis–St. Paul International Airport and the Mall of America has already been constructed. The first light rail vehicle is expected for track testing in January 2003.

—Karen Louise Booth and Jennifer Lovassen
Metropolitan Council
St. Paul, Minnesota

Light rail vehicle for Hiawatha line.

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Experience, Economics, and Evolution
From Starter Lines to Growing Systems

Portland, Oregon
November 16–18, 2003

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The conference program will be developed by a joint steering committee of the TRB Committee on Light Rail Transit (John Schumann, Chair) and the APTA Light Rail Transit Technical Forum (Melvin Clark, Chair). The chair of the steering committee is John Schumann.

Potential session and paper topics include

- *Updates: North American and International Systems*
- *LRT in a Post-Reauthorization World*
- *How Are We Doing? A Critique of LRT Progress*
  - Lessons learned from maturing systems,
  - Changes in system productivity,
  - Affordability and efficiency trends, and
  - Public attitudes and perceptions on LRT.
- *Planning and Project Management*
  - System planning,
  - LRT Design—How much is enough?,
  - Project financing and contracting alternatives,
  - Intermodal coordination,
  - Transit-oriented development,
  - Shared track and shared corridors
  - LRT, DMU, BRT, and other modes,
  - Serving niche markets and special generators,
  - Lessons learned in designing coordinated bus–rail systems,

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- Lessons learned in providing park and ride capacity, and
- Station area planning.

- *LRT and Economic Development*
  - LRT and urban revitalization,
  - Complementary planning initiatives to leverage LRT investments, and
  - Historic trolleys, streetcars, and economic impacts.
- *Technical Considerations*
  - Light rail vehicles,
  - Power and signal,
  - Track and infrastructure,
  - Stations and terminals,
  - Yards and shops,
  - "Cordless" LRT (e.g., DMUs), and
  - Standards and standardization.
- *Traffic Engineering and Safety*
  - Intelligent transportation systems applications, and
  - Vehicle and pedestrian traffic interface, coordination, and integration.
- *Safety and Security*
  - LRT system and passenger security
  - CPTED (crime prevention through environmental design),
  - Onboard enforcement,
  - LRT security precautions, and
  - The role of LRT in transportation system security.
- *Fare Policy and Collection*
  - Pricing trends and impacts,
  - Evolving technologies,
  - Enforcement best practices, and
  - Bus and rail service fare integration.
- *Regulations and Institutional Issues*
  - State safety oversight,
  - Shared track and integrating modes,
  - Operations and maintenance,
  - MUTCD (Manual of Uniform Traffic Control Devices),
  - Section 13c: Federal Transit Labor Laws,

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- Governance structure to enable LRT system development, and
- Bus and rail service fare integration.

- *Operations and Maintenance*
  - Rules and procedures development,
  - Staffing strategies,
  - Accommodating travel demand for special events, and
  - Best practices.

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