A1E12: Committee on Light Rail Transit
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Light Rail Transit
Future Opportunities and Changes

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More than a century ago, the electrical railway pioneer Frank Sprague introduced three critical technical elements that made electric streetcars and rapid transit practical by developing ways to

- Mount traction motors on the axles or trucks, rather than the car body;
- Collect electric current reliably from an overhead wire; and
- Operate two or more powered cars in a train from a single control point.

Electric street railways sprang up in city after city during the 1890s, quickly displacing cable, steam, and horse-powered predecessors. Elevated, then subway rapid transit lines followed in the largest conurbations, and electric interurbans competed with steam railroads between cities.

Technical innovations followed incrementally as electric railway mileage ballooned in the years before World War I, then shrank as auto mobility swept North America. Two major improvements came in response to declining transit use. First, during the Great Depression of the 1930s, was the Electric Railway Presidents' Conference Committee streetcar, which provided a quantum leap in vehicle performance and passenger comfort.

The second major improvement came in the mid-1970s with a resurrection of interest in mostly at-grade metropolitan electric railways, newly dubbed light rail transit (LRT). This renewed interest, stimulated by continuing European LRT technology developments, did not begin until all but seven U.S. cities had abandoned their original streetcar systems. Since 1980, the number of U.S. metropolitan regions with LRT in operation has more than doubled, to a total of 18.

The great benefit of LRT is its inherent locational flexibility, which permits compatibility with many physical environments. This flexibility translates to opportunities for LRT to be located within a variety of different right-of-way types: fully grade-separated, semi-exclusive, and shared. As a result, it is possible for light rail trains to be operating on a reserved alignment as high-speed rapid transit, and moments later in a surface street lane shared with other traffic.

LRT system development will flourish as some metropolitan regions expand existing LRT networks, while others plan, design, and build more "new start projects."

OPPORTUNITIES FOR LRT

Planning for new LRT lines and extensions of existing lines in the next millennium will focus on seven opportunity areas:

Influence on Urban Form

Efficient urban development patterns and the role of transportation facilities and services in accomplishing these patterns will be an ever-increasing challenge. With its rapid transit potential and locational flexibility, LRT will expand its influence on urban form. LRT's influence will be optimized when combined with land use policies that work hand-in-hand with and support transit. Thus, LRT investments within urban service areas will encourage cities to design more compact development patterns, which will lead to shortened trips, reduced automobile vehicle miles of travel, and improved air quality.

Concentrated Development Around Stations

As LRT systems expand within metropolitan regions, accessibility offered to individual station areas—on a regional basis—will become increasingly important as a catalyst to development at and around the stations. The future LRT planning process will increasingly team with station area planning and will focus on corridor land-use patterns and livable communities.

Multimodal Corridors

Historically, most transportation corridors have been developed for a single mode, with the purchase of only the right-of-way required to accommodate a particular transportation improvement. The future emphasis in corridor planning will be multiuse and multimodal, as new transportation modes and communication facilities are implemented in and retrofitted into existing corridors. To optimize the limited rights-of-way available, LRT will increasingly be designed in joint or shared use with other facilities. The emphasis will be on person capacity per travel lane or track.

Partnerships

Broad-based partnerships among government agencies, private sector, LRT system designers and builders, and the public will create new approaches and new support for LRT implementation. Typical future LRT partnerships will expand and range from staff sharing to community "adopt-a-station" programs, private-public joint development activities, competitive award of contracts to provide services, and city-transit agency joint planning efforts to effect transit-compatible land use design and station areas.

New Passenger Markets

As job centers become more dispersed, LRT will expand its customer base by developing specialized and all-day markets. For many metropolitan regions, in addition to downtown areas, LRT will effectively serve the higher-capacity transit demands of key activity centers, such as arenas, stadiums, health care facilities, convention centers, universities, shopping malls, and airports.

Facilitation of Multimodal Connections

For an increasing number of metropolitan regions, LRT will continue to evolve from a single line to a system of routes, which in turn will serve as an element of a larger multimodal transit system. In this role, LRT will be a significant distributor of passengers

from commuter rail, inter-city rail, and airports. Further, it will also serve as a significant collector of passengers from suburban bus feeder connections.

Phased Implementation of Lines

Phased implementation and upgrades of LRT systems will be accomplished in the form of a starter system with subsequent line extensions and additions, single-track construction initially (with later addition of a second track) and grade separation of existing heavily used at-grade segments.

LRT TECHNOLOGICAL CHANGES

The basics of 20th century technology will be greatly improved through significant enhancements in passenger comfort, conveniences, and electronics of the LRT systems in 2000.

Light Rail Vehicles (LRVs)

Low-floor LRVs will be used increasingly to make boarding easier and faster. These LRVs will be found on urban routes and on longer regional lines linking cities and suburbs. Future innovations in LRV design will find

- High-performance partial low-floor cars;
- New car-body fabrication materials and methods to reduce initial capital, costs (less costly materials, faster fabrication), and energy consumption (lighter vehicle weights);
- Energy absorption designs for improved crashworthiness; and
- Multiplexing of train lines to reduce onboard wiring requirements.

Fare Collection

Self-service, barrier-free proof-of-payment (POP) fare collection will continue to be a basic element of cost-effective modern LRT systems because it enables one-person operation of multiple-car trains using open surface station platforms without a discrete "paid" area within barriers. Effective POP systems rely upon efficient and reliable ticket vending machines, which will improve to include better bill readers and debit and credit card sales capability. There will be increasing use of "smart cards" of both the contact and contactless types. Finally, developments in fiber-optic communications and personal computer-based databases will lead to significant improvements for managing multimedia, seamless fare structures among multiple transit carriers.

Track and Roadbed

Emphasis in LRT track and roadbed will be on durability, ride quality, and reduction of noise and vibration. Concrete cross ties and innovative "direct fixation" systems will be increasingly common in the placement of LRT trackage.

Another new development will be the match of low-profile girder rail and a reduced-vertical-profile supporting slab that together will help designers reduce the amount of excavation and related utility relocation required for in-street trackage.

Traction Electrification

Designs of overhead contact system (OCS) elements will be refined to reduce the visual intrusion of the facilities and to include wider use of higher voltages. Other alternatives

will continue to be researched and tested in order to use ground level and buried methods of power distribution to avoid the need for an OCS.

Train Control and Signals
Communications-based train control (CBTC) is undergoing field trials. Today's prototype installations will lead to wider application of CBTC on LRT systems in coming years. Intelligent transportation systems will be prominent with features such as warning devices for at-grade crossings, managing LRT control center operations, and providing on-street traffic signal priority.

Communications
Quantum leaps in computers and fiber-optic data transmission technologies will continue to reduce costs and expand the amount of management information available to LRT operators. Automated, real-time train location will be common for LRT systems. All major LRT stations will have real-time train arrival information to enhance the customer's use of the system.

LRT REGULATORY CHANGES

The institutional and regulatory outlook for developing and operating LRT will be different from the immediate past. Financing will continue as a paramount issue after 2000.

Institutional Relationships
Institutional and regulatory changes will evolve in an ever-closer relationship, representing the expected increasing regulation of light rail and the continuing competition for transportation funding from all levels of government.

Design Opportunities
LRT design criteria typically represent the vision of the development and operating organizations. As such, these criteria often reflect system specifications that are more like higher-cost conventional heavy- or rapid-rail transit than the concept of a "modern streetcar." Even where lower cost LRT "starter" lines are built initially, grade separations, exclusive trackways within road rights-of-way, and systemwide "enhancements" to improve safety, or operations, or both, will add capital and maintenance costs as LRT systems expand.

Existing freight railroad corridors will continue as opportunities for new LRT lines. Fewer of these corridors will be available for exclusive LRT use; however, shared use and joint operation with freight railroads will increase due to advances with communications and sensor equipment that will enhance safety by virtually ruling out the possibility of a collision.

Project Delivery
Project delivery mechanisms that may reduce the effective first costs, or distribute costs to the governmental agency over a longer period of time, will continue to be a focus. More design-build, design-build-maintain, and design-build-operate-maintain contracting by public agencies will be in evidence. These delivery mechanisms are a form of private sector "front-end" financing and will continue.

CONCLUSIONS

As a long-established mode of urban and suburban public transit, the vehicle and support system package called “light rail” is a grouping of mature technologies. Benefits are gained from ongoing modest incremental improvements to the various LRT system elements, and occasional “sea change” milestones—most recently, the widespread adoption of low-floor LRVs. LRT system developers in the new millennium will be well-served by following a series of basic guidelines central to LRT design philosophy:

Keep It Simple

Simple designs generally cost less to build, are easier to maintain, and are cheaper to fix. Sometimes, there may be a role for “advanced” engineering solutions, but prospective builders of new LRT projects should let those already operating established systems do the research and incur the risks.

Emphasize Operating Safety

The nature of LRT operations will continue to take advantage of at-grade running. Research efforts will need to develop technologies that lead to a continual improvement of LRT operating safety.

Satisfy the Customers

LRT must work as part of a coordinated regional public transport system. LRT will be the higher capacity transit line haul element in many of the heavier traveled corridors within regions. Buses will be deployed to feed and distribute LRT riders to form a seamless, integrated system featuring easy cross-platform transfers at transit centers, timed transfer schedules to minimize connecting times, and a unified regional fare structure that includes all transit operating entities in the metropolitan region. And, increasingly, LRT will provide the feeder and distribution function to commuter rail, Amtrak, and air modes.

Think Quality!

LRT projects typically result in placement of well-designed, attractive facilities in the public domain, where they are subject to normal “wear and tear” and, unfortunately, occasional abuse. Trash, dereliction, and graffiti can quickly reduce the best-planned system to a civic embarrassment. Defensive design and effective maintenance policies are ultimately just as important as functional design. Further, the goal of LRT designers must be that when components fail, they should: (1) fail safely, and (2) allow trains to continue in service, perhaps at reduced performance levels, consistent with operational safety. Designs of LRVs and support systems, as well as development of operating rules and procedures, all must be considered against these criteria.

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