URBAN MASS TRANSPORTATION PROGRAMS

A. R. Childs
Special Assistant to the Administrator
Urban Mass Transportation Administration (DOT)
Washington, D. C.

President Nixon proposed the landmark Urban Mass Transportation Assistance Act of 1970; legislation that swept through Congress with wide bi-partisan support. The new law joins the Federal government in partnership with local cities and towns in a major effort to revitalize our urban mass transit systems. This Act provides $10 billion over a 12 year period for transit assistance.

Secretary of Transportation, John A. Volpe, says: "We have taken this law and put it to work. Up to the present our transit grants and loans have saved or stabilized bus transit systems in 60 American cities. Our funds have helped buy 7,900 buses, 1,100 rapid transit rail cars, and 885 commuter rail cars. We are, in addition, helping seven major cities to develop plans for the building of rapid rail transit projects."

The UMTA Research, Development and Demonstration (RD&D) Program is authorized by Section 6 of this Act as follows:

> "Section 6. (a) The Secretary is authorized to undertake research, development, and demonstration projects in all phases of urban mass transportation (including the development, testing, and demonstration of new facilities, equipment, techniques, and methods) which he determines will assist in the reduction of urban transportation needs, the improvement of mass transportation service, or the contribution of such service toward meeting total urban transportation needs of minimum cost. He may undertake such projects independently or by grant or contract (including working agreements with other Federal departments and agencies). In carrying out the provisions of this section, the Secretary is authorized to request and receive such information or data as he deems appropriate from public or private sources."

The RD&D program adopts an experimental approach designed to produce, through theoretical and empirical methods, a spectrum of projects contributory to the transportation goals specified in the Act as cited above. Also emphasized is the establishment of balance among promising directions of technological development, and a practical, economic approach. The complete potential of such projects is realized when they can become part of regular transit system operations through local funding with Federal financial assistance, if necessary, under UMTA's capital grant or loan program.

The research, development and demonstration activity of the Urban Mass Transportation Administration is organized according to mode of transportation, with principal subdivisions of bus transit, rail transit, and new systems (which involve advanced technology or unconventional methods).

BUS TRANSIT

UMTA's research, development and demonstration activity in bus transit involves vehicles, service innovations and operational methods.

Bus Technology

New Transit Bus Prototypes. UMTA has initiated an accelerated design and development project to produce one or more prototypes of a modern 40-foot transit bus. Design goals include greater safety; improved passenger comfort; easier access and egress; reduced noise, vibration and pollution; easier maintenance; increased reliability; faster acceleration and operating speed; and increased operating efficiency. The first delivery of a modern prototype transit bus is anticipated before the end of 1972. After evaluation and public service demonstration, a standard bus design will be adopted, based on features of one or more prototypes evaluated, to replace the current design which has been in production since 1959.

Steam Propulsion for Buses. UMTA is developing a low-pollution external combustion engine with desired performance at least equal to that of present diesel engines. Four design approaches are being investigated, including both reciprocating and turbine configurations. All four power plants have been operated under laboratory test conditions, and two have been used to power buses at speeds up to 50 miles per hour. Steam bus engine design will be further developed as an alternate propulsion system for UMTA's new transit bus.

Anti-Pollution Kits for Buses: Two projects for testing a commercially developed kit to reduce emissions from diesel engines are nearing completion. With these kits, pollution from older buses can be greatly lowered (hydro-carbons by 80 per cent and carbon monoxide by 50 per cent) whereas new bus engines are presently being produced with the most effective component of the kits already installed. The kits have been found to reduce odor and greatly reduce smoke and noxious emissions.

Flywheel Energy Storage for Rapid Transit Propulsion. An energy-storage device utilizing an advanced flywheel will be developed, installed on a New York City rapid transit car, tested and demonstrated. During acceleration, power from the flywheel will be used to help accelerate the train. During braking, the excess energy dissipated as heat in current subway cars will be stored in the flywheel. The innovation is expected to reduce propulsion energy requirements, reduce heat generation and improve safety by permitting the car to be moved to the nearest station under flywheel power in the event of a failure in the external power system.

Commuter Rail Vehicles and Systems

GTE Dual-Power Commuter Cars. This project, an extension of earlier UMTA-sponsored work, will demonstrate and evaluate propulsion systems that can be powered either by third-rail electrical power or by electric power generated by an on-board gas turbine. These cars will be especially useful where commuter lines serving suburban commuters are only partially electrified. The switch from one power source to another will be made at operating speed.

Rail Supporting Technology

Pueblo Test Track. UMTA's rail supporting technology program is centered at the DOT High Speed Ground Test Center near Pueblo, Colorado. UMTA, in cooperation with the Federal Rail Administration, is constructing a rapid transit test facility, including a 9-mile oval track, and a laboratory for testing track, structures and vehicles. Problem areas such as safety, noise, vibration, power collection, reliability and maintenance will be addressed at the test facility.

Environmental Control Handbook for Underground Transit Facilities. Using scale models, numerical simulation and field experiments, material is being collected for a handbook for use by designers of underground rapid transit facilities. The handbook will contain detailed information on environmental criteria, analysis and design. It should help reduce the cost of subway ventilation systems and provide criteria for possible modification and improvement of existing ventilation systems.

NEW SYSTEMS

Personal Rapid Transit Systems

Personal Rapid Transit (PRT) systems are advanced-technology systems which offer non-stop, self-service mass transportation on small vehicles operating under computer control between stations on a network of exclusive guideways.

Morgantown Demonstration. The first PRT system to be installed for demonstration in an urban environment is being constructed at Morgantown, West Virginia. The Morgantown system will consist of individual rubber-tired vehicles operating at speeds up to 30 mph at 15-second headways over a concrete guideway (generally elevated). The 21-passenger vehicle (8 seated) will contain on-board switches and can be used in either a scheduled or demand-actuated mode of operation.

Personal Rapid Transit Systems at TRANSPO 72. Four distinct types of prototype personal rapid transit systems will be operated and displayed at TRANSPO 72, the international transportation exposition, in May and June 1972 at Dulles International Airport, in Virginia. One of the systems uses small cabs levitated by air cushions and propelled by linear electric motors. Another is suspended from an overhead guideway. The third and fourth are rubber-tired systems with capacities of 20 to 30 passengers, one with guideway switching and the other with on-board switching. After the exposition, these systems will be thoroughly tested at the Dulles site. Later, one or more of these systems (modified as required), will be demonstrated in urban areas.

Haddonfield Dial-A-Ride Demonstration. This project will demonstrate the use of a computer system to assign small buses to routes which change as requests for passenger service are received by telephone. The passenger shares the vehicle with others travelling in the same general direction as he, yet the computer assures that each passenger will arrive at his destination within the time specified when his telephone request was confirmed. Demonstration operations using a manually-dispatched system will be followed in a few months by computer-controlled operations. The on-call, door-to-door service to be provided may solve such problems as providing public transportation for the elderly and handicapped (one vehicle will be specially adapted to accommodate wheel-chairs) and extending transit service to areas where passenger demand is too scattered or infrequent to sustain fixed routes and schedules.

Urban Tracked Air Cushion Vehicles

This project seeks to develop, test and demonstrate a new, pollution-free urban mass transportation system for high-speed urban travel in such applications as airport access and for long trips of 10 to 50 miles within metropolitan areas. Two design contracts have been completed and fabrication of a prototype for testing is planned soon.

New Systems Requirements Analysis

UMTA is attempting to improve substantially the computer programs used in planning new transit systems for urban areas. The principal improvements sought are full and explicit consideration of all modes of urban transportation (including new systems still under development) in models used to predict passenger and vehicle flows; sketch-planning techniques intended to produce useful predictions in weeks rather than months; and micro-simulation models for predicting detailed passenger and vehicular movements in and near transit facilities.

CONCLUSION

UMTA is also engaged in transportation "software" research, and research involving the costs and benefits of urban mass transit. The Urban Mass Transportation Administrator, Carlos C. Villarreal, has said: "During the next ten years, transportation will need a major hardware and software engineering effort in order to achieve the enormous improvements required."

A catalytic muffler, still under development in a companion project, promises to reduce substantially the oxides of nitrogen, a feature not offered by the commercial kit. The muffler is being designed to fit most existing bus muffler compartments so that installation into existing bus fleets will be feasible.

Advanced Concept Bus Engines. Advanced engine configurations are under consideration for longer range improvements in low-pollutant engines, including conversion kits to enable existing engines to use liquid natural gas; a noiseless, nonpolluting liquid oxygen-liquid hydrogen engine; flywheel energy storage and hybrid propulsion concepts.

Bus Traffic Systems and Service Innovations

The objective of this effort is to develop and demonstrate ways to increase the volume of people moved over urban streets and highways and to assess market response to innovations such as express bus service and free parking at suburban bus collection points.

Shirley Highway Express Bus Service over Exclusive Freeway Lanes. In Northern Virginia, UMTA is demonstrating that former automobile users can be attracted to bus transit by offering fast service over an exclusive busway in modern, comfortable buses. The increased operating speeds made possible by separating the buses from congested highway traffic promise to increase labor and equipment productivity by permitting more trips per bus during peak demand periods. Initial results indicate diversion of substantial numbers of former auto commuters to the express bus service. Further increase in passenger volume is anticipated when fringe parking and additional buses are made available.

Seattle Express Bus Service. In Seattle, an express bus service called the "Blue Streak" operating between North Seattle and downtown Seattle, using the reversible lanes of Interstate 5, is beginning its second year. Although there is mixed bus and auto traffic on the reversible lanes, auto volumes are limited by access controls to assure rapid traffic flow. The project has been highly successful, the park-and-ride lot served by "Blue Streak" having been filled to capacity since the third-week of operation. Analysis of project results to date indicates that 1,200 new daily riders have been attracted (a 30 percent increase), most of them to the 500-car park-lot. A bill is pending in the Washington State legislature to approve funding for an expansion of this type of service throughout the Seattle region. A survey of users at the park-ride lot showed that over 70 percent were former auto commuters. This shift from auto to bus transit should reduce time delays caused by traffic congestion.

Coordinated Fares, Schedules and Information. Users of urban mass transportation in areas having more than one transit franchise face problems of overlapping service, multiple fares, uncoordinated scheduling and lack of a central source of transit information. UMTA plans a demonstration project that will overcome these problems by means of providing single-fare service over multiple franchise areas, coordinating schedules for the various transit companies, and establishing a centralized information service.

Service will be improved by allowing the transit rider access to all existing services without the penalty of a double fare and by making information concerning routes and schedules more reliable and readily available. The costs of transit operations will be reduced by eliminating duplication of facilities and services.

Transit information services will be improved first. A computer print-out describing alternative routes between points will be used in answering inquiries. A study will be made of the feasibility of automating telephone information service to assist operators in answering inquiries more accurately and quickly. Fare-splitting and coordinating of schedules between various transit companies will be studied and a pilot project implemented to demonstrate the effect.

Automatic Vehicle Monitoring Systems. Four competing technologies will be tested in Philadelphia this fall and winter for electronically locating transit or other public service vehicles as they move over urban streets. This tracking capability will provide transit operators with real-time information on the location and schedule adherence of all their vehicles. The dispatch center will then be able to take action as needed to keep each route on schedule and maintain the proper level of service. The rider will be spared the now-too-common occurrence of a long wait for an overdue bus followed by the arrival of two or three buses running in tandem.

The tracking technologies will eventually be integrated into an overall automatic vehicle monitoring (AVM) system which can provide two-way voice communication, automatic signaling of mechanical problems, automatic collection of ridership data needed for route planning and a driver-actuated "silent alarm" which will instantly summon police aid when criminal action threatens. The system will also speed up the resumption of normal service after disruptions. Transit operators will be able to better utilize their equipment and manpower resources by having modern command and control techniques available for the first time. A conservative estimate is that AVM systems will allow reduction in size of an operating bus fleet by 4 percent without reducing service levels. Data provided automatically by the AVM system will also permit reassignment of many personnel now assigned to routine data collection or street supervisory positions. One large municipal transit authority has estimated that an AVM system will yield $2.5 million in annual benefits and will fully amortize itself within four years.

Bus Priority System Demonstration. Buses operating on urban streets are subject to the same delays and congesting-engendered stoppages as is all other traffic operating on these streets. Yet, buses represent a far more efficient use of available street space than any other form of urban street transportation operating today. If buses could be provided with some form of preferential treatment so as to increase their speed relative to the general traffic stream, their people-moving efficiency would increase still more, and the shorter trip times thus possible should attract increased numbers of riders away from autos contributing to increased urban mobility, in addition to providing better utilization of transit equipment.

Work will continue during FY 1972 on installation of a computerized bus priority system (BPS) in the District of Columbia. Jointly supported by the FHWA and UMTA, their experimental automated system controls traffic signals so as to optimize vehicle flow. The BPS feature of the equipment identifies buses on their approach to an intersection, and if possible, will give them priority to move through the intersection by holding the "green" phase for a longer period than usual.

Transit Operations and Management Systems. The Transit Operations and Management Systems (TOMS) is a comprehensive program to develop, test and demonstrate modernized operating procedures and management methods that can be widely adopted by the transit industry. Transit operating expenses (including depreciation, but not taxes) amounted to nearly $1.9 billion in calendar 1970, according to the American Transit Association. A substantial reduction in these costs can be achieved and, at the same time, better service provided to the public, by replacing outmoded transit management practices with up-to-date practices, including automation where appropriate. Savings on the order of 20 percent are anticipated. Other benefits, such as those enjoyed by riders using a well-run, reliable system, cannot be quantified.

RAIL TRANSIT

Mass transportation rail systems are needed in major metropolitan areas because they possess the capacity to move very large volumes of passengers (up to 60,000 per hour in peak periods). Although only twelve cities have rail systems in operation or under construction, the rapid rail, commuter rail and light rail system in those cities carry about 2.3 billion passengers per year. Many of these cities are seeking to upgrade or extend their rail transit service, and other cities are planning new rail systems.

Cities with Rail Transit Systems

Rapid Rail	Commuter Rail	Light Rail
New York	New York	Newark
Chicago	Chicago	El Paso
Boston	Boston	Boston
Philadelphia	Philadelphia	Philadelphia
Cleveland	Cleveland	Cleveland (Shaker Heights)
San Francisco*	San Francisco	San Francisco
Washington*	Washington	New Orleans
	Pittsburgh	Pittsburgh
	Detroit	

*under construction

There are about 15,000 rail transit cars in service (10,000 rapid rail, 4,300 commuter rail and 1,200 light rail). Some of these have been in use for 30 years or longer. Now that the need to upgrade rail mass transportation service is becoming generally recognized by the cities and with the availability of partial Federal financing through UMTA capital grants, UMTA will design, develop and demonstrate, first, the best rail transit cars that current technology can provide and, ultimately, advanced concept trains involving fresh innovations. Design and hardware specifications for these new cars will be made available to the cities for use in acquiring new or replacement rolling stock.

Rapid Rail Vehicles and Systems

The rapid rail RD&D sub-activity will concentrate on three areas: urban rapid rail vehicles and systems, advanced propulsion systems, and guideline specifications for rapid rail cars. The systems management approach has been adopted for this program.

BART Prototype Cars. Ten prototype cars for San Francisco's Bay Area Rapid Transit (BART) have been engineered and produced and are now being tested and evaluated with UMTA providing assistance for this effort under a FY 1969 grant. These cars will form the basis for subsequent production of BART cars. The systems manager will review the demonstration and monitor the progress of the BART prototype cars. He will then recommend methods for incorporating safety and performance improvements appropriate to the development of State-of-the-Art and Advanced Concept Train Cars.

State-of-the-Art Cars. Two new State-of-the-Art cars (SOAC) will be built. These cars will incorporate existing technology and will be demonstrated in Boston, New York, Philadelphia, Cleveland, and Chicago. The car's primary goals are safety, passenger convenience, and operating efficiency. UMTA's systems manager will procure two cars representative of the current state-of-the-art, plan and conduct technical tests of these cars, and direct the operational demonstration of these cars in the five cities. The St. Louis Car Division of General Steel Industries is fabricating the SOAC prototypes, scheduled for delivery to the Pueblo test facility in September 1972.

Advanced Concept Train. As a long-range goal, an Advanced Concept Train (ACT) will be produced. The demonstration and evaluation of the ACT vehicles on operating transit systems will lead to the upgrading and replacement of existing obsolete rail vehicles. The new vehicles will be designed to permit efficient and economic dynamic substitutions of improved subsystems in complete modules. Two cars, capable of operating over the same transit lines as the SOAC cars, will be built under the direction of the Systems Manager. After evaluation of operational test results, a complete train of ACT cars will be built and demonstrated in revenue service.

Alternating Current Propulsion for Rapid Rail Cars. A demonstration project in Cleveland, Ohio, will evaluate the performance of a pulse-width-modulated solid-state control system and alternating current traction motors on three rapid transit cars. Cost savings are expected from regeneration of electric power during braking and from lower maintenance requirements. In addition, the interior and exterior of the three cars have been refurbished to improve appearance; public response to both ride quality and appearance will be assessed.