Dual-Mode Station Design

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Dual-mode transit service is of interest to many urban transportation planners and engineers because variations of the concept represent a synthesis of the best features of urban transportation modes. Dual-mode transit combines the flexibility of the automobile with the high-volume capability of fixed-route transit.

Many of the planning and design principles and standards developed for fixed-route, fixed-schedule stations may not be applicable to dual-mode stations. The most significant differences between dual-mode, demand-responsive stations and the fixed-route, fixed-schedule stations are as follows:

1. Although the pattern of user flow is similar in both types of stations, the nature of user behavior within that flow pattern is different;
2. The dual-mode, demand-responsive system may tend to concentrate impact at particular locations and have no impact at others, and the fixed-route, fixed-schedule system may spread impact evenly over many station sites; and
3. Fixed-route, fixed-schedule stations often have to be designed to serve expanded user demands as the system develops, and many dual-mode stations may have to be designed to be phased out of service (the sign of the successful dual-mode system might well be the phase-out of origin stations).

These major differences between dual-mode, demand-responsive stations and fixed-route, fixed-schedule stations indicate that significant alterations may have to be made in station design.

1. Stations may have to accommodate a more free-floating user population;
2. Station design may have to facilitate station reuse or removal;
3. Stations may have to be located so that concentrated development can be accommodated adjacent to destination stations and so that adjacent development will not be encouraged to avoid adverse economic effects if the origin stations were phased out of service; and
4. Station design will have to simplify the use of the dual-mode, demand-responsive system.

The nature of dual-mode, demand-responsive operation is such that the present first-in, first-out structure of the fixed-route, fixed-schedule system must be altered to accommodate a wide variance in waiting times. One user may enter and order a vehicle that arrives in 1 min. Another user may order a vehicle that does not arrive for 5 min. When the number of peak-hour users and the wide variability in destinations are combined, the deviation around the mean wait time will vary significantly. Moreover, as the variability of the wait time and the number of users are increased, the demands placed on ancillary, non-transit-related facilities such as rest rooms, retail facilities, and long-term seating areas will increase. This demand will be created by ticketed users, and hence such facilities may have to be placed in paid areas rather than in free areas, as is now done, to serve both users and nonusers.

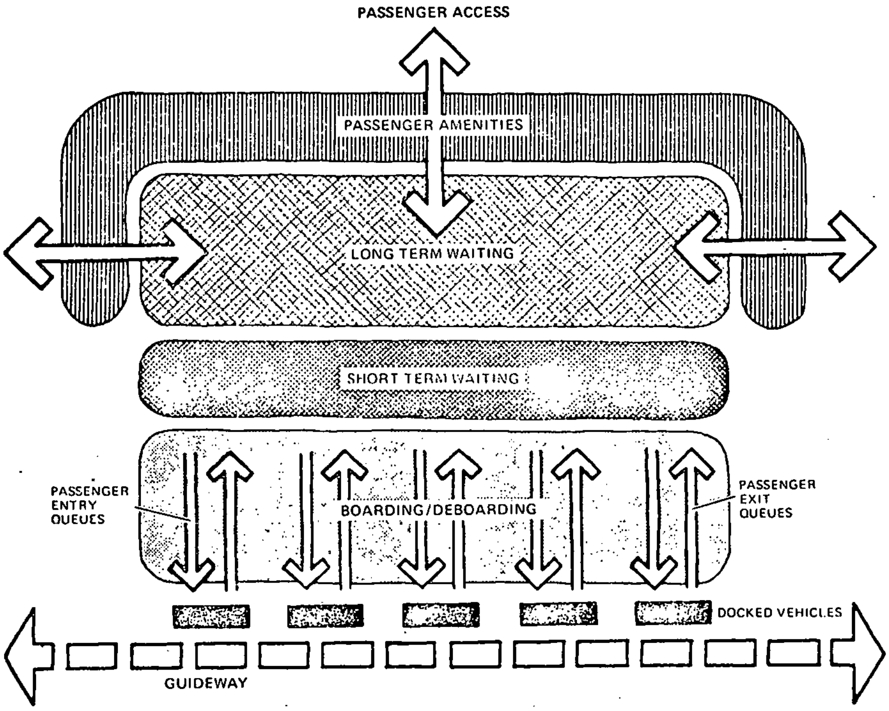
To accommodate the variability in user flow, we must carefully analyze pedestrian behavior and determine how the station space can best respond to user needs. Because there are no existing facilities to provide data for empirical evaluations, simulation can be used in determining how variability in wait times affects the amount of user space.

Of utmost concern in simulation are the ticketing and platform areas, for these activities differ the most from those of the fixed-route, fixed-schedule model. Space in dual-mode, demand-responsive stations for ticketing and platform activities should be designed to accommodate a pedestrian density lower than that found in fixed-route, fixed-schedule stations since there is greater variation in the direction and intensity of user flow. Within the ticketing area, low pedestrian density, e.g., 0.9 m^2/person (10 ft^2/person), will help minimize queuing and permit easy circulation among vehicle ordering, ticketing, and information activities. Because the ticketing activity may require a variable amount of time (15 to 90 s to order a trip and receive confirmation), a substantial number of machines may be necessary to reduce queuing. However, as the number of machines increases, congestion caused by people circulating among the machines and the boarding area may also increase.

Low pedestrian density may also be required in the platform area to accommodate the movements associated with the variable wait patterns. Essentially, the platform area of a dual-mode station should consist of the following three areas (Figure 1).

1. The boarding and deboarding area is immediately adjacent to the guideway. Persons entering or exiting a docked vehicle pass through this area, which should be clear space and contain only those devices required to direct, regulate, or register the entering or exiting passengers. As a queuing area, the boarding and deboarding space can be designed for fairly high pedestrian densities.
2. The short-term waiting area is behind the boarding area and accommodates the users who anticipate the near-term arrival of their vehicles. This area serves

Figure 1. Activities in dual-mode station.



quite a bit of cross flow movement and should be designed at relatively low pedestrian densities.

3. The long-term waiting area serves those persons who have a long wait (approximately 5 min or more) for their vehicles. This area accommodates free-flow movements rather than queuing and should be designed for fairly low pedestrian densities. The area should be linked to any ancillary facilities provided in the station, for station user amenities are most required during long waiting periods to reduce the perception of extended wait time.

Dual-mode stations to serve trip origins will likely be phased out as the system becomes fully operational and the user's residence becomes the trip origin station. Until that time, however, stations will be required and will encourage development adjacent to them. Because the station may be a transitory facility, its development should be accompanied by zoning to limit land speculation and to ensure that adjacent development does not depend on the operation of the station.

Attention must also be given to the location and design of major destination stations so that they serve the development potential in those locations. Techniques such as joint project development will ensure that the station is properly linked to the area it serves and the new development that it generates.

In summary, dual-mode, demand-responsive stations have unique aspects that require different approaches. The flexibility of dual-mode operation requires greater attention to the use of station space than is required for a fixed-route, fixed-schedule station. Similarly, the unique aspects of system operation may also alter accepted notions regarding the stability of a transit station location or the ubiquity of station area impact.