A1E14: Committee on New Transportation Systems and Technology
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New Mobility
Using Technology and Partnerships To Create More Efficient, Equitable, and Environmentally Sound Transportation

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NOTE: The interests of Committee A1E14 include a variety of subjects: propulsion systems and fuels, vehicle design, information and communications systems, maintenance systems, and other systems and components that enhance the efficiency, safety, and attractiveness of transit and related technologies. This paper addresses a topic of particular interest to the committee.

Land development and personal vehicle travel continue to outpace population growth. Efforts to manage this growth and the adverse impacts associated with it have been mostly ineffective. Promising technology solutions include telecommunications (telecommuting, electronic commerce, teleconferencing); small personal vehicles (electric bikes and neighborhood vehicles); and new "smart" transport modes (carsharing, "smart" paratransit). These technology-based options have the potential to be environmentally and economically superior to today's car-dominated system. Yet each has its drawbacks and none have flourished. Single-occupant vehicles continue to provide unparalleled versatility, privacy, comfort, and convenience.

New mobility is a fundamentally new approach to transportation (Figure 1). The underlying premise is that existing alternatives to the privately owned automobile have faltered because they have been introduced individually and incrementally—not as part of a system. By integrating some of these technology-based options and providing a supportive policy context, synergies might result that would lead to a healthier, more efficient, and more equitable transportation system.

COST AND CONVENIENCE OF NEW MOBILITY

For alternatives to traditional single-occupant vehicles to succeed, they must provide one or more superior attributes; cost and convenience are primary. For new mobility services and options to flourish, households must choose to reduce the size of their fleet of conventional vehicles by one or more. If they don't, the alternatives will generally be economically unattractive.

Vehicles provide a variety of benefits, such as home-like security and entertainment. They offer more than just a convenient conveyance of cargo and people. They are a social symbol and an office. Alternatives to today's privately owned vehicle can thrive in two

situations: 1) when cost is less and important car attributes are not overly compromised; and 2) when the alternatives provide greater convenience.

SEARCHING FOR ALTERNATIVES

Alternatives that already exist and have been tried by most people include walking, bicycling, and conventional mass transit; they account for a small and shrinking share of trips. Nonetheless, they have strong attractions and could be revived through enhancement of complementary mobility options. In the case of transit, this means enhancing and personalizing intermodal connections to better fit the demands of today's travelers. An important technology may be travel-planning devices that provide information and billing. These devices, linked to the Internet and personal digital assistants (PDAs) can facilitate new mobility options.

Other, less-tested alternatives include small personal vehicles (*1, 2*), shared-use vehicles (*3*), various telecommunication complements and substitutes (*4*), and smart paratransit (*5*). Not entirely new, these options have all been experimented with and gained some acceptance in some regions and some population segments. But their net impact has been miniscule. By coupling these options with each other, with conventional cars and transit, and with ever-cheaper and more available communications and information technologies, synergies will arise that create the potential for greatly increased market share by these alternative modes.

SMART PARATRANSIT

"Smart" paratransit is a potentially attractive alternative to conventional transit and conventional single-occupant vehicles. It is perhaps the greatest single hope for reducing vehicle use in suburban areas, where population density is too sparse to support fixed-route transit services. "Paratransit" refers to a broad range of services that do *not* have fixed routes or fixed guideways. It operates in the gap between large transit vehicles (buses and rail transit) and cars. It responds to the transportation dilemma posed by suburban development patterns. It represents another transportation alternative that might benefit from the availability of still other complementary transportation services and options.

Smart paratransit builds upon three earlier initiatives: the failed "dial-a-bus" demand response technology of the 1960s and 1970s, shuttle vans that began serving many airports in the late 1980s, and specialized services for disabled travelers. Today, the introduction of communications-based technologies is beginning to make paratransit services a bit "smarter." Instead of requiring travelers to plan their trips a day or more in advance, smart paratransit requires only minutes notice for trip scheduling. This is because each vehicle in a smart paratransit system is equipped with a real-time vehicle locator, vehicle occupancy tracker, and communication device such as a CB radio or a cellular phone. When a traveler calls for a pick up, the real-time vehicle locator allows the dispatcher or reservation service to check automatically if a paratransit vehicle is near the desired pick-up location. If so, the dispatcher can direct the driver to pick up the traveler via the communication device in the vehicle. If no vehicle is in the immediate vicinity of the desired pick-up point, the dispatcher can direct the next empty vehicle to the traveler. In this way, the dispatcher or reservation service can coordinate the paratransit vehicles on the road in real time, and the smart paratransit system becomes a more efficient mode of transportation for both the provider and the traveler.

In the future, the use of up-to-the-minute service and traffic information would eliminate the pretrip reservation requirement of the old dial-a-ride concept and current

airport shuttle vans. Travelers would request rides through telephones, cellular phones, interactive televisions, modem-equipped computers, and public computer terminals; the call would be routed to small transit vehicles passing nearby.

The challenge is to increase intensity and reduce costs (the operating cost per passenger for today's demand-responsive services is about $13, versus about $2 for fixed-route bus service) (*6*). One way to enhance its attractiveness and thereby increase demand is by complementing smart paratransit with carsharing, local telecenter options, and easy neighborhood travel. Likewise, the availability of smart paratransit will likely enhance demand for those other options.

CARSHARING

Another way to create diversity, reduce vehicle travel, and lower transportation and environmental costs is to make short-term vehicle rental—carsharing—easier. Renting a vehicle from a conventional rent-a-car company usually means considerable paperwork, advance reservations, inconvenient access, and rental periods of at least one day. Carsharing, especially when combined with modern communication and reservation technologies, provides a low-cost, variable-time carsharing system with instant access.

Existing car-sharing programs are located mostly in Switzerland and Germany, but also elsewhere in Europe, Canada, and recently in the United States and Singapore (*3, 7*). The largest car-sharing organization, located in Switzerland, has more than 1,200 vehicles spread across 800 locations serving over 27,000 members (*7*). Virtually all such organizations were established in the past decade, and most are neighborhood-based. Vehicles are located in small lots dispersed throughout a community.

In Europe, vehicles are typically rented for round trips and returned to the same lot. In the United States, sprawling land uses are likely to require either a dense multi-lot network that allows members to rent vehicles from one lot and return them to another, or an "interrupted" one-lot rental, for example, that allows commuters to leave a vehicle at a transit station in the morning and return to the station for another vehicle in the evening.

When a traveler wants to use a vehicle, he or she makes a reservation through a dispatcher, either by telephone operator or telephone voice messaging (or the Internet in the near future). The traveler goes to the carsharing lot and either picks up the vehicle key or, with new systems, gains "keyless" access to the vehicle using "smartcard" technology. Typically, fees for vehicle use are levied per hour, plus a distance-traveled charge. These fees, along with the nonrefundable membership fee, cover all costs for the vehicles, including purchase, insurance, fuel, and maintenance. Most existing programs require vehicles to be dropped off at the lot where they were picked up.

The types of vehicles will vary depending on the nature and environment of the carsharing program. At office parks and other business settings where trips are short and air pollution a concern, vehicles may be small or low-emission cars, many of which could be powered by batteries. In neighborhoods, some large sport utility vehicles and pickup trucks might be made available.

Although few careful evaluations of carsharing have been conducted, initial evidence suggests that travelers who join car-sharing organizations and reduce their household fleet by one vehicle end up reducing their overall vehicle travel by one-third to one-half (*7*). These reductions occur for two reasons: carsharing makes transit more accessible (easier access to and from transit stations) and most vehicle costs are converted into variable costs

(rather than the fixed costs of vehicle purchase, insurance, and registration of individually owned vehicles).

Carsharing results in some reduction in convenience. The car is not in your garage or parked at your doorstep. But in return for some inconvenience, one gains potential advantages of cost reduction, access to a greater range of vehicle types, and no responsibility for maintenance, registration, or insurance. Carsharing is not for everyone, but it potentially appeals to large segments of the population. The challenge in North America is to identify business partnerships, intermodal connections, appropriate market (and financing) models, and customer packages that fit the local environment.

NEW (SMALL) PERSONAL VEHICLES

A key element in new mobility is small motorized vehicles—a new class of vehicles, sometimes referred to as neighborhood vehicles or community cars. One might disaggregate these vehicles further, largest to smallest, as ultracompacts (just smaller than a subcompact), mini-vehicles, neighborhood electric vehicles, and electric bicycles.

Ultracompact vehicles, at the upper end, have top speeds around 60 mph, are designed to meet the safety standards of conventional full-sized vehicles and can travel on any road (though it may not be advisable to do so on high-speed roads). Because of the necessary sophisticated engineering, they are generally built by major automakers. Two examples are the Toyota e-com and Ford Th!nk. The e-com is a small, fully enclosed two-seater powered by nickel-metal hydride batteries with a driving range of about 60 miles on a single charge. It is being demonstrated in Japan and the United States. The Th!nk, first developed by a small Norwegian company, has similar performance and size attributes. Other major car companies with advanced prototypes of ultracompact electric vehicles are Honda and Nissan.

In addition to these electric ultracompacts, many companies are selling gasoline-powered small cars. The DaimlerChrysler Smart is a two-seater that made its debut in 1998. It is powered by a 3-cylinder, 600 cc gasoline engine and is 2.5 meters long and 1.5 meters wide, about half the size of a conventional vehicle. The top speed is nearly 80 miles per hour.

On a still smaller scale are what might be called “neighborhood” cars. The U.S. Department of Transportation officially acknowledged this category on June 17, 1998, by adopting safety standards and rules for vehicles operating under 25 mph (*8*). Within this lower-speed category is the only mass-produced four-wheeled small personal vehicle now available for sale in the United States: the Bombardier NV (Neighborhood Vehicle). Introduced in 1998, it is a small, fully enclosed two-seater electric vehicle with the “footprint” of a golf cart. Maximum speed is 25 miles per hour, and range is 30 miles per charge.

At the bottom of the size range are electric bicycles. An expanding number of companies are entering this market. In Japan, over 100,000 are now sold per year by Suzuki, Yamaha, Honda, and others. Electric bikes mostly sell in the range of $500 to $1,000, with ranges of about 15 miles at about 15 mph. By pedaling, the range is extended. Most can be easily pedaled with the motor disengaged. They are legally treated as bicycles and thus there are no rules constraining their use.

Two downsides of small vehicles are real and perceived safety concerns and high initial cost. As production volumes increase and designs are improved, costs will decrease to levels well below those of conventional cars, even when powered with batteries. The more fundamental, troubling, and complex concern is safety. The challenge is to design

vehicles safely and create protected driving environments for the smaller and slower vehicles.

TELECOMMUNICATIONS AS A SUBSTITUTE AND COMPLEMENT

Another important component of the new mobility vision is telecommunications technologies. These technologies may be used to replace *and* complement travel. They complement travel by making it more convenient and less expensive, as indicated above in the case of smart paratransit and smart carsharing, and they replace physical trips via telecommuting, teleshopping, and teleconferencing.

The most prominent form of substitution is telecommuting, whereby one works at home or at a local telecenter, rather than traveling to an office. About 6 percent of Americans telecommute at least some of the time, resulting in about 1.5 percent modeshare on any given day (*9*). Although it has received considerable attention and has attracted many practitioners, telecommuting still plays a minor transportation role.

A related option is teleconferencing. This service could be provided from a neighborhood telecenter or main business office, eliminating a long airline (or car) trip. Still another form for replacing trips is teleshopping, or electronic commerce (e-commerce) as it is now becoming known. E-commerce allows consumers to buy goods from companies directly through the Internet.

In general, greater availability of telecommunications services will facilitate and increase overall communication, which in turn increases the number of people who learn of new activities, goods, and services, which in turn leads to increased passenger and goods movement. Although some of the growth in telecommunications will serve as a substitute for personal travel, the absolute growth in the whole communications "pie" (see Figure 2) (*10*) will dwarf these effects of substitution for personal travel.

The challenge is to devise strategies that accelerate the introduction of telecommunications technologies in a manner that provides the most benefit at the least economic and environmental cost. We hypothesize that use of these technologies can be increased and accomplished in a societally desirable fashion by linking them with other mobility options. For instance, if carsharing and smart paratransit were available, a traveler could use them for occasional trips to the office and airport. And perhaps a small inexpensive vehicle could be used for neighborhood travel and accessing a local telecenter for teleconferencing. Under this scenario, one can imagine the household reducing its fleet of vehicles by one. The net effect may prove to be more overall travel, but if so it would be accomplished in a less costly fashion and would reflect expanded interactions.

PATHWAYS AND SYNERGIES

No single alternative is flourishing in the United States, principally because none can offer the versatility of the conventional full-sized car. For a new mobility system to function more effectively than single stand-alone alternatives, the alternatives must be coordinated so as to capture synergies, especially with respect to the user. These synergies will generally take the form of lower cost or greater convenience for the traveler (as well as lower overall social costs).

Strong synergies and large incentives are needed to accomplish a major transportation transformation. These synergies and incentives include building constructive relationships between carsharing and "clean" technology vehicles, between telecommunications technologies and transit, and between telecommunications technologies and carsharing. An

important first step is to demonstrate the variety of options available to reduce the cost and impact of travel, and to disseminate this information and knowledge. Education is critical to customer experimentation, adoption, and acceptance.

Partnerships between new mobility businesses, such as local carsharing organizations, bicycle retailers, and local bus and train operators, need to be fostered. These partnerships will create a strong new mobility core business community and will facilitate the intermodalism necessary for a new mobility system to thrive. The initial group of new mobility partners could grow to include manufacturers and retailers in the small personal vehicle industry, the "smart" technology industry, the personal computer industry, the package delivery industry, and more. None of the alternatives to the privately owned vehicle can succeed alone. Their success in competing with this dominant mode of transportation will stem from synergies that exist between them.

CONCLUSION

This paper proposes a vision for examining and pursuing new forms of low-impact mobility and transportation using a mix of advanced and conventional technologies. Already, a variety of initiatives are being pursued. Research is being launched to determine why some services and options flourish while others do not. Partnerships are being formed between local governments, businesses, community groups, and technology suppliers. Demonstrations are being designed that link carsharing, small electric and very low-emitting vehicles, telecommunications, and reservation and communication technologies. Where and when they will bear fruit remains to be seen.

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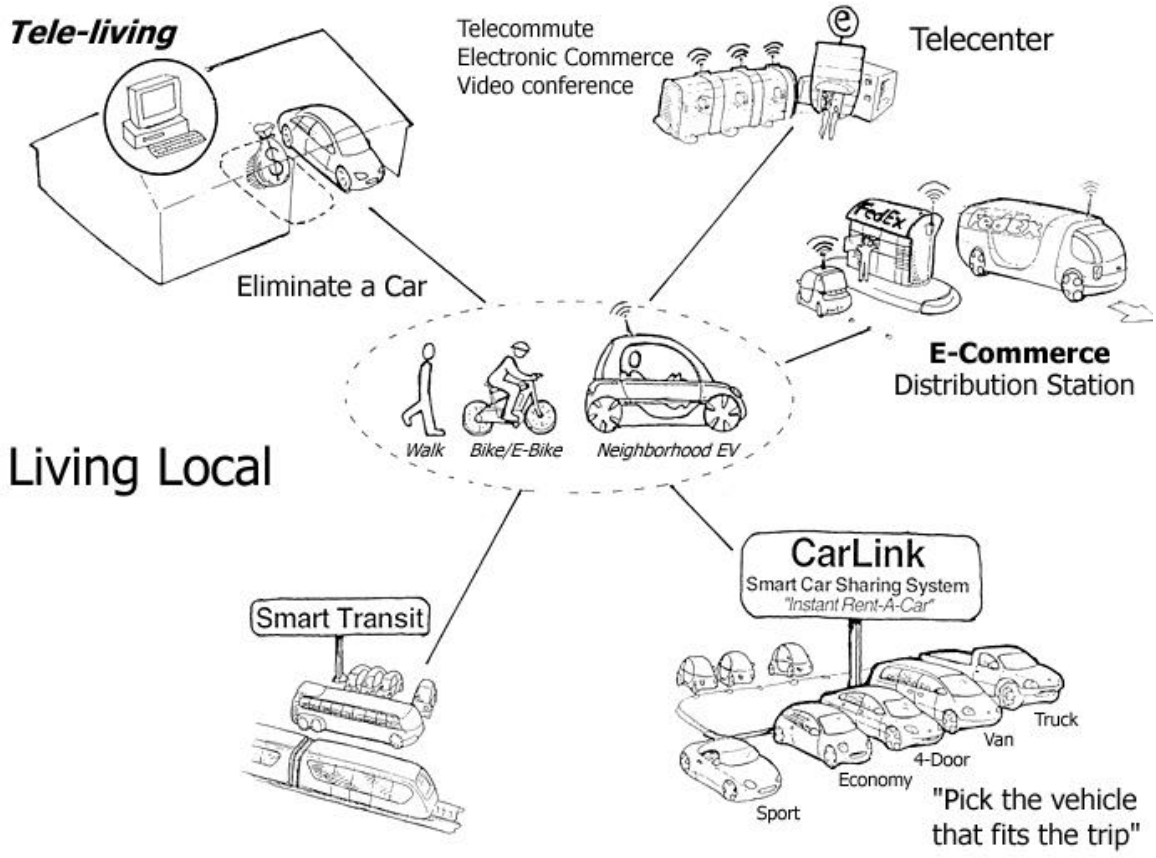

Figure 1 Conceptual and illustrative drawing of a new mobility system.

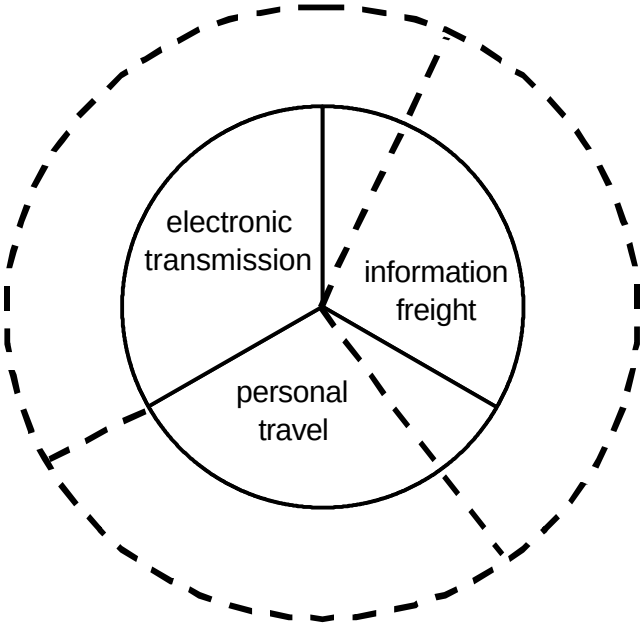

Figure 2 Absolute growth in total communication with relative substitution among modes of communication (*10*).