San Diego Association of Governments

TRANSPORTATION COMMITTEE

January 19, 2007

AGENDA ITEM NO.: **7**

Action Requested: INFORMATION

2007 REGIONAL TRANSPORTATION PLAN WHITE PAPER:
EMERGING TECHNOLOGIES IN TRANSPORTATION File Number 3000400

Introduction

SANDAG has identified several key components to be developed for the 2007 Regional Transportation Plan (RTP). For each of these areas, staff is preparing a white paper to stimulate discussion and gather input from the SANDAG Policy Advisory Committees and Working Groups. The Emerging Technologies in Transportation White Paper describes the major trends and technologies in transportation. Vehicle Infrastructure Integration, alternative fuels, and capacity projects are focal points. Recommendations from this paper will help shape the 2007 RTP in terms of which technologies are discussed and also calls for monitoring emerging technologies as a precursor to future RTP updates.

Discussion

Technological advances are keys to achieving our regional mobility goals. Vehicle Infrastructure Integration (VII) is a set of applications and emerging technologies that create a wireless internet for vehicles and roadside transportation. VII applications include elements of the Automated Highway System and Intelligent Vehicle technologies, which were demonstrated in the San Diego region starting in the 1990s.

A number of emerging technologies are designed to add capacity to our transportation system, including magnetic levitation, personal rapid transit and group rapid transit, and other conceptual systems. Many are high-speed, grade-separated systems that offer alternatives to our traditional modes of public transportation.

The white paper evaluates these major trends and technologies as possible contributors to the region's long-range transportation goals over the next 30 years and beyond. Major technologies are discussed, including issues, policy implications, and recommendations for the 2007 RTP, and future analysis.

To ensure that the most important areas of focus have been included in this white paper, SANDAG staff solicited input from the Stakeholders Working Group at its November 14, 2006, meeting; the Cities/County Transportation Advisory Committee at its December 7, 2006, meeting; and the San Diego Traffic Engineers Council at its January 11, 2007, meeting. Comments received were incorporated into the white paper (Attachment 1) as appropriate.

BOB LEITER
Director, Land Use and Transportation Planning

Attachment: 1. Emerging Technologies in Transportation White Paper for the 2007 Regional Transportation Plan

Key Staff Contacts: Linda Culp, (619) 699-6957, lcu@sandag.org
Samuel Johnson, (619) 699-6958, sjo@sandag.org

EMERGING TECHNOLOGIES IN TRANSPORTATION WHITE PAPER FOR THE 2007 REGIONAL TRANSPORTATION PLAN

Introduction

Technology is key to achieving our regional mobility goals, to both add capacity and to maximize the efficiency, utilization, and safety of our current system. Technology is always changing and key developments that are emerging are worth an initial evaluation in the San Diego region. Many times, public agencies are constrained by funds or overly-cautious of being on the leading edge of technology, which can be perceived as non-responsive to technological advancements.

Technology systems and software can play a key role in getting the most out of the system and various emerging technologies have generated substantial support as having the potential to significantly augment transportation approaches and designs for systems management. The most compelling set of applications and emerging technologies for the transportation industry are bundled under the category of Vehicle Infrastructure Integration (VII). VII essentially creates a "wireless Internet" for vehicles and roadside elements, such as traffic sensors and signals, to communicate and exchange data with each other.

There also are new developments such as alternative fuels that also can maximize our current transportation system potential. We are well aware of the increased popularity of hybrid vehicles. There also are next-generation, hybrid technology transit vehicles in use in Europe and plans to introduce them in the United States.

A number of emerging technologies are designed to add capacity to our transportation system, including magnetic levitation (Maglev) systems, other people-mover technologies such as Personal Rapid Transit and Group Rapid Transit, monorails, and many other ideas that are at the conceptual stage. Many are high-speed, grade-separated, high-capacity systems aimed at competing with the automobile and offer an alternative to our traditional modes of public transportation.

This paper evaluates these major trends and technologies as possible contributors to the region's long-range transportation goals over the next 30 years and beyond. Three main types of technologies are discussed: Vehicle Infrastructure Integration (VII), Alternative Fuels, and Capacity Systems. Issues, policy implications, and recommendations for the 2007 Regional Transportation Plan (RTP) and future analysis also are discussed.

Objectives for 2007 RTP

The objectives of this white paper for the 2007 RTP are:

- Identify and plan for improvements necessary to support regional goals for transportation monitoring and management through VII.
- Assess the current state of technologies that add capacity to the transportation system and include key alternatives to be discussed in the RTP.
- Develop a list of conceptual systems to be monitored for possible inclusion in future RTPs.

Background

Vehicle Infrastructure Integration

The objective of VII is to deliver a communications network that delivers safety, traffic, and traveler applications by enabling vehicle to infrastructure and vehicle to vehicle communications. Although the U.S. Department of Transportation (US DOT) formally adopted the VII initiative in 2004, the underlying concepts are derived from the Automated Highway System (AHS) and Intelligent Vehicle efforts in the early 1990s. The capabilities and benefits of AHS and intelligent vehicles are embodied within VII, including the primary functions of improving safety and mobility. While VII is more focused on assistive functions than autonomous vehicles, the core design still relies on the exchange of information between an intelligent vehicle and an intelligent infrastructure. This network is made possible due to advances in wireless communications and provides for the rapid sharing and analysis of data to deliver groundbreaking safety applications, as well as provide the data collection and dissemination mechanisms needed for the identified mobility strategies.

The US DOT, private industry, and educators are strong supporters of VII applications capability to reduce the 42,000 annual highway fatalities, increase throughput, and to improve management capabilities.

The US DOT is in the final stages of concept testing and development of a nationwide deployment plan. A few key regions/agencies, including the Metropolitan Transportation Commission in the San Francisco Bay Area, have functioned as the leaders in evaluating the potential of VII. These regions have deployed operational test beds through partnerships with the Federal Highway Administration and various firms from private industry to explore the capability of VII applications to improve safety and enhance mobility. Their findings to date have been promising and regions are in the process of expanding their efforts and increasing their investments in the technology.

The US DOT is expected to conclude these discussions during FY 2008 and make a formal announcement on committing to a particular protocol, frequency, and national deployment. In anticipation of US DOT support, private industry, and the academic community are expanding efforts to develop applications, operational strategies, and data management concepts.

Alternative Fuels

New technologies also are emerging that can benefit our current transportation systems. Using alternative fuels can reduce pollutants and exhaust emissions and most can be domestically-produced and derived from renewable resources. Developments in alternative fuels include increased use of biodiesel, electricity, ethanol, hydrogen, and natural gas.

Hybrid-electric vehicles combine gasoline engines and electric motors. Nearly all hybrids require gasoline and diesel, although advances area being made with ethanol, hydrogen, and solar hybrids. For example, SunPower Corporation is developing a solar-powered hybrid battery.

There also are next-generation, hybrid technology transit vehicles in use in Europe and plans to introduce them in the United States. In addition to transit vehicle orders in New York, Toronto, and Seattle, the growth of hybrid buses in the past year has been on a steep, upward climb: estimates are that between 1,000 and 2,000 hybrids are already operating in revenue service or will soon be deployed. In addition, another 1,000 or more hybrids likely will be procured during the next two years, and several other thousands are said to be considered in orders during the next five years.

Capacity Systems

Since the early 1950s, systems have been seriously studied and in some cases implemented that use cutting-edge technology such as maglev, monorails, and other people-movers. More recently, some of these technologies have been studied for implementation in the San Diego region.

Maglev

Magnetic levitation (Maglev) technology is a guided, ground-based system in which a vehicle is lifted and propelled by magnetic force along a guideway without physical contact. Maglev trains can travel at very high speeds, 300 miles per hour or more, with reasonable electricity consumption and noise levels. There are currently two Maglev systems in commercial operation, including a 19-mile system in Shanghai, China. In FY 2006, SANDAG studied the possibility of a Maglev system along an East-West corridor between downtown San Diego and a possible future airport site in Imperial County. The study found that this system would be feasible but noted lack of operational experience, particularly in mountainous terrain and through long tunnels. Fares were expected to cover the operations and maintenance costs. Capital costs ranged from $15.2 billion to $18.2 billion for alignments that ranged from 79 miles to 98 miles in length.

Pending a change in federal funding legislation, SANDAG also plans to study the potential for Maglev in a north-south corridor that would connect to an extensive Maglev system that is currently planned by the Southern California Association of Governments (SCAG). The SCAG system has been under development for more than 10 years and includes a number of Maglev corridors to connect the major airports in the greater Los Angeles area.

German-owned Transrapid International designed and constructed the 19-mile Shanghai airporter system. In California, the Federal Transit Administration has sponsored General Atomics in San Diego to develop "urban maglev." As a result, General Atomics has constructed a test track and facility at its Torrey Pines location.

Monorail

Monorail systems are trains that straddle a fixed guideway formed by a single beam or rail, powered by electricity, with vehicles that are often wider than the guideway. Many monorail systems are elevated, but can also be at or below grade. The most famous monorail system has been in operation since 1959 at Disneyland, but other monorails also provide an alternative in many large cities. Other U.S. examples include Newark International Airport, Seattle, Jacksonville, and Las Vegas. International examples include a number of monorails in Germany (home of the oldest monorail in operation since 1901), Asia, and Japan. Recently in San Diego, a network of monorail corridors has been proposed by Ellorin Consulting Engineers. Routes include service to the Uptown and Downtown San Diego areas, Interstate 15, and service to Coronado via the San Diego Coronado Bay Bridge.

Aeromovel

The Aeromovel system is a people-mover that utilizes low pressure forced air within the tube of a fixed guideway to move the vehicle. Forced air is provided by commercially available fans or blowers used in industrial air systems. Vehicles operate on an exclusive guideway. There are pilot Aeromovel systems in operation in Brazil and Indonesia. In San Diego, the North County Transit District (NCTD) conducted a study in 1997 that provided a comparison between a bus way and aeromovel system for the future SPRINTER rail loop to California State University San Marcos. The

purpose of the study was to compare the requirements and costs of a proposed bus way and an Aeromovel system. The study concluded that the latter system was more expensive to build and operate.

Personal Rapid Transit/Group Rapid Transit

Personal Rapid Transit (PRT) and Group Rapid Transit (GRT) systems have been studied since the 1950s. PRT offers the advantage of small, private-party vehicles and nonstop trips. These systems also require little right of way, are fairly quiet, and energy efficient. One example that has been in operation since the 1970s is the PRT at West Virginia University in Morgantown, West Virginia, a nine-mile corridor with five stations. Although known locally as a PRT, the characteristics of this system are more GRT because of the capacity of vehicles (about 25 people) and the fact that not all rides are non-stop. Other U.S. examples are in Detroit and Miami. Other PRT/GRT systems are in place in Europe, including service at the Dusseldorf International Airport in Germany and in Japan.

Other emerging technologies are in the conceptual stage and some have been promoted as alternative transportation in the San Diego region:

SkyTran

SkyTran has been conceptualized as personal Maglev transporter, with two-person vehicle traveling at speeds between 100 to 150 miles per hour on exclusive elevated guideway. The system is powered by electricity and uses a similar technology as Maglev. The system is on demand, meaning that passengers can pick up a vehicle and go straight to their destination. Capital cost is estimated at $10 million per mile.

Rideway

For several years, the Hoffman Rideway is a concept that has been presented to SANDAG and other groups as an alternative to traditional transit systems. Ridecars are vehicles with four seats which enter the Rideway via a mobile crane. The Rideway uses a conveyor to move cars around the region. The system is fully automated and grade separated for safety.

Discussion

Issues and Policy Implications

Several components of these emerging technologies present particular challenges for the region. These include:

- The VII initiative is a tremendous undertaking with various detailed and high-level issues still to be addressed. Detail items pertaining to technical issues such as the communications protocol and frequency are highly debated and best left to the academic community and private industry to reach consensus. Some of the issues that may require active involvement and discussion by policy makers include infrastructure investment and timing, privacy issues, ongoing maintenance, and operations.

- There are finite resources available for transportation systems at the local, state, and federal levels. There are costs associated with research and development, implementation and capital costs, and operations and maintenance.

- Many times there can be disadvantages for agencies desiring to be on the cutting edge. Agencies may find themselves paying more for research and development costs. Furthermore, some emerging technologies should take advantage of a regional network (e.g., coordinating efforts with SCAG for potential Maglev applications). The region should also ensure that systems are compatible and can be linked.

Recommendations

For RTP Update

It is recommended that the RTP include a discussion of VII and highlight Maglev as an emerging technology in terms of adding capacity to the transportation system, relying on the SANDAG Phase 1 Maglev Study for details.

Other emerging technologies will be monitored for inclusion in future updates of the RTP. Specifically, SANDAG will make review of emerging technologies a regular component in future RTPs.

For Future Analysis

SANDAG will work to secure federal funds for the Phase 2 Maglev Study to identify a potential North-South Corridor and connection to the SCAG Maglev network.

SANDAG will work to secure federal, state, and local funds, and formalize public private partnerships to establish a VII Validation Corridor for a field operations analysis of near term benefits and development modeling criteria for other regional corridors.

SANDAG will work to secure funds, including planning grants, to conduct a more detailed study of the advantages and disadvantages of emerging transportation technologies in anticipation of the next RTP update. One possibility might be to convene a peer review of emerging technologies.

Bibliography

USDOT Web Sites

2006: Vehicle Infrastructure Integration – A Major ITS Initiative, www.its.dot.gov/vii, www.its.dot.gov/vii/vii_overview.htm, www.its.dot.gov/vii/vii_concept.htm

2006: Vehicle Infrastructure Integration (VII) Initiative, powerpoint presentation, www.its.dot.gov/vii/docs/vii_pres.ppt

ITS America

2006: VII White Paper Series – "Primer on Vehicle-Infrastructure Integration", www.itsa.org/itsa/files/pdf/VIIPrimer.pdf

2006: VII White Paper Series – "Technology Evolution: Lessons Learned and Their Impact on VII Applications", www.itsa.org/itsa/files/pdf/VIITechnologyEvolution.pdf

Alternative Fuels

2006: California Energy Commission, www.energy.ca.gov

2006: U.S. Department of Energy, Energy Efficiency and Renewable Energy, www.eere.energy.gov

2006: WestStart – CALSTART, Transforming Transportation, *BRT newsLane,* Vol. 5, No. 1, 2006.

Maglev

2006: *SANDAG Phase 1 Maglev Study*, Final Report, March 17, 2006.

2006: Federal Transit Administration, Urban Maglev Program, www.fta.gov

Aeromovel

1997: Bus Way and Aeromovel Cost Comparison Study for the California State University San Marcos Loop of the Oceanside-Escondido Rail Project, NCTD.

Other Technologies

2006: *Supported-Vehicle Automated Peoplemover (APM) Technologies,* Innovative Transportation Technologies website at http://faculty.washington.edu/~jbs/itrans/itrans1.htm

2006: Anderson, J., *Some Lessons from the History of Personal Rapid Transit (PRT),* Innovative Transportation Technologies website at http://faculty.washington.edu/~jbs/itrans/itrans1.htm

2003: *The Hoffman Rideway*, at http://faculty.washington.edu/jbs/itrans/hoffman.htm

2006: SkyTran, at http://www.skytran.net

2004: S. Raney and S. Young, *Morgantown People Mover*, at http://www.cities21.org/morgantown_TRB_111504.pdf

2006: The Monorail Proposal for the City of San Diego and City of Coronado, Ellorin Consulting Engineers