TRANSPORTATION AND SAFETY IN JAPAN

P-DRGS AND ECO-POINT TDM PROJECT IN THE SECOND STAGE AT THE AICHI EXPO

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1. INTRODUCTION

An array of ITS technologies has been implemented at the Expo 2005 in Aichi, Japan starting in March 2005, including IMTS (Intelligent Multimode Transit System), parking lot guidance systems, bus location systems and off-site security systems. July of the same year has been designated as "ITS Month" and a showcase and various events will be held in mid-July as part of an ITS-EXPO Core Week. The showcase will feature further developed versions of working demos first introduced at the ITS World Congress in October of 2004; if the demos at ITS World Congress are thought of as a "hop" in triple jump, the Expo showcase could be said to represent the next, "step". The showcase will include exhibitions of approximately 20 systems developed by national and regional organizations and industrial partners, such as real-time traffic signal control, Public Transportation Priority System, barrier-free IT, and ETC multiservice application. This report will focus on a pair of systems developed by our research group to be implemented in the Aichi EXPO showcase: P-DRGS (Probe-vehicle-based Dynamic Route Guidance System) and the Eco-Point TDM Project.

2. PRONAVI

Our research group has been promoting an industry-academia-government project under the auspices of the Ministry of Internal Affairs and Communications, Strategic Information and Communications R&D Promotion Program. This project involves the deployment of the world's largest fleet of probe cars within the city of Nagoya as an experimental validation platform for use in the implementation of a dynamic route guidance system researched and developed by the six-member "P-DRGS Consortium"* of Nagoya University, NEC Corporation, Denso Corporation, Toyota Mapmaster Inc., the Japan Weather Association (JWA) and A-Works Co., Ltd. Dynamic route guidance systems help to alleviate needless traffic congestion resulting from spatiotemporally determined concentrations in demand for transportation, not only by the effective use of existing road infrastructure, but by providing a system that might be termed "killer content" to meet the demands of individuals seeking to find the fastest route to their destinations.

The P-DRGS Consortium developed a prototype, "PRONAVI", a multimode dynamic route guidance system, as part of its goal to implement a high-performance route guidance system. This system comprises a central server and terminals connected over the Internet. When a destination is selected on a terminal, the central server calculates the time required to reach it from the point of departure and send the results to the terminal. Future plans include equipping terminals to a vehicle's onboard PC, and in the development of a cell phone version similar to the "Man-Navi" system used in GPS-capable cell phones.

Time to destination is calculated based on a time table maintained on the central server. This table was compiled from 9 months of data gathered from 1,500 taxis servicing the Nagoya area and 6 months of VICS input using an algorithm developed by our research group. Using 9 tables reflecting distinct patterns, such as for different days of the week and national holidays, the system calculates travel time through each road link on a digital road map (DRM), corrected for time-of-day related factors in 5-minute intervals (288 intervals per day). The central server also collects real-time data. At the ITS World Congress, real-time data was collected from 1,500 taxis servicing the Nagoya area. This real-time data was used to develop a time series model periodically applied to correct and update the stored time-to-destination tables and enable more accurate travel time forecasting.

Terminals display the two routes calculated as shortest time to destination, and following the "Man-Navi" example, also display train routes as well. Train routes are calculated from train timetable data stored on the central server. Estimated carbon dioxide (CO_2) emissions are also displayed for each route, and it is possible to show recommendations for park and ride and other environmentally-conscious information. Information on construction and other road traffic restrictions provided by

*URL: http://www.p-drgs.com

JARTIC (Japan Road Traffic Information Center) is downloaded in real-time and used to correct the calculation of travel time estimates, adding even further to the user-friendliness and effectiveness of the system.

A demonstration of PRONAVI was staged at the Nagoya University booth and technical tour at the ITS World Congress. More than 1,200 people participated in the demo, and of respondents to the exit survey (valid responses=92), nearly 100% indicated they recognized the difference between PRONAVI and traditional car navigation systems, and the useful advantages it offered. Many of the respondents indicated particular interest in the supplementary CO_2 emissions and construction/traffic restriction information.

At the Aichi Expo, 1,000 monitors will be recruited for a PC-based informational demonstration of an improved version of the PRONAVI system. Monitors will be provided with the improved version of PRONAVI, and the stability and accuracy of the system will be verified in a limited, larger-scale demonstration to users across a wide area and ultimately, the world. By collecting evaluations of system function from large numbers of users, we also hope to gather information that will be useful in further ascertaining user needs and improving the system toward its future real-world implementation.

The improved version of PRONAVI being introduced at the Aichi Expo allows dynamic multimode route searches via PCs over the Internet (Fig. 1). This version includes the features of previous versions, and has been expanded to allow searches for departure points and destinations across all of Aichi Prefecture, which is intended to provide visitors to the Aichi Expo with a dynamic, multimode route guidance system. The system is not limited to vehicular data alone, but includes real-time updates of JARTIC construction and road restriction and JWA weather information as well, which it is hoped will allow the system to provide extremely accurate calculations of estimated time of arrival and recommended fastest routes. During the ITS-EXPO Core Week schedule for ITS Month events at the Aichi Expo, in addition to the PC-based route search system, a demo will be made of an improved PRONAVI system featuring GPS tracking function for in-vehicle use, such as is planned for the future.

3. ECO-POINT TDM PROJECT

"Public transportation Eco-Points" are awarded to commuters in highly trafficked urban areas for choosing to use public transit, and points thus collected can be used to receive discounts on public transportation fares and other rewards. The Eco-Point award system is a means of encouraging and providing incentives for activities beneficial to society, designed to be both "money-saving and fun", which is being looked to as a means of inducing changes in attitudes toward public transportation and self-initiated changes in behavior, resulting in a transition to more regular usage of public transportation which may lead to significant returns for the general environmen-

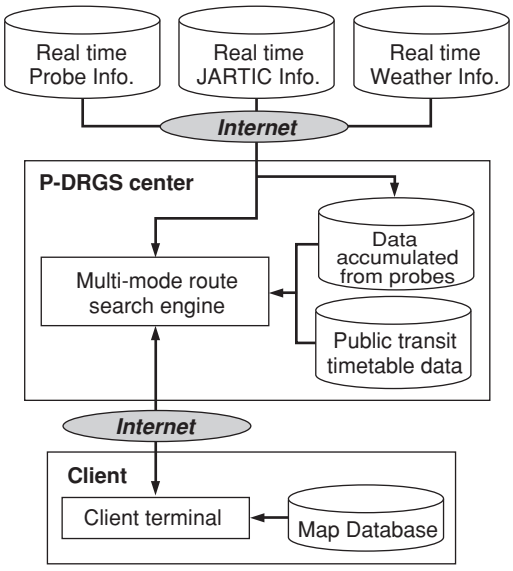

Fig. 1 PRONAVI system

tal consciousness movement.

In 2004, an "Eco-Point TDM public experiment planning session" attended by members of academia, government, industry and citizens was held, and for a period of two months that included the convention of the ITS World Congress, 1,000 monitors joined in the public experiment. IC tags carrying the world's smallest IC chip, the Hitachi μ chip, were distributed to the monitors who accumulated points when using city subways by presenting the IC tags to card readers at subway stations and other specified locations. In principle, one point was awarded each time the user presented the tag to be read, but, to encourage the usage of public transportation for travel to non-routine destinations in the city, awards were tripled between 10:00 a.m. and 4:00 p.m., and quintupled on weekends and holidays. Accumulated points were managed in a central server, and monitors could keep track of their individual point totals via cell phone email messages or a confirmation screen on the project website. On accumulating certain numbers of points, monitors were given rewards, such as restaurant discount coupons or prepaid subway fare cards (Fig. 2).

Prior to the start of the experiment, monitors were recruited using fliers, posters and Nagoya city information bulletins, a recruitment that drew 2,688 applicants in only a brief period. A separate survey indicated that there were some cases in which people did not apply because they had no plans to visit the downtown area of Sakae, or because they did not use a PC or cell phone. To achieve greater accessibility and broader usage in the future, we need to investigate means of use other than via cell phone or PC email, as well as the installation of card readers at additional locations.

Of the 1,000 monitors in the experiment, 903 used the system at least once. The average number of uses per user over the experiment period was 37, showing an active level of participation. If we compare CO_2 emissions for subway uses versus travel by automobile, approximately 33 fewer tons of CO_2 were produced by the subway travel during the experiment period, equivalent to about 2.5 hours of air conditioner use (approximately 630g) per person per day.

About 60% of the monitors responded to the follow-up survey that they had made changes in their patterns of transportation usage, such as "used more public transportation" or "traveled less by car", and 99% of the monitors stated that they would like to participate in similar programs again. Also, as a result of survey analysis, it was statistically demonstrated that environmental awareness was increased as a result of the public experiment, leading to changes in patterns of transportation usage and other eco-friendly activities.

A demonstration of the system during the technical tour at the ITS World Congress, which was held during the experiment period,

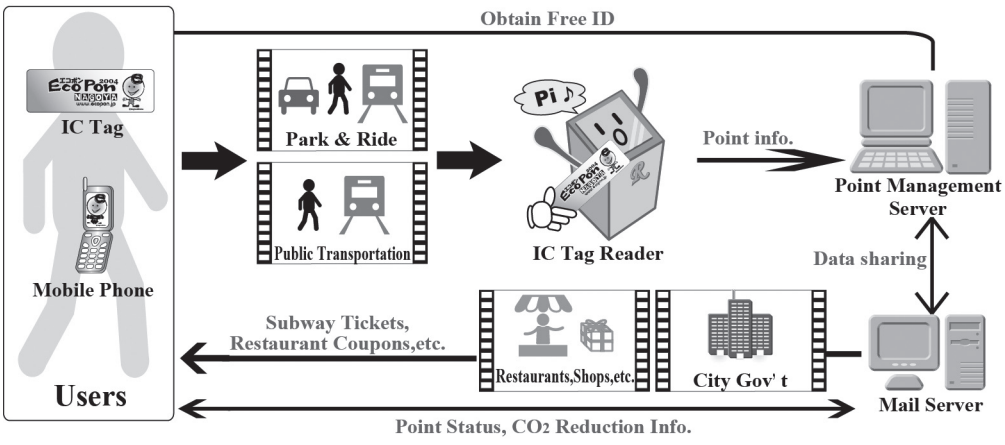

Fig. 2 Eco-point TDM system

was evaluated favorably by many experts and representatives from various organizations both from within Japan and around the world, and the regions of Matsuyama and Okinawa are now both investigating the possibility of conducting similar public experiments or actual system implementations in those locales.

For the current fiscal year, we plan to conduct a larger scale study involving about 10,000 monitors over a six-month period, which will provide us with findings by more closely approximating an actual implementation, and will serve to increase public awareness of the public transportation Eco-Point award system in advance of implementation. The devices and servers used as the infrastructure in last year's program will serve as a base for the expanded study, supplemented by the installation of card readers in additional locations and improvements to server function and efficiency, which will increase the robustness of the system to the level needed for actual implementation.

The system will further be linked to the Eco-Money system being used at the Aichi Expo, and linkups with credit card companies and the car sharing business program introduced in the city of Nagoya last autumn, along with increased participation by businesses in the downtown area, and possible expansion to broader areas are planned, with the goal of developing a sustainable business model for the public transportation Eco-Point system in which all participants share costs equitably. In addition, demonstrations are planned for ITS-EXPO during the Aichi Expo, which will serve to increase the visibility and public awareness of the public transportation Eco-Point system and transportation and environmental problems, which should further facilitate implementation.

Linkage of the public transportation Eco-Point system with the PRONAVI system described in the preceding section, by providing users with Eco-Point awards and information on CO_2 emissions levels, represent a promising synergistic model for promoting the switch to park and ride use among the commuter base. And by linking the public transportation Eco-Point system to real-time traffic information it would be possible to develop a dynamic system in which point awards could be adjusted to traffic congestion levels, which could simultaneously increase benefits to the users and to society as a whole, by helping to improve the efficiency of the usage of the road and public transit infrastructures.

4. TOWARDS THE "JUMP"

In 2001, the Japanese cabinet established an IT Strategy Headquarters and launched the e-Japan Priority Policy Program. The further sophistication of ITS represents one element of this rapidly deployed IT policy package, and is undergoing significant reinforcement. With the goal of achieving a truly ITS society, the Ministry of Land Infrastructure and Transport has been promoting the implementation of ITS devices on vehicles and infrastructure to enable smooth flow at gate checkpoints via DSRC (Dedicated Short Range Communication), local guides tailored to locale and user needs, and timely driver support services for high-accident areas, detailed construction restrictions and end of congestion alerts, all of which are scheduled for implementation by 2007. These ITS devices are also equipped to transmit data collected by probe vehicles. The Ministry of Economy, Trade and Industry (METI) is also heading a project in which discretely formatted probe data showing speed and location will be collected from private passenger vehicles and commercial trucks, buses and taxis and used in a government-industry collaboration to develop standardized traffic information software. The overall costs for these programs, which are scheduled for implementation in 2007, are 1.5 billion yen, to be covered entirely under national budgetary plans.

The implementation in 2007 of vehicular ITS devices and software compatible with probe data will make larger sets of probe data available than ever before, thereby enabling the acquisition of even more detailed traffic information on a nationwide scale. By taking advantage of that expanded set of data, the PRONAVI system currently being developed shows great promise for implementation across the entire country.