Abstract

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Topic:	**Survey and analysis of existing and potential Intelligent Transport Systems (ITS) in the public transport sector of Japan**
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This thesis aims to survey and analyze existing and potential Intelligent Transport Systems (ITS) in the public transport sector of Japan and was elaborated during a stay at the Traffic Engineering Lab at the University of Tokyo. It focuses on the most specific and innovative systems, which are observed exemplarily in the Tokyo Metropolitan area, where public transport is highly developed and consists of diverse means of transportation.

At the beginning, a catalogue of available ITS technologies that is based on an international literature review is presented. It categorizes ITS into three main fields of application: Fleet management, traveler information and electronic fare collection.

For a better understanding of the deployment conditions for ITS, this thesis provides some information on the public transport sector of Japan in general and on the urban transport framework in the Tokyo Metropolitan area:
The modal ratio of public transportation in Japan is roughly 27 percent and regarding the overall traveled distance, with an amount of about 400 billion passenger-kilometers per year, public transport is about 4 times higher than in Germany.
The Japanese public transportation sector is dominated by the former state-owned JR (Japan Railways) companies, especially for long-distance journeys. The different JR companies provide a high-speed railway network, which connects the large metropolitan areas and accounts for 62 percent of the total railway passenger-kilometers.
Bus transportation accounts for approximately 3 percent of travelled kilometers of all modes.
Inside the metropolitan areas, foremost in Tokyo, there is much more competition between the different means of transportation, such as railways, subways, monorails, AGTs, trams and buses and between a variety of public and private transport operators.

In the following, this thesis depicts important Japanese ITS promoters and essential policies in the field of ITS that lead to the spread of those technologies by providing knowledge and financial support. ITS have been promoted in Japan for decades by different government bodies and private organization in order to bolster public transport by making it more convenient and for the purpose of supporting transport companies to make their operations more efficient. Another important goal is to strengthen the ITS related industry.

The "Comprehensive Plan for ITS in Japan" includes important guidelines for ITS in public transport. A relevant factor to provide traveler information in a useful way, is the promotion and realization of a ubiquitous society.

The Universal Traffic Management System (UTMS) of Japan fosters bus companies with a subsystem called Public Transportation Priority System (PTPS), which aims to shorten and reduce travel time variation in a centralized approach, where traffic control centers modify traffic lights according to the position and the route of a vehicle.

Different standardization activities in the domain of ITS are elaborated in ISO with the aid of Japan and in a national context, DSRC specification is considerable.

Based on the foregoing categorization of internationally available ITS technologies, a variety of Intelligent Transport Systems are described for different means of transportation and shall be summarized briefly:

- Many bus companies throughout the country make use of PTPS that applies infrared beacons in order to identify the position of a public transport vehicle.
- Bus location systems that rely to GPS and DSRC are deployed to achieve more efficiency in fleet management and to provide traveler information.
- ITS can support demand responsive transport (DRT) to maintain mobility in regions with low travel demand. A cloud computing based on-demand bus system, which was developed at the University of Tokyo, was introduced in different Japanese municipalities.
- Automatic passenger counters (APC) are rarely deployed by Japanese transport companies, but data arising from electronic fare collection (EFC) systems offer the opportunity to analyze travel demand.
- In railway operations, radio-based train and route control systems were put into use on some train lines and will be further developed. Research on radio-interlocking devices with the aid of RFID tags is in progress and passed first field tests.
- Advanced traveler information systems (ATIS), which include inter-company and intermodal approaches, are highly developed for all means of transportation and provide travelers with information before and during their journeys.

- A so-called Autonomous Decentralized Transport Operation Control System allows high density train operations in the high traffic demand area of Tokyo Metropolis and combines fleet management, traveler information, maintenance work management, signaling and interlocking functionalities.
- Electronic fare collection in Japan is based on Sony's FeliCa IC card standard. The two compatible IC card systems in Tokyo Metropolitan area, Suica and Pasmo, which deploy automatic ticket gates that don't interrupt passenger flow are highly adopted by travelers and can be used for electronic payments other than fare collection as well.

It is clearly visible that internationally available ITS technologies are highly developed, especially in the large metropolitan areas, and further research and development on ITS is undertaken.

In some fields of application, Intelligent Transport Systems in Japan are more advanced than in other countries, as for example in Germany. Besides the above mentioned promotion by government bodies and private organizations, this might also be related to the market environment, which is characterized by a high density of population in the metropolitan areas and a high attraction of Japanese users to technical innovation, for example in the field of mobile traveler information.

This milieu creates a demand for high-frequency operations, reliable passenger information and efficient fare collection, and the possibility to reach a lot of customers, e.g. for advertisement activities in combination with traveler information. It offers a great opportunity to transport companies to invest into ITS technologies in order to make their operations more productive and efficient, and to provide additional services to the customers.

The use of ITS technologies certainly increases the attractiveness of public transport for the travelers as it enables high frequency operations in the metropolitan areas as well as on-demand services on the countryside. Traveler information can be obtained in a convenient way and EFC simplifies the fare collection.

Large international corporations based in Japan, such as Hitachi, NEC, NTT, Panasonic or Sony, dominate the Japanese ITS market. Those electronics groups and telecommunications corporations are the main suppliers and developers of ITS technologies.

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