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Intelligent Transportation System

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ABSTRACT

Intelligent transportation systems (ITS) hold great promise for public works professionals seeking to optimize those public investment strategies that deal with traffic congestion and other growth pressures. Advanced traffic and fleet management systems as well as traveler information and vehicle-based systems can take advantage of information technology advances and private market products to substantially improve the productivity, connectivity, and safety of transportation. And as the new federal transportation act further spurs deployment of these systems, ITS research programs will continue to play a vital role in supporting such deployment and the overall evolution of ITS. Such research includes developing technology tools, providing testing and evaluation environments, and helping advance the state of the practice.

Traffic control has been an issue since humans put the first wheels on the first cart. The modern world demands mobility. Cars represent the main method of mobility, but today's congested highways and city streets don't move fast, and sometimes they don't move at all. Intelligent traffic systems (ITS), sometimes called intelligent transportation systems, apply communications and information technology to provide solutions to this congestion as well as other traffic control issues. Intelligent Transportation Systems (ITS) represent a major transition in transportation on many dimensions. ITS is an international program intended to improve the effectiveness and efficiency of surface transportation systems through advanced technologies in information systems, communications, and sensors. ITS (Intelligent Transport Systems) is a system which is designed to promote advance technology, to ensure that the Electronic Toll Collection System (ETC) is effective and to support safe driving. With this system, people, roads, and vehicles use the latest information communication technology.

The intelligent transport system (ITS) takes the first step towards meeting this challenge by providing effective, reliable and meaningful knowledge to motorists in time. Problems like high traffic congestion, low transportation efficiency, low safety and endangered environment can be solved through innovative and sophisticated ways of handling latest techniques that have emerged in recent years in integrating information technology, electronics and telecommunication with roads and traffic management. Intelligent transportation systems.

1, INTRODUCTION

In 1986, an informal group of academics, federal and state transportation officials, and representatives of the private sector began to meet to discuss the future of the surface transportation system in the United States. These meetings were motivated by several key factors. First, the group was looking ahead to 1991 when a new federal transportation bill was scheduled to be enacted. It was envisioned that this 1991 transportation bill would be the first one in the post-Interstate era. The Interstate System, a $130 billion program, had been the centerpiece of the highway program in the United States since the mid-1950s. By 1991 this project would be largely

complete. A new vision for the transportation system in the United States needed to be developed. While the Interstate had had a major and largely positive impact in providing unprecedented mobility at a national level, transportation problems remained. From the perspective of 1986, highway traffic delays were substantial and growing. Rush-hour conditions in many metropolitan areas often extended throughout the day. Further, safety problems abounded, particularly highway safety.

Intelligent Transportation System is an international program aimed at using advanced technology for improving the efficiency, safety, and environmental impact of land transportation. It incorporates a wide variety of advanced technology systems and products.

The concept of Intelligent Transportation Systems was first introduced as a concept of automating traffic flows. Intelligent Transportation Systemic the incorporation of information technologies and advances in electronics into all parts of the transportation network. Simply speaking, it is the application of technology to transportation systems. Thus Intelligent Transportation Systems involve the integration of technology in areas such as communications, information systems sensors, and operation research methods with conventional transportation infrastructure to address many transportation issues that confront the conventional system at this time.

As more electronics are incorporated into the automobiles at higher rates, a new automotive market is developing - The Intelligent Vehicles market. These systems, applied to automobiles, will affect the vehicle in three basic functional areas - Basic vehicle, Safety and security and Telematics. Intelligent Vehicles systems will help lessen traffic congestion, improve safety, driver comfort and convenience, and foster a cleaner environment.

HISTORY OF ITS :

Intelligent Transportation System technology can be defined as the application ofinformation technology to surface transportation in order to achieve enhanced safetyand mobility while reducing the environmental impact of transportation.

ITS aims to facilitate a national multi-modal surface transportation system that features a connected transportation environment around vehicles of all types, the infrastructure, and carry-in passenger devices to serve the public good by leveraging technology to maximize safety, mobility, and environmental performance.

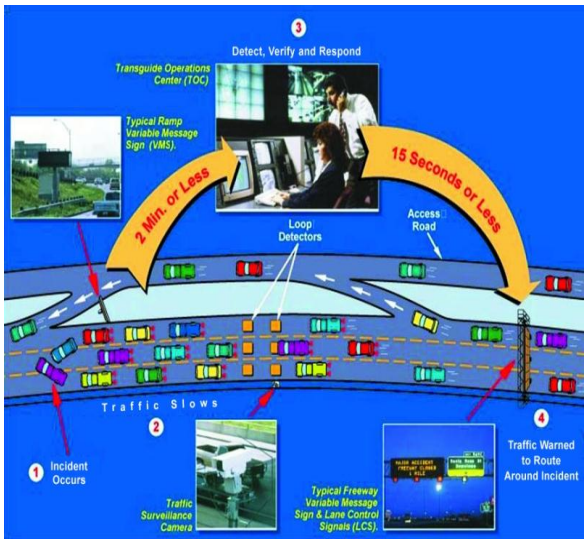
Intelligent Transportation Systems (ITS) is a tested route to mitigate traffic congestion problems. ITS can be broadly defined as the use of technology for improving transportation systems. The major objective of ITS is to evaluate, develop, analyze and integrate new technologies and concepts to achieve traffic efficiency, improve environmental quality, save energy, conserve time, and enhance safety and comfort for drivers, pedestrians, and other traffic groups. An overview of ITS can be schematically represented as shown in Figure 2. State-of-art data acquisition and evaluation technology, communication networks, digital mapping, video monitoring, sensors and variable message signs are creating new trends in traffic management throughout the world. The synergy of data acquisition, analysis, evaluation, and information dissemination helps in developing an all-encompassing system of traffic organization that enables information sharing among the managers and users of traffic.

Intelligent transportation technologies

Intelligent transportation systems vary in technologies applied, from basic management systems such as car navigation; traffic signal control systems; container management systems; variable message signs; automatic number plate recognition or speed cameras to monitoring applications, such as security CCTV systems; and to more advanced applications that integrate live data and feedback from a number of other sources, such as parking guidance and information systems; weather information; bridge deicing systems; and the like. Additionally, predictive techniques are being developed in order to allow advanced modeling and comparison with historical baseline data. Some of the constituent technologies typically implemented in ITS was described in the following sections.

Advanced Traffic Management Systems (ATMS):

Integrates various sub-systems (such as CCTV, vehicle detection, communications, variable message systems, etc.) into a coherent single interface that provides real time data on traffic status and predicts traffic conditions for more efficient planning and operations. Dynamic traffic control systems, freeway operations management systems, incident response systems etc. respond in real time to changing conditions



Advanced traffic Management system

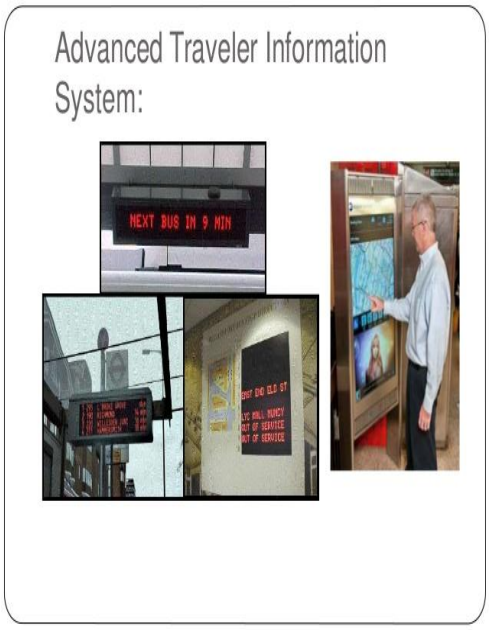
Advanced Traveler Information Systems:

(ATIS) provide to users of transportation systems, travel-related information to assist decision making on route choices, estimate travel times, and avoid congestion. This can be enabled by providing different information using various technologies such as:

i) GPS enabled in-vehicle navigation systems

ii) Dynamic road message signs for real time communication of information on traffic congestions, bottlenecks, accidents and alternate route information during road closures and maintenance

iii) Website to provide a colour-coded network map showing congestion levels on highways (a.k.a. congestion index).



Advanced traveler information system

Communication Technologies:

The use of networks for communications between the electronic control units of a vehicle in production cars dated from the beginning of the 1990s. The **Controller Area Network** (CAN) was first introduced by BOSCH with the clear intent to serve communication systems for automotive applications and it is still dominant in automotive networks. The CAN is not fully satisfying requirements such as predictability, performance and dependability which are mandatory in automotive communications. To overcome the limitations of the CAN technology, a number of technologies have been developed for designing automotive networks such as **Time-Triggered Protocol** (TTP), **Time-Triggered CAN** (TTCAN), **Byte flight** and **Flexray**. Wireless communication technologies such as ZigBee, Bluetooth (Bluetooth, 2006) and Wi-Fi are also expected to be widely employed in the near future in automotive communication. It is evident that wireless communications can be used in- vehicle, inter-vehicle and between vehicle and infrastructure in transportation applications. Bluetooth is currently the most widely used automotive wireless technology for in-vehicle communication and Wi-Fi is used for vehicle to vehicle communication by several pilot research projects, e.g., the Car2Car consortium Ultra Wide Band (UWB) is an emerging wireless technology that uses a very large bandwidth. It is targeted for multimedia networking whereas 802.11 networks address data networking. Intelligent collision avoidance and cruise control systems can be developed using UWB technology as those systems need high ranging accuracy and target differentiation capabilities. UWB technology can also be integrated into vehicle entertainment systems by downloading high- rate data from road-side infrastructure UWB transmitters. Communication Air-interface, Long and Medium range (CALM) has many potential applications in V2V and V2I communication. ZigBee will be able to fill the gap left by these other technologies, mainly in the interconnection of wireless sensor devices with vehicles and infrastructure. The ZigBee standard has evolved since its original release in 2004 and it is a low cost low power wireless networking standard for sensors and control device

Wireless communications:

Various forms of wireless communications technologies have been proposed for intelligent transportation systems. Short-range communications (less than 500 yards) can be accomplished using IEEE 802.11 protocols, specifically WAVE or the Dedicated Short Range Communications standard being promoted by the Intelligent Transportation Society of America and the United States Department of Transportation. Theoretically, the range of these protocols can be extended using Mobile ad-hoc networks or Mesh networking

Floating car data/floating cellular data:

Floating car data (FCD), also known as floating cellular data, is a method to determine the traffic speed on the road network. It is based on the collection of localization data, speed and direction of travel and time information from mobile phones in vehicles that are being driven. These data are the essential source for traffic information and for most intelligent transportation systems (ITS). This means that every vehicle with an active mobile phone acts as a sensor for the road network. Based on these data, traffic congestion can be identified, travel times can be calculated, and traffic reports can be rapidly generated. In contrast to traffic cameras, number plate recognition systems, and induction loops embedded in the roadway, no additional hardware on the road network is necessary.

Sensing technologies:

Technological advances in telecommunications and information technology coupled with state-of-the-art microchip, RFID, and inexpensive intelligent beacon sensing technologies have enhanced the technical capabilities that will facilitate motorist safety benefits for intelligent transportation systems globally. Sensing systems for ITS are vehicle and infrastructure based networked systems, e.g., Intelligent vehicle technologies. Infrastructure sensors are indestructible (such as in-road reflectors) devices that are installed or embedded on the road, or surrounding the road (buildings, posts, and signs for example) as required and may be manually disseminated during preventive road construction maintenance or by sensor injection machinery for rapid deployment of the embedded radio frequency powered (or RFID) in-ground road sensors.

Intelligent Transportation Systems:

As mentioned earlier, the technology oriented functional areas and the application oriented functional areas constitute the basic system components of the Advanced Transportation Network System. Thus, they make up the whole physical architecture, which account for how the system works.

Vehicle Information And Communication Systems (Vics)

Vehicle Information and Communication System is a digital data communication system, which promptly provides the latest necessary road traffic information to drivers via car navigation systems. Information is transmitted in the direction of traffic flow to the drivers to suit their needs, from beacons installed on the roadside via on-board car navigation equipment. There are over 2 million VICS units already in use. The benefit of this system is that, the road traffic conditions informed in advance makes a driver more relaxed and comfortable. It also gives alternative choice on routes to avoid traffic congestion. This ensures that VICS changes from a "Luxury" to a "Necessity" once people use it.

One of the areas having the greatest potential payoff for electronics in automobiles is in the relationship of the car and driver to the road. Seemingly, the key feature of automatic intelligent transportation net is precise and real-time interaction between vehicles and a net of ways. Improvements in traffic flow in congested areas might be possible if the driver has information concerning traffic problems on the road ahead. The two most popular means of communication between the vehicle and the driver are given below.

A Study of Bus Rapid Transit:

ITS technologies are being implemented more commonly in European, North American countries, and Australia than in developing countries. BRT systems in developing countries are still limited in ITS applications because of the capital and operating costs. ITS technologies mainly contribute to the image, safety, and operating speed but are not essential features for a successful BRT system. The BRT systems in Bogotá, Quito, Beijing, Mexico City, and all Brazilian systems are successful examples that have not implemented or have very limited ITS technologies. Transit Signal Priority (TSP), real time passenger information systems, and Automatic Fare Collection (AFC) are examples of typical ITS applications in BRT systems. Implementation of TSP has grown rapidly among the U.S. transit systems. Real time passenger information systems increase productivity of passengers while waiting for buses, avoid crowding at stations, and enhance the image of the shelters. Automatic Vehicle Location (AVL) systems help track the locations of vehicles, which can be used for real time fleet management and future planning purposes. The global positioning system based AVL system is perhaps the most popular among the available location technologies. One of the new ITS technologies for BRT are lane assist systems being implemented in the BRT systems in Orlando and Minneapolis. Lane assist permits BRT vehicles to operate at higher operating speeds with improved safety. Precision docking technology (implemented in Las Vegas, but more popular in European cities) helps reduce dwell time. Some features below applied in several BRT systems. i. Fare Collection Methods - Automatic fare collection (AFC), although originating in other transit systems, has become a regular feature of BRT systems worldwide. Advanced AFC with a common smart card allows integration of several modes in one single system, which offers customer convenience (GTZ 2006). In surveys carried out among transit users in Hong Kong, Taipei, New Delhi, London, Oslo, Copenhagen, Washington D.C., San Francisco, Chicago, Rome, Bangkok, Seoul, and Istanbul, smart cards were noted as being effective in promoting ridership, increasing customer satisfaction, improving boarding time, and increasing ease of access

Development Areas

Intelligent Transportation System (ITS) is a field of very rapid development in all the areas that it is concerned with. Hence, for simplicity the overall development of ITS can be grouped into the nine development areas of Intelligent Transportation Systems which include the following:

- Advances in navigation systems.
- Electronic toll collection systems.
- Assistance for safe driving.
- Optimization of traffic management.
- Support for public transport.
- Increasing efficiency in commercial vehicle operations.
- Support for pedestrians.
- Support for emergency vehicle operations.

Each of these development areas are discussed in detail below:

ISSUES AND CHALLENGES OF ITS IN INDIA

The rapidly advancing economy of India, in par with the rest of the world has resulted in aphenomenal increase in use of personal automobiles on Indian urban roads. The cumulativegrowth of the Passenger

Vehicles segment in India during April 2007 – March 2008 was 12.17percent. In 2007-08 alone, 9.6 million motorisedvehicles were sold in India. It is expectedthat India will surpass China as the fastest growing car market within the next few years.

Economy-induced automobile usage is complicated further by the constant influx of rural population into urban areas, thus making enormous demands on the transportation infrastructure in an overloaded region. In 2001, India had 35 cities with a population of more than one million people. The heterogeneity of economy and the physical limit on how much additional infrastructure a city can hold complicate transport management further.

Some of the main issues facing the deployment of ITS in developing countries like India, reported by a World Bank study are: an underdeveloped road network, severe budget restrictions, explosive urbanization and growth, lack of resources for maintenance and operation, less demand for automation, lack of interest among government decision makers, and lack of user awareness.

CONCLUSION

The focus for ITS in the future is clearly on deployment. Taking research and operational test results and putting them into routine practice is the emphasis in the ITS world today. How to best advance the deployment agenda is currently a matter of intense discussion in the ITS community. The best approach is for ITS to focus on regions as critical units of economic competition. Often, we speak of the "competitive region". First, the natural partnership between ITS and the nascent National Information Infrastructure (Nil), a communications network of unprecedented scale, scope and functionality, can provide substantial deployment benefits to both. Second, the strong trend toward freight and traveler intermodals provides a critical boost to ITS technologies. This is where ITS can help overcome intermodalism's weak point ~ the transfer process ~ through information and communication technology. Pulling these ideas together:

The strategic vision for ITS, then, is as the integrator of transportation, communications and intermodalism on a regional scale.

This is an ambitious vision and one that will require substantial leadership to achieve the technology deployment and the institutional change that will be needed to achieve such an outcome. ITS has had a dynamic but short history. Challenges have been overcome in these early years. Many remain for the fixture. When the Transportation Quarterly celebrates its 100th anniversary, I believe we will look back on this time as a seminal period in the history of transportation and one in which a truly intermodal transportation/information infrastructure was deployed, advanced by our ITS program.

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