INTELLIGENT TRANSPORT SYSTEMS THE FUTURE TRANSPORT SOLUTION FOR JAKARTA

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Abstract: Intelligent Transport System (ITS) for developing countries such as Indonesia is not a technological handicap, the technologies already exist. To implement ITS in Indonesia the Government should decide the system used and it should highly supported by politicians. The technology should consider the rapid development of the system and is should be compatible with the existing equipment. From experience in some developed countries, ITS shows a good economical and financial viability. To implement ITS in Indonesia could start from the existing Area Traffic Control System (ATCS), and plan for extension of the system.
The Proposed Jakarta extension ATCS Project could further improved in a more advanced system by utilization of private sector involvement on information system to influence users mobility behavior and better time management by individual traffic management and on line travelers information for public transport users.

1. INTRODUCTION

Within Jakarta the capital of Indonesia which cover an area of 661 square kilometers there were over 9 million inhabitants in 1995, over 2 million registered motorized vehicles in 1993 (of which 48 percent were motorcycles), and 5.7 thousand kilometers of road of all classes. During the last 10 years, urban populations increased steadily at an average rate of 2.7 % per annum, while motorized vehicles increased at 8 % per year and roadway network increased at only 4 % per year. Transport facility development could not keep up with in crease in traffic demand, furthermore conventional bus system as a representative mode of public transportation provides a low level of service. If the service level is not improved, an increase in the utilization of private cars and motorcycles cannot be avoided as income levels rise. On the other hand traffic management still have not yet been sufficiently developed. The result of this are transport inefficiency and daily congestion's on the city streets leading to excessive delays and hence huge losses in travel time and vehicle operating cost. Average speeds of under 10 km/h are common place, journey to work can frequently take three hours.

To cope with the Jakarta's Traffic Problem, measures such as ITS is one important step of solutions for the future, where transmission of information is the key to reduce physical transport demand and to improve the quality of movement along the road network if traveling is required.

2. WHY INTELLIGENT TRANSPORT SYSTEM

Many people are saying that Intelligent Transport System as one of traffic management tools is something of the future and can only be implemented in developed countries. This statement is not always true because developing countries can always jump to this new technology. It is true that ITS is a sophisticated technology, but with the experience in communications. Indonesia for example is one of the first countries in the world that uses satellite technology for communications, it was already in use since the 70's which uses sophisticated technology, so the use of ITS technology is not an impossible thing to do.

With this new technology, the transport system can be manage in a much efficient way, and eventually reduce environmental impact and improve safety. It is said to be efficient because:

- the traffic can be manage to run at a reasonable speed by informing the road users about the traffic conditions and give them suggestions of the routes they could take to get to their destination;
- reduce potential traffic accidents as the effect of good traffic management
- to improve public transport services by controlling their locations and manage the headway and inform the passengers about the arrival time of the coming bus

All these will give benefit of the transport system users. The system can be incorporated with road pricing, so economically speaking for metropolitan and large cities it could be financially and economically feasible and could be work out together the private sector.

3. HOW TO GET THERE

Jakarta already have an Area Traffic Control (ATC) System running since year 1990, and also has implemented in Surabaya and it will be followed by the city Bandung. Having an ATC is a very good start for implementing the early stage of the Intelligent Transport System which later on could be expanded to a more sophisticated system. Figure 1, 2 and 3 shows the techniques used to improve the existing Intelligent Transport System.

The first step toward ITS is the simple Area Traffic Control System which simply optimize signal timing in the area based on information received from traffic detectors, CCTV or observation from the traffic police. These system was for the first time introduced in Jakarta in the 70's and expand and renewed in early 90's. And it's being plan to extend the system to the whole city with a more advanced system which would be responsive to the traffic flow.

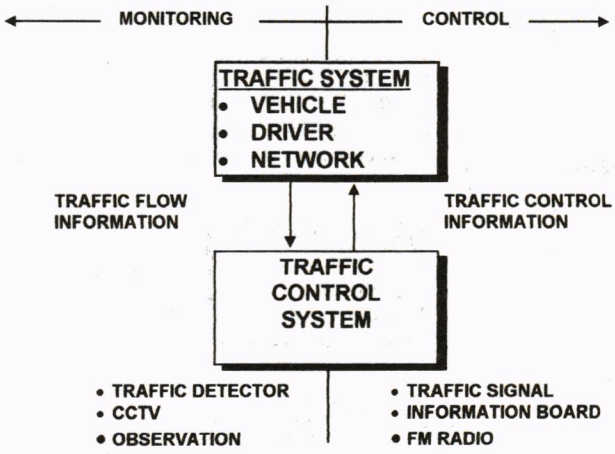

Figure 1. Collective control

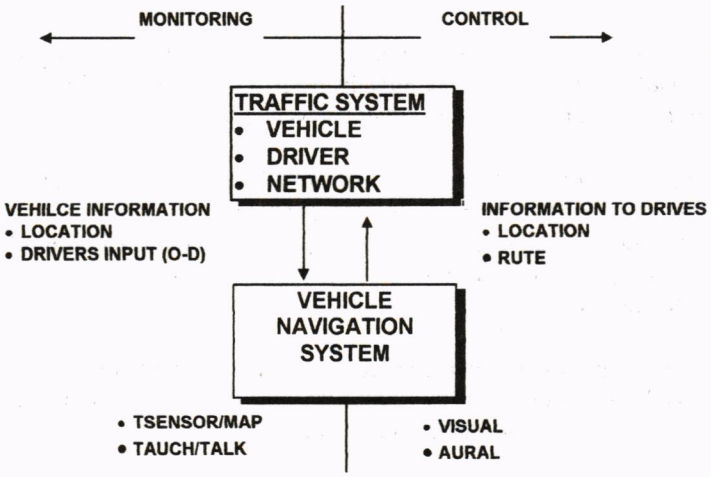

Figure 2. Vehicle navigation

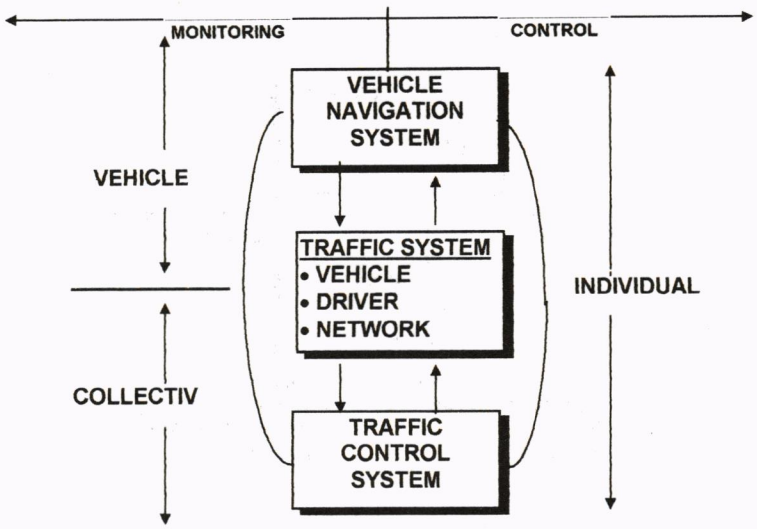

Figure 3. Integrated systems

The Proposed Jakarta ATCS Project is shown in figure 4, which could further improved in a more advanced system by utilization of private sector involvement on information system to influence users mobility behavior and better time management by individual traffic management.

Expanding a system that is already running is much easier than starting something from scratch. The early stage of ITS has already been used in several cities in the form of collective traffic control. This system could be expanded by :

- introducing information to the transport users with the help of FM radio,
- introducing variable sign to inform or instruct drivers,
- the introduction of public transport priorities at intersections controlled by traffic signals by using transponders for the busses and bus detectors for the purpose of a better public transport service.

Further improvement such as vehicle navigation and automated vehicle location detection to improve public transport services should be considered as an important step to cope with the future fleet and traffic management problems.

Toll roads could also be improved with automated transaction by using debit smart cards to reduce delays that occurred during transactions either at the entry ramps or at exit ramps, if toll fee is collected based on distance. This system could reduce delay, accidents and less pollution due to stop and go actions at the toll gate.

Another advantage of ITS is the ability to automatically detect overloaded freight trucks. Using high speed vehicle axle load detectors incorporated with video camera could detect the vehicle number and special lanes for the enforcement of violators. This would be an effective way to reduce the personal judgment on overloading and let the technology do the enforcement.

4. IS IT A TECHNOLOGY CONSTRAINT?

The answers is no, because it is a matter of detection of traffic and transport performance, transmission of the information, processing the information and send the result to transport system users.

5. STEPS TO THE FUTURE TRANSPORT SOLUTION

The first step is how to get the information of transport performance at the right time by using vehicle detectors or video cameras to detect the flow and speed of the traffic or to locate public transport vehicles.

The second step is to process all the information and look for the best solution and send the solution to the transport system users. The communication is then send by using variables sign, FM radio or through navigation by Global System Mobile (GSM) which is already in use in several cities in Indonesia and Vehicle Position Tracking by using GPS to give the driver on line traffic information, routing and guidance system.

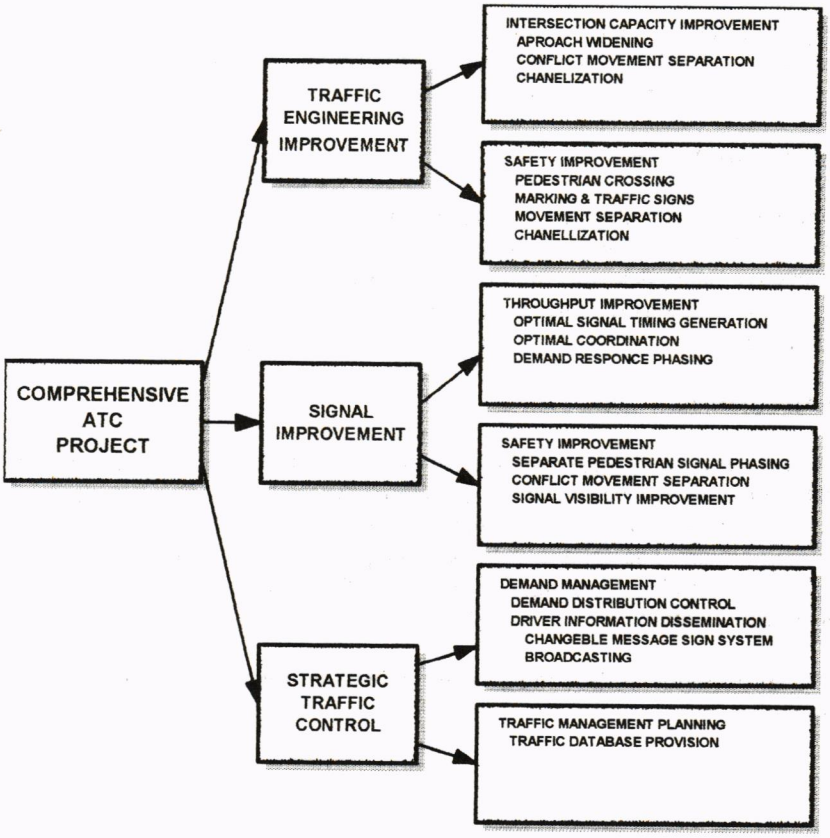

Figure 4. Comprehensive Jakarta's ATC Project

6. WHERE TO START

Since Jakarta is preparing for a Mass Rapid Transit for the Blok M - Kota corridor and Light Rail Transit from Bintaro to Kota, advanced fleet and traffic management is needed to attract passengers to use public transport. The first step to be taken is to improve public transport services and then restrict private vehicle users from entering the CBD either by physical measures or by pricing policy.

Public transport could be improved by several measures such as pre trip information planning, multimodal trip reservation, integrated fare media, in terminal/vehicle information system, road usage priority, etc.

Pricing policy scheme could be done with a more advanced technology by using electronic road pricing such as the one under construction and testing in Singapore.

7. THE JAKARTA'S CASE

The proposed Jakarta ATC system consists of several sub-systems including: traffic surveillance, signal control, database management, closed circuit television, driver information system, man-machine interface and communication network. Figure 5 display these sub-systems and the interrelation among them.

7.1. Traffic Surveillance System.

It consists of detectors and data processors. Detector data is send to the central equipment via the communication network. There are a variety of vehicle detectors in actual use. For this Project, inductive loop detectors are recommended. But other types would be considered for special locations. Pedestrian push buttons are also detectors that can be actuated by pedestrians.

7.2. Signal Control System.

It consists of signal heads and local controllers, local master controllers, and central controllers establishing a three-level hierarchy. Local masters shall be placed between the central and local controller. The communication network connects these devices and performs data transmission. The Jakarta ATC system planed to be equipped with the following signal control modes: Flashing, time-of-day (TOD), traffic responsive, traffic adaptive and offset coordination.

Monitoring of signal operation at the control center is required for malfunction detection and performance evaluation.

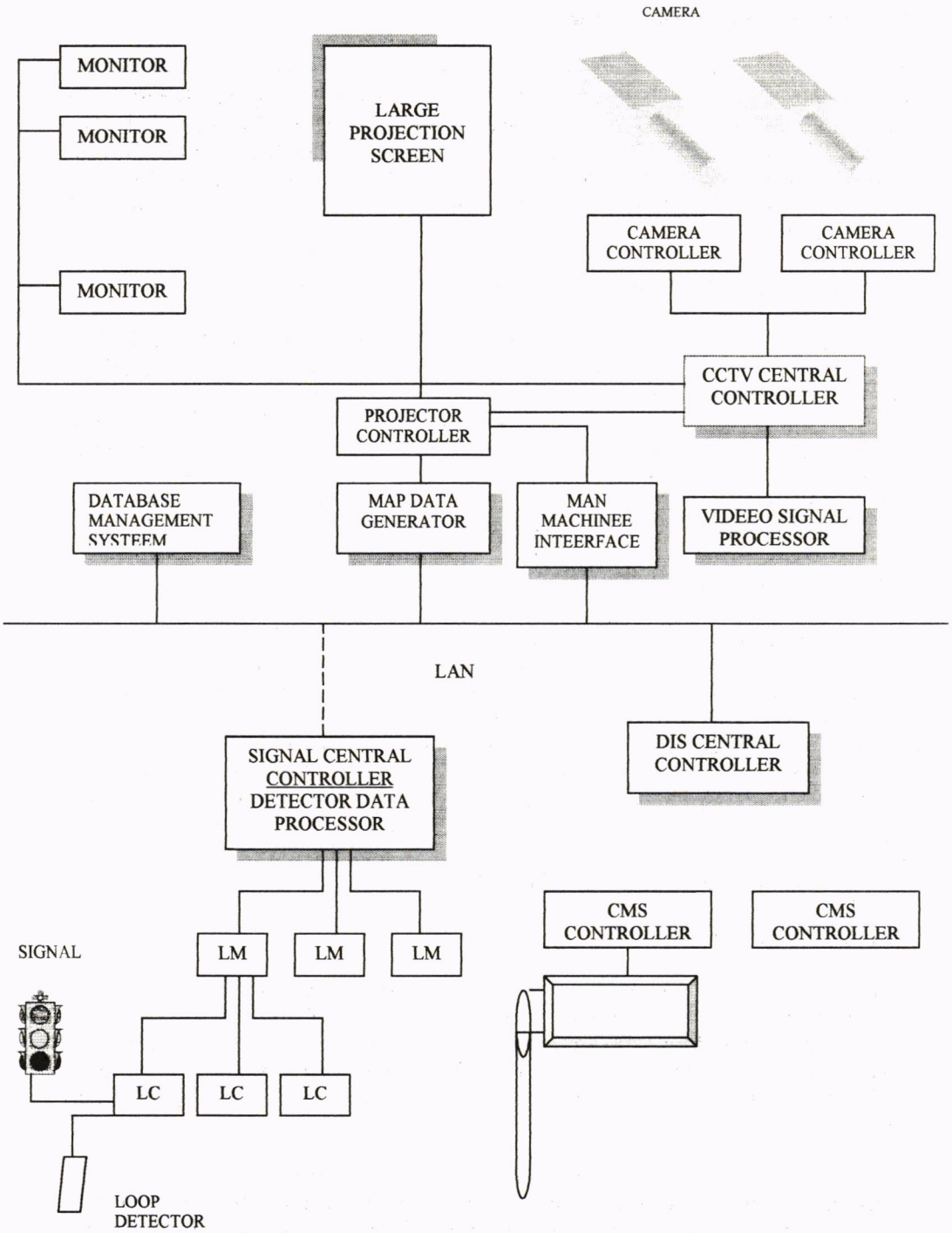

Figure 5. Proposed Jakarta's system configuration

7.3. Database Management System.

An ATC system is in essence a computer network where software and database are two major components. Software that is capable of processing and storing data is part of the database management system. Access to database must be controlled for data security. The database management system shall be equipped with processing functions for statistical data, query and reporting. The ATC system should permit uploading of data to the center and downloading data to the local controller. Database should be network based capable of handling multi-users.

7.4. Closed Circuit Television (CCTV) System.

This is an effective tool for traffic surveillance since data are presented visually. The proposed system consists of cameras, camera controllers, audio amplifiers and speakers, and transmission and central equipment. Color CCD cameras are recommended. A total of 16 camera locations are planned. 16 TV monitors, signal switcher, display controller and camera controller would be required at the center. Video signal requires wide band transmission. A base band transmission over optical fiber cable is recommended for Jakarta ATC system. A set of computers with traffic counting software connected to the CCTV system is recommended for video signal processing.

7.5. Driver Information System (DIS).

Some information on traffic conditions should be conveyed to drivers. Two types of media are considered for this purpose: changeable message sign system and broadcasting. Changeable message sign system conveys traffic information to driver through character of graphic display on a signboard. A veriety of changeable message signs using different techniques is available. Among those, the dot matrix pattern type has become predominant for its flexibility and capability of displaying graphic patterns. Under this category, there are three display types: incandescent lamp, LED and magnet disk. The LED type that uses light emitting diodes in place of lamp is recommended for this Project. A total of 16 changeable message signs and locations are suggested. Traffic information broadcasting is another way to convey traffic information to the road users.

7.6. Communications Network.

Various kinds of data are exchanged between the control center and terminal devices. Except for the video signal sent from the camera, ordinary telephone lines with bandwidth 300 to 3400 Hz are adequate for these devices. Wide bandwidth of 6 MHZ is required for video signal. Three different medias for data and image transmission are widely used for traffic signal and networked systems: these are, twisted pair cable, fiber optical cable radio.

Twisted pair cable has been used for many years and is a matured and proven technology. Fiber optical cable is now widely used for video signal transmission because of its wide bandwidth immunity against electromagnetic noise, lightweight, and small attenuation per distance compared with copper cable.

The Radio communication systems are wireless, which is an advantage for the communication link. However, the locations must consider future high rise buildings or

obstructions and also the availability of frequencies. The cost of transmission equipment at the broadcasting station is generally higher than a wired system.

All local terminals should be connected to the control center through the transmission channel. All data communications are made between the center and the terminal. For Jakarta ATC system, a self-owned cable system is recommended due to quality of service and availability of lines.

7.7. Control Center.

The traffic control center is the nucleus of an ATC system. At the center, data are collected and processed automatically or upon request. Computers at the control center shall have a distributed network configuration in which each computer is assigned a specific task thus more flexibility in system configuration and future expansion, reduction in cost due to the use of common products and fault tolerance. In the network, each computer has a specific function: traffic surveillance and signal control, database management system, man-machine interface, driver information system, and remote terminal. The software and data requirement for each computer must be so designed that short period interruption of the network does not affect the operation of each system. Processing of detector data, monitoring and control of signal are carried out by one computer. Database management system manages the data used in the ATC system and has the following function: file server, answering to query, statistical, display and report data processing. Man-machine interface computer is a tool for the system operation operator to communicate with the computer network.

Video projection system receives the queue information from the traffic surveillance system for automatic queue data display on the wall map. The driver information system has a dedicated computer which functions as changeable message sign monitor and dot pattern editor. CCTV video processors are connected with CCTV system and convert the video signal from CCTV system to the digital signal suitable for transmission over the network. Remote terminal is a variation of man-machine computer intended to provide the user outside the control room with the system status and traffic condition information.

8. THE MAIN INTELEGENT TRANSPORT SYSTEM USERS

The main user needs that could be fulfilled by Intelligent Transport System are various categories of users, such as:

Individual Traveler's (by car or public transport) :
- Existing multi modal transport alternatives;
- Information about fares and tariffs;
- Booking and payment services;
- Current traffic situation and forecasts;
- Hazards, disturbances and emergencies;
- Guidance including information about traffic modes, timetables and interchanges.

Fleet drivers:
- On board Intelligent Transport System;
- Traffic information;

- Predictions related to the route they have to drive;
- Better pre-booking of ferry connections and facilities.

The next figure shows the expansion of the ATC System toward intelligent transport system in the future.

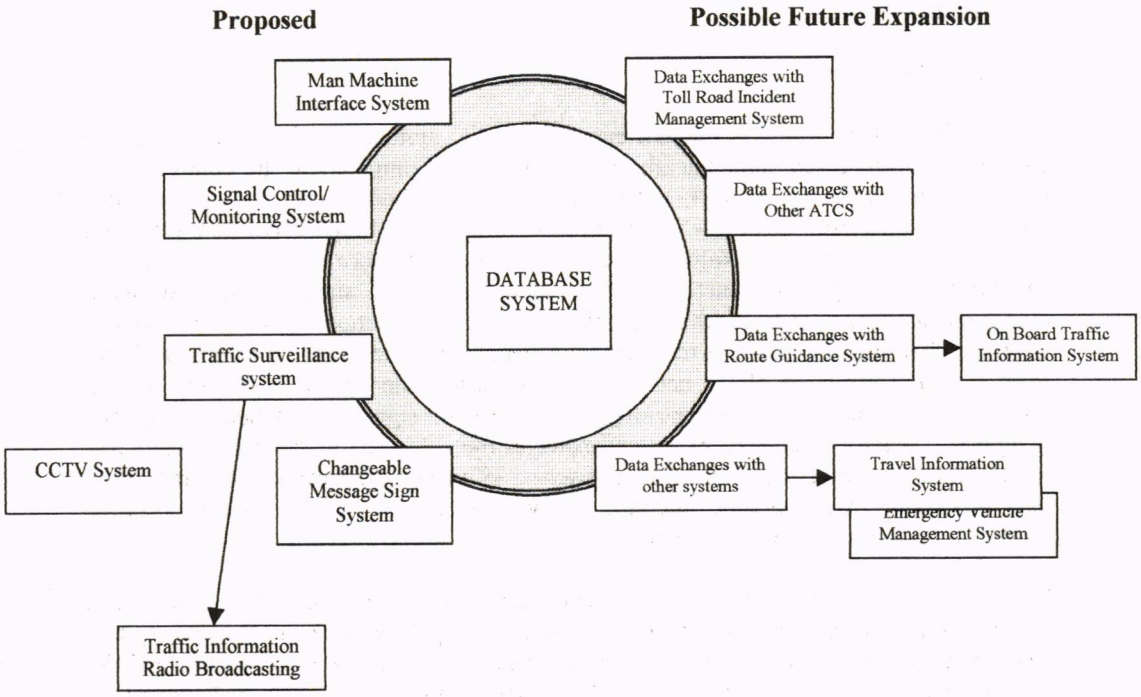

Figure 6. Comprehensive ATC System Configuration

9. PUBLIC PRIVATE PARTNERSHIP

To accelerate the development of individual vehicle routing and guidance system and on line traveler's information for public transport users could be privatized, as already being proposed by private sector for Jakarta. The private sector will work together with the ATCS to get the traffic information, and this information will then be on line distributed to individual vehicle or buses and bus stops. Users of these system has then to buy LCD display, in vehicle interface, in car GPS device, digital road map and has to pay yearly users charges.

10. CONCLUSIONS

Traffic management has significant potential to be implemented in metropolitan and large cities in Indonesia for helping private and public transport vehicles and public transport users.

The various technologies required for future vehicle navigation, fleet management and route guidance system will relieve drivers from tedium of planning routes and finding the ways over them have already been developed, or are within reach. To accelerate the implementation of ITS is by inviting private sector to participate in financing the system.

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