Innovative Transportation Technique: A Need for Urban Traffic Control, Regulation and Management

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***Abstract*—Existing road infrastructures are becoming incapable of handling the rapid traffic growth in metro cities. Further expansion of infrastructure in these cities is having limitation of land availability. Keeping in view these, it has become imperative to increase the efficiency of these road infrastructures by making them and vehicle moving over them as intelligent. The innovative transportation technique can reduce the delay at the traffic intersection and hence idling time. This results in; apart from travelers' time saving, vehicular emission reduction. The road traffic capacity can be increased many folds and travelers can be guided appropriately to reach their destinations. In the present study, the benefits of Innovative Transportation Technique in tackling the urban traffic have been summarized. Also, the frame work to employ this emerging technology on urban roads in India is described in brief.**

***Index Terms*—APTS, ATMS, ATIS, AVCS, CVO, ITS Technologies, area traffic control.**

I. Introduction

Transportation is a driving force behind development and the well being of all people around the world. Modern life demands growing mobility. Frequently it is secured through ever-increasing use of private cars. The resulting burdens on the transport infrastructure, that is already heavily stretched, are multiplying. Despite major expenditures on new road infrastructures, traffic congestion continues to rise. Past gains in road safety and environmental improvements are decreasing. These problems can be solved simply by building more roads or by relying on past approaches. Innovative efforts are clearly needed on a broad front. Innovative Transportation Technique is transport systems that apply information, communications, and the control technologies to improve the operation of transport networks. Innovative Transportation Technique tools are based on three core features-information, communications and integration-that help operators and travelers make better and coordinated decisions. The aim of this paper is to make aware the people regarding concepts of Innovative Transportation Techniques.

II. Components and Applications

Broadly, the Innovative Transportation Techniques can be classified into following categories,

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1) Sensing and Surveillance Technologies
2) Information Technologies
3) Communication Technologies
4) Traffic Control Technologies

This processed information could be useful in handling the problems related to the following functional groups:

A. Advanced Public Transportation Systems (APTS)

Advanced Public Transportation Systems build upon the technologies to enhance all types of public transportation. The increased level of services made possible by these systems results in a more attractive transportation option for the public, thereby increasing ridership, and reducing the burden on the congested highway system. APTS include Automatic Vehicle Location (AVL) and communications systems to enhance fleet management operations, electronic fare media, and new techniques to more effectively use and monitor Heavily Operated Vehicle lanes.

B. Advanced Traffic Management Systems (ATMS)

Advanced Traffic Management Systems use advanced technology to monitor traffic conditions and provide real-time adjustments to traffic control systems so as to ensure optimum traffic flow rates and respond to incidents sooner and more effectively. Some examples of ATMS are coordinated signal systems, electronic toll and traffic management systems, and traffic surveillance systems based on image processing and radar. ATMS applications in selected corridors have significantly reduced delay, travel time, and accidents.

C. Advanced Traveler Information Systems (ATIS)

Advanced Traveler Information Systems provide to travelers Advance Traffic Management System data on current traffic and road conditions, vehicle location and navigation information, and safety warning messages, and also allow travelers to signal for help when needed, via mobile communications systems. ATIS offers significant potential benefits in reductions in travel times and associated benefits by enabling travelers to more efficiently use the transportation network based on real-time status information.

D. Advanced Vehicle Control Systems (AVCS)

Advanced Vehicle Control Systems employ advanced sensor and control technologies to assist the driver in responding to the immediate environment on the roadway. AVCS will develop in an evolutionary manner, seeking first to enhance the driver's perceptions of his or her immediate environment. Products will include sensors which detect obstacles in vehicle blind spots, collision warning systems, and infrared vision enhancement systems.

A further evolution of AVCS will be collision avoidance systems which take temporary control of vehicle operation. Full scale deployment of AVCS systems offer dramatic benefits, such as vastly increased highway capacity through the use of tightly packed automated vehicles traveling at freeway speeds, and increased safety by reducing the potential for driver error.

E. Commercial Vehicle Operations (CVO)

The Commercial Vehicle Operations component is aimed at improving the safety and operational efficiency of commercial vehicles by applying advanced technology to the unique needs of commercial users. For instance, weigh-in-motion (WIM) and Automatic Vehicle Classification (AVC) systems are currently used by States for weight enforcement. Automatic Vehicle Identification (AVI) systems are used by motor carriers for electronic toll collection and other applications requiring the interchange of data with the roadside, to reduce the number of required stops enroute. Automatic Vehicle Location (AVL) systems, which enable individual vehicles to be tracked, combined with messaging systems, are revolutionizing fleet management techniques.

III. Challenges Ahead and Its Technologies

The prosperity of our country mainly depends on productivity of our industries and maintenance of our environment. Transport has an important role in facilitating increased efficiency that can enhance our prosperity. The challenges ahead to be met in the present century includes

1) Growth in travel with population and industry growth.
2) Need for more secure transport.
3) Increased freight transport.
4) Impact of traffic incidents.
5) Constraints on building new roads.
6) Degrading environment.

Good outcomes Innovative Transportation Technique for society in the following areas:

1) Safety and Security.
2) Efficiency and Productivity.
3) Mobility and access.
4) Transport pricing
5) Environment.

A. Safety and Security

Innovative Transportation Technique improves safety and security by providing transport managers with real time information on the location of vehicle, better surveillance of transport stations and stops and better management of road system and performance. The road side safety includes variable speed limit signs, speed enforcement cameras and variable message signs for road safety messages.

B. Efficiency and Productivity

By improving transport system efficiency and productivity Innovative Transportation Technique benefits individual and society as a whole. The efficiency of transport systems can be enhanced by ITS as advanced traffic control system to ensure faster travel times for public transport and cars. Better productivity is also afforded to commercial fleets to reduced business costs. Electronic commerce in the freight transport sector is a vital part of managing the paperless flow of information necessary for procuring, shipping, loading, transferring, receiving, payment and meeting any associated commercial and legislative requirements efficiently.

C. Mobility and Access

Society wants fair access to community services and adequate mobility by all modes. The Innovative Transportation Technique has a vital role in provisioning of information on scheduled and actual transportation services by all modes. This information enables better planning of trips for traveler of all ages with or without disabilities. Innovative Transportation Technique enables real time information to be provided on bus, tram and train arrivals that benefits travelers prior and during their journeys. New electronic ticketing technologies provide automated payments and convenience to consumers.

D. Transport Pricing

Electronic toll collection (ETC), allows toll roads to operate a free flowing highway speeds, which avoids delay and reduces congestion and emission due to stopping at toll booths and reduces time for toll at plaza.

E. Environment: Innovative

Transportation Technique can benefit the environment too by providing automated systems for fleet managers to ensure their vehicles take the most efficient route, thus saving fuel and green house gas emissions. Improved fuel economy also reduces other emissions such as particulates, carbon monoxides and hydrocarbons which affect human health, cause smog and damage to the environment. Technologies reduces the traffic congestions, travel time and fuel consumptions. Thus the induction of ITS technology would be boon in restoration of environmental degradation in coming years.

IV. Benefits of Innovative Transportation Technique

A. Road Crashes

Reduction in road crashes due to the introduction of Innovative Transportation Technique is a significant benefit due to the reduction in primary crashes, better road management (driver information, enforcement etc.) and reduction in secondary crashes as incidents are better managed and resolved.

B. Pollution/ Energy

Studies have shown that Innovative Transportation Technique has positive impact on environment. The results include reduced congestion, improved traffic flow and increases in Innovative Transportation Techniques speeds. It is worth noting that all these factors decreases total vehicle emissions. Improvements in traffic flow, congestion and delay times, as a result of ITS, will also have a positive environmental effect by reducing the fuel consumption.

C. Quality of Travel

Innovative Transportation Technique can improve quality of travels to customer satisfaction by making trips more enjoyable for motorists, particularly through improved driver information.

D. Effective Capacity

Innovative Transportation Technique increases the effective capacity of road network by using variable speed limit systems as the variable speed varies depending upon the traffic density. The results have also indicated an increase in effective capacity during peak hour.

V. Area Traffic Control (ATC)

An Area Traffic Control System is basically a collection of electronic circuits, computers and software, microprocessors, which skillfully put together and form a sophisticated tool for the traffic engineer to use and help to solve traffic problems in the city. It involves the extension of the principle of coordination to include signals in a substantial area.

Area Traffic Control involves coordination of traffic signals over a complete network of signals covering an area that may be considered homogeneous from the point of view of traffic operation. Such a system has to be computer aided as the problem is extremely complex because of crossing of several route at the common intersections.

The objective of area traffic control system includes:

1) Effective and comprehensive traffic control.
2) Control and coordination of traffic signals on a wide basis to ensure traffic movements in platoons in safe and smooth manner.
3) Reduction in journey times and vehicle stops to attain minimum delay.
4) Continuous monitoring of traffic signal equipments of the system to ensure speedy rectification.
5) Reduction in traffic congestion caused by road works and accidents.
6) Reduction in journey time for emergency vehicles by providing priority facility.
7) Maximum utilization of road space.
8) Reduction in fuel consumption and consequently vehicle operation cost. (VOC)
9) Reduction in air pollution from vehicle exhaust fumes.

VI. Case Study

A. Case Study of Ahmadabad City

Ahmadabad is an ancient trading city which has transformed into a major manufacturing centre in the 20th century. The consistent level of economic opportunity available in Ahmadabad has attracted migrants from all over the country. As per Census of 2001, the city was spread over 212 sqkm with a population of 34 lakh. With the population reaching a density of 217 persons per hectare, the limits of the city were increased to 324 sqkm in 2006.For the purpose of urban planning; the city is placed within the Ahmedabad Urban Development Authority (AUDA) area of 772sqkm which is governed by the development Plan notified in 2004.

The economic growth of Ahmedabad attracts many people to seek job opportunities from neighboring areas. Due to the rise in people commuting within Ahmedabad, the government has taken steps to broaden existing roads and construct flyovers to combat this rise. The answer solely doesn't lie in construction of infrastructure but the use of increase in public transportation. The construction of the BRTS is a marvel in its own feat. The existing policy of continuously adding infrastructure (buses, bus shelters etc.) in the public transportation is not a sole answer. This results in the various problems like congestion of the roads, rise in the pollution levels, road accidents and increase in the fuel consumption. The need of the hour is to establish a system which would efficiently utilize the existing infrastructure. Information Technology coupled with the existing public transportation would effectively solve these problems. Innovative Transportation Techniques application may play a major role to overcome these problems.

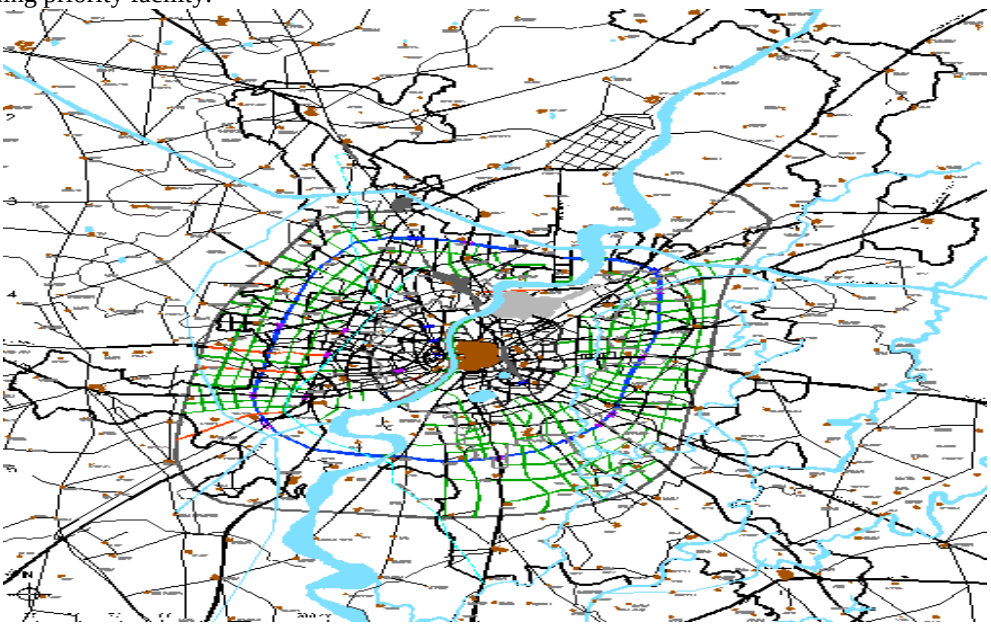

Fig. 1. Road network of Ahmedabad city.

1) Goals of BRTS Ahmedabad

- To Cut the number of fatal traffic accidents
- To improve the flow of traffic during peak and off-peak hours.
- To Eliminate traffic congestion and reduce delay times
- To Reduce vehicle fuel consumption
- To Reduce CO_2 and NO_x in urban areas for a healthier environment.

2) Data Recorded on Project Area

The study carried out in Ahmedabad and various data are to be collected.

- Traffic data, Speed data, Income data, Accident data, Trip data.

3) Ahmedabad City Growth:

Vehicular Growth in Ahmedabad

- 14 Vehicles / 10 families
- highest per capita vehicles in India
- Traffic management inadequate
- Average speed : less than 20km/hr

Road Length

- Study area – 3478 Km
- AMC – 1278 Km
- AUDA – 340 Km

Spatial Unit	Population		Growth Rate
	2001	2011	2001
1. Ahmedabad Municipal Corporation (AMC)	**3520085**	**3680016**	(2.0)
1.a Walled City	372633	318532	-0.7
1.b. East AMC	2521013	2496108	2.9
1.c West AMC	675362	865376	1.6
2. A.U.D.A. (Including AMC)	**4709180**	**5406798**	2.3
2.a East AUDA	202494	10454	4.6
2.b West AUDA	701424	1416395	4.4
2.c AUDA (Rural)	274391	299933	1.1
3. Kalol	112013	124652	1.9
4. Mehemdabad	30768	41639	1.7
5. Dehgam	38082	48086	2.0
6. Sanand	32417	36017	2.4
7. Other areas outside AUDA	**334531**	**412977**	0.8
8. Gandhinagar	**373663**	**490506**	2.9
8.a. Gandhinagar (GNA)	195926	267238	4.7
8.b. Rest of Gandhinagar	177737	223268	1.3
GREATER AHMEDABAD	**5417374**	**6560675**	2.2

B. Guiding Principles

Select those corridors which

1) can accommodate BRTS treatments,
2) could be Implemented quickly and inexpensively,
3) could contribute to ease the problems of transport in a significant way,
4) could improve mobility options of large segment of people, mainly the poor
5) provide opportunities for improvements in land use structure/ more compact urban structure,
6) Provide potentials for cost-recovery, and
7) Integrates well within the overall network including other mass transit modes i.e not compete with other public transit modes.

C. Technical Feasibility

1) Reduction in turn-around time leading to increased vehicle utilization
2) Size of operations increase
3) Large size operations mean mobility improvement to many
4) Extensions to the network possible
5) Flexible Operations
6) Possible to operate BRTS as independent operation
7) Closed System Operations become viable
8) Private participation

Monitoring and regulating of services become less complex

D. Result

1) System Wide Impacts

- Relieve congestion
- Improve safety
- Maximize the Ridership; present and the potential
- Have citywide impacts
- Serve the needs of the poor
- Provide opportunities for Transit-Oriented Development/ Promote Compact City
- Integrate with other modes and thus provide greater accessibility to amenities and opportunities for h. mobility
- Of course bus by nature, with use of CNG would ameliorate negative environmental impacts.

2) Land Development Option and Assumptions

- Total area likely to develop: 21 Sq. Km
- 50% of Residential /commercial and vacant land will available for development.
- The development will be staggered beyond 20 year time period and by 20th year 50% plot owners will use additional FSI

- F.S.I to be provided: 3.5 on either side of the road for 250 meters and 500 meters along intersecting road
- For the rate chargeable for additional F.S.I three scenarios have been developed
- a) Rs. 500 b) Rs. 750 c) Rs. 1000.

VII. Conclusions

The concept and the need of Innovative Transportation Techniques have been reported. The application areas of Innovative Transportation Techniques have also been described. The case studies of Ahmedabad city where the Innovative Transportation Techniques system are being implemented have been reported. In all the cases the significant benefits to the road users in terms of time saving, reduction in fuel consumption and improvement in air quality have been reported.

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