Feasibility Study of An Intelligent Transportation System

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Abstract- *The Intelligent Transportation System is one of the burgeoning inventions that uses new technology to solve a variety of issues. Its compatibility with real-world issues in developing nations like India, such as traffic congestion, infrastructure demand, high traffic loads, and non-lane traffic systems. It is critical to assess a technology's potential in order to determine its viability. The goal of this article is to determine the utility cost ratio of implementation so that it may be evaluated without changing the existing infrastructure design. The end result is a utility cost analysis approach that takes social, economic, and environmental issues into account. As a result, the analysis is quickly examined so that the technology may be applied according to its appropriateness.*

Keywords- Investments, Congestion, Intelligent Transportation System (ITS), Benefits.

I. INTRODUCTION

1.1 GENERAL

The Intelligent Transportation System (ITS) is a concept for reducing or at least limiting traffic congestion that is still evolving. Population growth and quick development have resulted in an increase in the number of cars on the road. And, in many locations, the growing number of cars began to outnumber the road's capacity. Congestion happens in some areas when the demand limit is surpassed. Several studies on traffic have been released.

To address the primary issue of traffic congestion and a reduction in the quality of service provided by roads, government authorities spend a significant amount of money on improvements such as road expansion, over or under bridge construction, and so on. However, owing to a lack of room and other constraints, it was unable to attain full advantages. Then, as a result of the emission of hazardous gases such as CO and NOx, the congestion issue has an impact on human health, since air quality is reduced as a result of the increased vehicle population.

1.2 Criteria of Smart Cities

Various research on the assessment and monitoring of smart city development have been performed. The European Union (EU) Urban Audit Dataset was used by Caragliu, Del Bo, and Nijkamp (2011) to examine variables that influence the performance of smart cities. The EU Urban Audit provides data on over 250 variables in the areas of population, social factors, economic factors, citizen engagement, training and education, environment, travel and transportation, information society, culture and entertainment for European cities. The dataset, however, does not include an index for measuring intelligence in cities. Focusing on the urban environment, Karags et al. (2011) found that education, accessibility, and the use of ICTs in public administration are all significantly linked to urban intelligence.

i. Smart environment

The attractiveness of natural conditions, pollution reduction, and resource management sustainability are all characteristics of a smart environment (Monfarazade & Berardi, 2015). The attractiveness of natural circumstances, pollution levels, environmental protection, and sustainable resource management are all factors that influence the smart environment (Gifinger et al., 2013). Important elements of sustainability, such as responsible resource management and energy efficiency, are often highlighted in smart city definitions.

ii. Smart people

The characteristics that define the kinds of people required in a smart city include human and social capital, resilience, inventiveness, tolerance, cosmopolitanism, and engagement in public life (Monfarazade & Berardi, 2015). Levels of efficiency, commitment to lifelong learning, social and racial diversity, resilience, inventiveness, cosmopolitanism, open mind, and engagement in public life are all academic criteria (Gifinger et al., 2013). To be really clever and creative, even smart cities need "smart people."

Fig 1: Homogeneous Traffic

Fig 2: Heterogeneous Traffic

1.3 SCENARIO IN INDIA

Study of implementation of ITS in India:-

As previously said, owing to the peculiarity of the country's natural environment and climate, ITS in India need a comprehensive and flexible approach. Sensors, frameworks, and software must be adapted to the environment in order to establish ITS. Modifications have been made to modules and other components to suit current local requirements. A traveler is someone who travels. As a result, cautious action is critical in the development of ITS in India. There is a need for customers from the Indian viewpoint. Chinta Sudhakar Rao, M. Parida, and S.S. Jain examined the consequences of global warming in their article. The function of ITS devices in data transmission to drivers and drivers' responses to ITS devices in traffic flow management. Using ITS modules such as APMS, VMS, and ATIS, research was conducted to better comprehend the facts, with a focus on the city of Delhi. Prof. UJ Phatak, Mr. Lintu Abraham, Miss Reported Kaushik, Mr. SudeepMitra, Mr. SudeepMitra, Mr. SudeepMitra, With the assistance of the contextual analysis technique, SagarDalal tried to study traffic congestion in India. The focus region of the SH60 reaches Pune through the Kharadi Bypass as a consequence of the Chayano Bacorifata. One of the reasons leading to traffic congestion is poor infrastructure. In the future, planning may become a major problem. The municipal planning department should give upgraded roadways more priority, according to this paper. It is possible to identify and solve infrastructure issues in the form of roadways in the urban suburbs.

- Root guiding systems, which are commercially available and extensively utilized, are examples of successful ITS installations.
- On highways, toll collecting and passenger information systems are used.
- In cities, there is a road pricing system and an electronic vehicle monitoring system.

With a passenger information system, you can monitor your vehicle and manage your transportation. In this article, several ITS installations in India are discussed

1.4 BASIC OBJECTIVE OF RESEARCH WORK

1. To investigate the benefit-to-cost ratio of ITS characteristics in the Indian context and effect of intelligent transportation systems (ITS) on fuel use.(Added in Methodology)
2. To investigate the effect of IT'S on the social, economic, and environmental advantages that it provides.
3. To conduct a comparative examination of ITS deployment on roads with other modes of transportation.
4. To estimate the cost of infrastructure as well as public opinion on the suggested Intelligent Transportation System.

1.5 SCOPE OF PROJECT IN BROAD SENSE

Traffic is made up of a variety of various kinds of vehicles, including automobiles, buses, lorries, two-wheelers, three-wheelers, and other similar vehicles. These two- and three-wheelers are of tiny stature; as a result of their existence, lane discipline is compromised. The flow of traffic has been disrupted. Induction loops may not be helpful for data collection in certain situations. conditions. Currently, researchers are using either manual data collecting approaches or video filming-based technologies to acquire information. We personally gathered vehicle traffic count (PCU) data from a variety of sources. Amravati is a city in India. These techniques are helpful in gathering certain macro-scale information, such as categorized traffic statistics, for analysisflow and is not helpful in gathering microscopic data, therefore we need to do further research. Deployment of ITS and recommendations for implementing so that we may solve these difficulties More advantages should be considered.

II. LITERATURE REVIEW

2.1 Road Accident Prediction Based on Traffic Parameters

Aside from the car and driver, factors like traffic flow or rate, traffic crash or jam, and traffic intensity all play a role in predicting road accidents. The probability of predicting a road crash will easily be tested using these criteria**.**

CiroCaliendo et al. (2007) presented a model for the prediction of multi-lane highway accidents Designed for an Italian four-lane motorway with a split median, this model was built to scale. Using injury data collected from the aforementioned roadway between 1999 and 2003, this model was developed. It was built on the basis of data from crashes, traffic movement, pavement surface conditions, and rainfall during a five-year period. When developing this model, factors such as horizontal and vertical orientation, visibility depth, traffic density, surface friction, and rain data were all taken into consideration. It is possible to compute the outcomes using full and severe injury counts in curves, tangents, and rain effects provided by this model. This model enhances the relationship between crashes and traffic flow, as well as the relationship between environmental circumstances and the geometric infrastructure features of two-lane country roads. When used in conjunction with engineering and pavement upgrades, this model may assist in the identification of accident critical factors as well as the assessment of viability. This model is customized and developed especially for Italian four-lane expressways, based on accident data collected over a five-year period.

III. METHODOLOGY

In this Chapter, the impact of intelligent transportation framework decrease fuel utilization, emission of exhaust pollutants and road-vehicle crashes under heterogeneous activity condition, and their impact on the related destination are examine.

3.1 ITS TECHNOLOGY AND FUEL CONSUMPTION

There are a number of techniques and technologies used for the reduction of fuel consumption to make the environment greener. ITS could be used for reduction of fuel consumption which would make the environment clean and green . Table 1 shows many techniques and technologies used for the reduction of fuel consumption in the road transportation system. Fuel consumption can be reduced by two ways, that is, reduction of fuel use and minimization of the average distance. Secondly, the technique on fuel consumption reduction introduces the importance of reduction of fuel consumption for green driving and reduction of fuel by intelligent driving, while minimization of the average distance can be done through traffic reduction by navigation and traffic reduction by transportation reduction. The ITS techniques and technologies can facilitate the reduction of fuel consumption by improving the driving behavior and minimizing the traffic congestion The ITS techniques and technologies can reduce energy consumption by changing the driving behavior, suggesting congestion free smooth path, automatic traffic control signal, electronic toll collection, and platooning. From the mechanical properties of the vehicle the automobile engineer proved that the vehicle running 50–70 km/h for gasoline engines and 50–80 km/h for the petrol engine consumed the lowest rate of fuel. Fig 4.1 illustrates the basic relationship of the vehicle speeds with the fuel consumption from which exhaust pollutant by the driving pattern can be assumed. By eliminating the congestion and suggesting an uninterrupted path with the aid of ITS technique the vehicle can maintain this green speed and then obtain the best fuel efficiency and pollution at minimum level . If the vehicle drives above green speed or runs bellow the green speed it will consume more fuel . The curve C in Figure 1 shows that if the aerodynamic drag is reduced at high speed, then fuel consumption will also be reduced . The speed versus fuel consumption for the hybrid and electric vehicle is shown by doted das line.

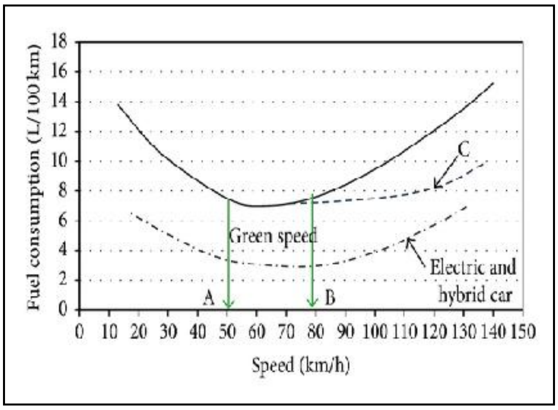


Fig 3: Relation between fuel consumption and average speed

3.2 TRAFFIC CONGESTION'S EFFECT

Traffic congestion has a number of impacts and are listed below

1. W Drivers and passengers are wasting their time.
2. Delay, which may result in missed opportunities for work, meetings, and education, as well as disciplinary actions or other personal tragedies.
3. Inability to predict journey time correctly

4. Higher idleness, acceleration, and braking as a result of increased air pollution and carbon dioxide emissions from waste fuel.
5. Emergencies: Congested roads hinder emergency vehicles from reaching critical locations. Because of these problems, the Amravati road may be developed without harming the current infrastructure.

3.3 DATA COLLECTION

The data of Signalized intersection is collected in term of PCU and considered for calculating average delay so that total fuel consumption per day is calculated and then total fuel consumption monthly, yearly and decade for ITS implementation is calculated.

3.4 DATA ANALYSIS

The collected data is analyzed, the fuel saving from difference of without ITS and with ITS implementation is calculated and from that saving cost is calculated by multiplying fuel saving with fuel cost and then comparative graph for fuel consumption with ITS implementation and without ITS is drawn. And likewise comparative graph for Emission rate of gases CO and NOX is drawn and for accident average cost per accident with signal synchronization and without synchronization is calculated and comparative graph is plot.

3.5 STUDY AREA

The study area consisted of the five intersections. The traffic data is collected in term of PCU. The study area conducted of 6 km stretch of Amravati city from Rajapeth to Kathora square of all total 5 intersections. Which includes; Rajkamal square, Irvin square, Panchavati square, Shegaon Naka, Kathora Naka. And for further calculations average PCU is taken.

IV. DATA COLLECTION AND DATA ANALYSIS

4.1 PRIMARYDATAANDSECONDARYDATA

4.1.1 Primary Information (Collected Traffic Data)

Primary data is about the study of Amravati roads and identification of traffic flow. The site is selected,the stretch from Rajapeth to KathoraNakaand the data is collected i.e. traffic volume count (PCU). In input data the initial cost and operating and maintenance cost is calculated. And for Output benefits the fuel consumption, emission rate and accidental rate is calculated. The data from road intersection, the delay reduction and fuel savings are added to evaluate socio-economic and environment parameters.

4.1.2 Secondary Information (Collected Responses from Questioner)

Secondary data is about collected responses which have been collected manually from questioner. Then the solution using ITS to the existing condition without changing infrastructure is identified. Hence comparisons between present condition and with suggested deployments are done.

4.2 TRAFFIC FLOW CONVERSION IN PCU

The PCU (Passenger Car Unit) is a measure used in transportation engineering to evaluate highway traffic flow rates. In comparison to a normal passenger vehicle, a passenger car unit is a measure of the form of transportation's impact on traffic factors (such as highway, speed, and density). It's also regarded as the equivalent of a passenger vehicle. Because India is a country with unusual traffic circumstances, all kinds of vehicles must be considered when studying. To address this issue, traffic flow has been redirected to PCU. The following are the conversion factors for the PCU:

Table 1: Values of PCU for different types of vehicles

Type ofVehicle	Twowheeler	ThreeWheeler	FourWheeler	HeavyVehicle
PCUFactor	0.5	1.00	1.00	3.00

4.2.1 Traffic Count Tally Sheet (Irvin Square)

Table 2: Traffic Count Tally Sheet (Irvin Square)

TRAFFIC COUNT TALLY SHEET						
Approach Road	Irvin Square					
Time Interval	Motorized					
	1	2	3	4	5	6
	Heavy Truck	Goods PickUp	Bus	Car	Auto Riksha w	Motor Cycle
7.30-7.32AM	0	6	4	10	20	20
7.32-7.34 AM	0	4	3	15	15	40

7.34-7.36 AM	0	6	4	11	13	26
7.36-7.38 AM	0	3	6	12	14	30
7.38-7.40 AM	0	0	5	12	20	35
7.40-7.42AM	0	13	10	10	10	40
7.42-7.44AM	0	10	8	12	14	44
7.44-7.46AM	0	5	8	12	18	27
7.46-7.48AM	0	2	6	12	25	22
7.48-7.50AM	0	7	7	20	20	20
7.50-7.52AM	0	6	4	12	20	16
7.52-7.54AM	0	1	5	15	18	13
7.54-7.56AM	0	0	5	15	20	34
7.56-7.58AM	0	4	4	20	19	15
7.58-8.00AM	8	5	7	27	20	15
8.00-8.02AM	7	6	8	15	20	33
8.02-8.04AM	7	4	4	13	12	20
8.04-8.06AM	8	3	4	14	20	40
8.06-8.08AM	8	5	3	20	15	25
8.08-8.12AM	5	9	5	30	10	15
8.12-8.16AM	6	9	4	3	20	27
8.16-8.20AM	6	4	5	10	10	33
8.20-8.24AM	10	6	10	30	12	27
8.24-8.30AM	8	6	10	10	25	30
Total	64	120	145	341	400	644
PCU/1 Hr.	192	120	145	356	400	322
					Total PCU/1 Hr	**1535**

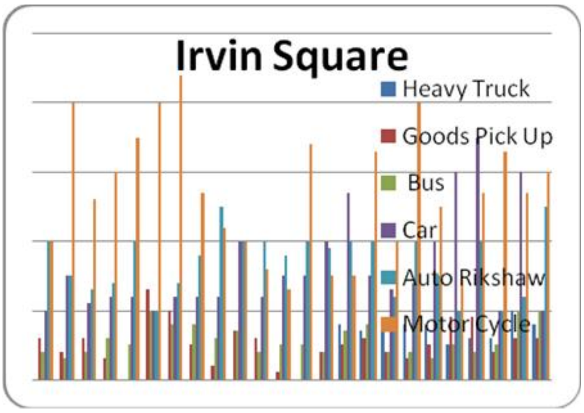


Fig 4: Irvin Square

4.3 TRAFFICVOLUMEDATA

When calculating traffic characteristics, the size of the cars on the road is critical. The statistics section at the end of this chapter provides data on traffic flow at each junction. The picture below shows data from all incoming lanes at each junction. The graphs below depict the traffic volume in PCU/hr for each of the five junctions.

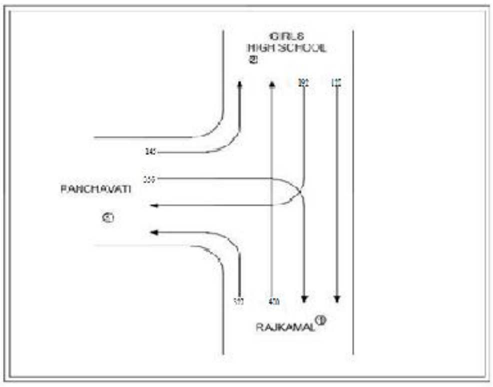


Fig 5: Collected Data of Irvin Square

4.4 BENEFITCOSTANALYSIS

The flow of cars has a beneficial impact on road efficiency and safety during peak hours. Passengers will be delayed by a few meters, but the overall journey time will be cut in half. Average vehicle speed rises, vehicle production rises, travel time falls, congestion falls, and accidents (particularly due to mergers) fall.

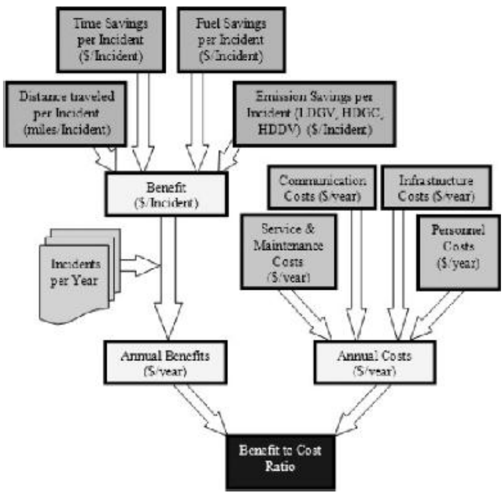


Fig 6: Benefit cost analysis

V. RESULTS&DISCUSSION

5.1 DISCUSSION OF THE FINDINGS

In this chapter, the results are calculated and are discussed; the impact of fuel consumption per day with ITS (Signal synchronization) and without ITS is calculated from that consumption monthly and yearly can be calculated. Likewise Emission rate of NOx and CO2 is calculated and average cost per accident.

5.2 Result obtained from Emission of Gases calculations

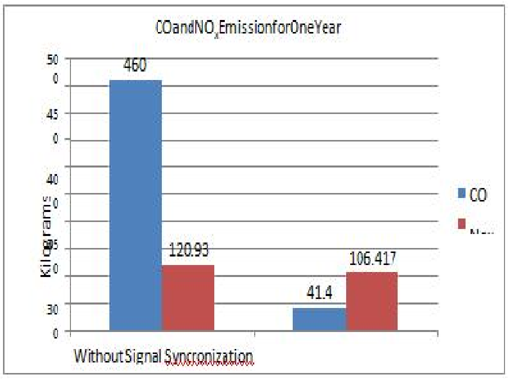


Fig 6:Graph showing the reduction in emission rate.

If Signal Synchronization is used and from the graphit can be seen that considerable amount of exhaust pollutants can be minimized if they are implemented.

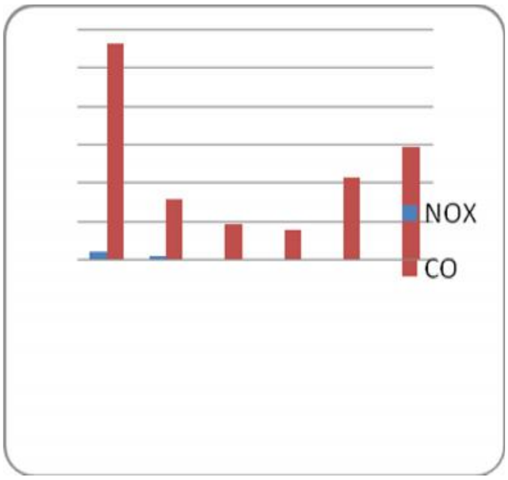
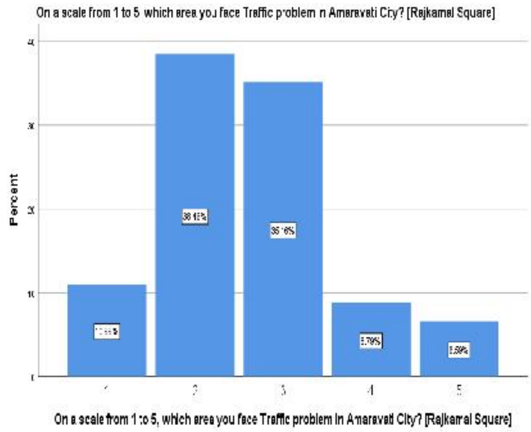


Fig 7: Environmental factor i.e. emission rate benefit cost ratio graph of NOx and CO gases of ITS deployments

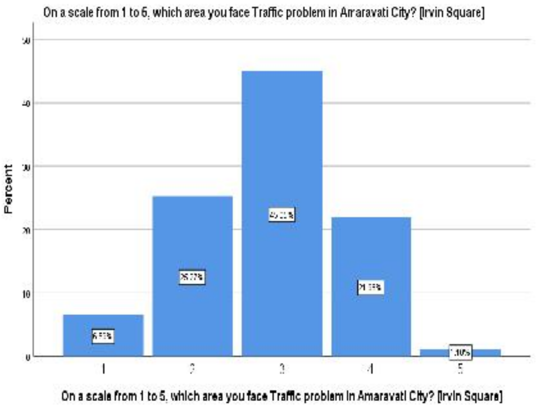
From above graph benefit cost ratio for adaptive signal control is greater, that means evaluated benefits of these deployments are greater and therefore there implementation would be profitable.

On a scale from 1 to 5, which area you face Traffic problem in Amaravati City? [Rajkamal Square]					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	10	11.0	11.0	11.0
	2	35	38.5	38.5	49.5
	3	32	35.2	35.2	84.6
	4	8	8.8	8.8	93.4
	5	6	6.6	6.6	100.0
	Total	91	100.0	100.0	



A study of traffic difficulties in Amravati, notably near Rajkamal Square, was undertaken, as seen in the graph above. 38.46% of respondents have dealt with traffic difficulties more than twice, and 35.16 percent have dealt with the situation three times. 10% of those who have had a single traffic problem in Rajkamal Chowk. 6.79 percent of the population will be confronted four times, and 6.59 percent will be confronted five times.

On a scale from 1 to 5, which area you face Traffic problem in Amaravati City? [Irvin Square]					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	6	6.6	6.6	6.6
	2	23	25.3	25.3	31.9
	3	41	45.1	45.1	76.9
	4	20	22.0	22.0	98.9
	5	1	1.1	1.1	100.0
	Total	91	100.0	100.0	



A study of traffic issues in Amravati, especially near Irvin Square, was performed, as seen in the graph above. 45.05 percent of respondents have dealt with traffic problems three times or more, and 25.27 percent have dealt with the situation twice. 21.98 percent of people who had been stuck in traffic four times in Irvin Chowk. 6.59 percent of the population will have one traffic issue, while 1.10 percent will experience five.

VI. CONCLUSIONANDFUTURESCOPE

6.1 CONCLUSION

There is a previous post and a pre-impact in the current debate. The goal of this research is to offer the bare minimal infrastructure and to give current research in the ITS field through a literature evaluation. Expanding ITS may decrease the frequency of accidents and save millions of lives, according to a prior debate. For the Amravati city we suggest some ITS as shown in fig 4.8 and from over all calculations and from results and discussion the impact of social, economic and environmental factors we have comparative graph, it can be seen that fuel saved is more for vehicular flow and for vehicular emission decrease in exhaust pollutants in society and crashes can be minimized/decrease and thus benefit costratios are obtained. The All conclusion are conclude from the below points

- Intelligent transportation systems decrease fuel usage by approximately 8% to 10% and even rise when used on a fully operational ITS network; in the long term, it also helps to minimize hazardous pollutants.
- These ITS advantages will have a positive effect on the country's socioeconomic growth, resulting in many job possibilities. This indicates that ITS is beneficial to society, the economy, and the environment.
- It is critical to the growth of any metropolitan metropolis, as it aids in the reduction of traffic congestion, accidents, pollution, and fuel consumption. When the socioeconomic and environmental aspects of a specific expansion are taken into consideration, the maximum positive benefit cost impact on positive signal control is 5.89 As a consequence, compared to road infrastructure, its installation is more expensive and appealing.

6.2 FUTURESCOPE

1. Several operational trials for the Rail Intersection Program Region, the newest area of ITS, are under ongoing, but no data has been published so far.
2. Many governments are increasingly exploring the advantages of ITS in facility and equipment maintenance and repair. Over the following several years, as the program develops, more data will become accessible.
3. We can all assess the cost-benefit ratio of expanding intelligent transportation.
4. CO and NOx were chosen as the study's two gases. Other gases may benefit from further study.
5. To get additional advantages, certain ITS deployments may be expanded to other routes in metropolitan areas.

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