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Comprehensive Reporting Of Traffic Management System With Planning & Execution Of Bus Rapid Transit Network In Indore City (M.P), India

Kartikey Tiwari
Department Of Civil Engineering, Sanghvi Institute Of Management & Science Behind IIM-Indore Pigdambar, Indore, India
Anurag Nayak
Department Of Civil Engineering, Sanghvi Institute Of Management & Science Behind IIM-Indore Pigdambar, Indore, India
Chittaranjan Singh Rathore
Department Of Civil Engineering, Sanghvi Institute Of Management & Science Behind IIM-Indore Pigdambar, Indore, India
Arehant S Bajaj
Department Of Civil Engineering (ME-Structures), Shri G S Institute Of Technology & Science Indore, India

Abstract:
The present paper details the systemic, functional, operational planning and design to implement the intelligent transportation solutions in the city of Indore. The paper documents the recommended technological improvements to improve operational performance of the pilot (A-B Road) BRTS corridor. The paper scope is limited to implementation of field and centralized equipment and software to the A-B Road corridor.
This document describes the Intelligent Transport System solutions that are proposed for the city of Indore, with emphasis on the scope of Transit Signal System, Bus priority and Architecture and other important items of the project are described in this document.

Key words*: BRT, Design, Intelligent Transport System, Transit Signal System, Technological Improvements*

1.Abbreviations And Acronyms

Acronym	Description
AFCS	Automated Fare Collection System
BCTU	Bus Control and Ticketing Unit
BCV	Bus Card Validator
BIM	Bulk Initialization Machine
Non-BRTS	Simple buses with two doors
BRTS	Bus Rapid Transit System
CCS	Central Computer System
CPD	Card Personalization Device
CSC	Contact less Smart Card
DCS	Depot Computer System
GPS	Global Positioning System
ICTSL	Indore City Transport Services Limited
ITS	Intelligent Transportation System
OTS	Off The Shelf

PIS	Passenger Information System (on BRT station)
SC	Station / Site Computer
SCP	(BRT) Station Card Processor
TOT	Ticket Office Terminal
TMC	Traffic Management Center
TSP	Transit Signal Priority
CCHS	Central Clearing House
ETM	Electronic Ticketing Machine
IVR	Interactive Voice Response
CRM	Customer Relationship Management

Table : 1

2.Introduction

Entering the 21st century, the Indian transportation system has been rapidly expanding; still it has not been able to keep pace with the congestion in our cities which continues to grow at an alarming rate. This increased congestion is adversely impacting our quality of life and increasing the potential for accidents and long delays. To fight and mitigate congestion, transportation professionals in India are working towards increasing the productivity of existing transportation systems through the use of advanced technologies. Intelligent transportation systems (ITS) encompass a broad range of wireless and wire line communications-based information and electronics technologies. When integrated into the transportation system's infrastructure, and in vehicles themselves, these technologies relieve congestion, improve safety and enhance productivity.

Figure : 1

2.1.Background

Indore, a historical city situated on the banks of rivers Khan and Saraswati, is the largest city of 'Indore Agro Industrial Region' of Madhya Pradesh. It is almost centrally located on the fertile Malwa Plateau at latitude 220 43' North and longitude 760 42' East and is the nerve centre of the economic activities of the state. Indore is the most populous city in Madhya Pradesh with population of about 1.6 million according to the 2001 census. It is likely to rise to 3.6 million by 2035 respectively. The average annual growth rate of population is around 40% as per the statistics of census 2001. Indore has an average literacy rate of 72%, higher than the national average of 59.5%: male literacy is 78%, and female literacy is 65%. Indore is one of the fastest growing Tier II cities in India. It already is the commercial capital of central India. The rapid industrial and commercial development coupled with the rise in population in the recent past has contributed to a large scale increase in traffic on the city roads. This increasing intensity of traffic has resulted in the manifestation of a number of problems like congestion, delay, accidents, pollution etc. which pose a potential threat to the economic vitality and productive efficiency of the city.

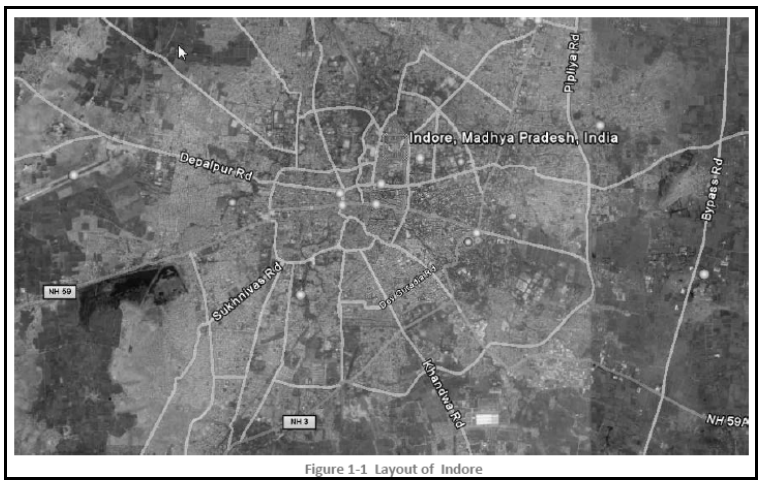

Figure : 2

2.2.Transport Development Strategy And City Plan

In 2006, the City of Indore put together the Indore Development Plan (IDP) 2021 which provides a comprehensive account of Indore's demographic and economic characteristics, land-use, infrastructure, environment, and housing and slums. Some of the salient features of the CDP are:

2.2.1.The plan documents the demographics of the City of Indore

According to the 2001 census, Indore's population growth is a whopping 42% with a similarly high population density of 1028 persons per hectare in Indore planning area.

2.2.2.The Plan identifies the gaps and deficits in city's infrastructure

- Water supply is available for only 60 minutes on alternate days, covering 55% of the city population. Average water supply is 80 lpcd. 50% of water is unaccounted for (UFW), including 40% transmission and distribution losses.
- Only 55% population has access to sewerage network and 80% of sewers are underutilized for want of maintenance.
- Only 25% of roads have storm water drainage.
- Solid waste collection suffers from poor handling and management.
- Narrow road widths, high vehicular ownership, and a mix transport modes resulting in traffic congestion problems and a high accident rate

2.2.3.The Plan identifies environmental pollution and lack of green cover as critical problems faced by the city

- According to the CDP, the main cause of air-pollution is vehicular traffic. The suspended particulate matter (spm) in the city is in excess of the threshold of .2 g/cum by Indian standards. Discharge of untreated domestic and industrial wastes has resulted in pollution of the surface water bodies in the city.
- The city has very limited green areas and recreational spaces.

2.2.4.The Plan presented the state of housing shortage

Informal housing form 50% of residence of Indore's population in the form of squatters and unauthorized colonies. 35% people live in slums and squatter settlements and another 15% in unauthorized colonies, with inadequate infrastructure facilities.

2.2.5.The Plan also detailed the inner city congestion

- The CBD has heavy population pressure and is suffering from congestion in terms of traffic, building intensity, and parking. Most of the buildings in the CBD area are said to have completed their life span.
- The Plan seeks to improve the city's existing infrastructure with "minimum basic services to the underprivileged" to ensure functional, sustainable development and further growth towards becoming a "world class commercial city".
- Keeping long-term growth in perspective, the City Development Plan has strategies to provide the city's entire population with round-the clock water supply by 2015 and efficient solid waste management using modern and scientific systems by 2016.
- The CDP envisages a well-organized public transport system which would include a metro rail, flyovers and elevated road intersections by 2014, and an environment friendly Indore by 2021.
- It provides information on the city's institutional set-up, with particular reference to the role of Indore Municipal Corporation (IMC) vis-à-vis other agencies involved in the provision and maintenance of infrastructure and services.

- The Plan details the role of agencies involved in urban development, these being the Indore Development Authority (IDA), Madhya Pradesh Public Works Department (MPWD), Madhya Pradesh Housing Board (MPHB), District Urban Development Authority, Madhya Pradesh Town and Country Planning Department, and Krishi Upaj Mandi Samiti.
- Special agencies are identified in the plan for the provision and management of city's transport. These are the Indore Development Fund limited which is owned by IMC and had been formed to mobilize funds for repair and construction of roads in the city and Indore City Transport Services which is a fully government owned company, set up to provide an efficient transport system in the city. The CDP has provided a detailed account of the finances of the Municipal Corporation of Indore.
- The development plan of the city is proposed to be conducted in two phases with the first phase to be implemented from the year 2007. Under the first phase of development 5,400 hectare of land would be acquired and an investment of Rs 500 crore and another Rs. 1,930 crore will be spent on its development. Around 70 per cent of the land acquired would be used to developed new roads and for the maintenance of old ones.
- In summary, the CDP has been prepared keeping a view the deficiencies and requirements till 2021. It focuses on the first phase of the target for sustainable and harmonious development by 2021. The Vision identified in the CDP for the city is:
  "Indore shall enter an era of prosperity with spatially restructured environment, improved urban infrastructure to achieve better lifestyle, minimum basic services to the underprivileged with functionally sustainable development and dynamism of growth which will pave the way for it becoming a world class commercial city".
  The vision consists of the following elements:
  - Healthy community life
  - Improved mobility
  - Housing for all
  - Sustainable city
  - Heritage and inner city area Conservation
- The goals identified in the CDP are:
  - Strategies are formulated after identification of sector-wise goals for the year 2021.
  - Water supply 100% population coverage and 24 hour water supply by 2015.
  - Sewerage 100% population and area coverage by 2020.
  - Solid Waste Management Development of a comprehensive system with modern and scientific methods by 2016.
  - Transport Efficient public transport, introduction of metro-rail, elevated road intersections and flyovers to remove congestion.
  - Environment Clean and environment friendly Indore by 2021 Slum less Indore by 2015, through construction of dwelling units for EWS and LIG category on 20% of land of its Town Development Schemes.

3.Indore-Urban Transport Scenario

As with all Indian cities, Indore has very few existing studies depicting the quality of service in the city. This chapter documents the studies conducted till date in the city.

3.1.Traffic & Transportation – Draft Development Plan For Indore (1974)

3.1.1.Some of the principle findings for draft development plan of 1974 were

- An estimated 500 passenger buses move into and out of Indore everyday
- An estimated 1200 trucks move into and out of Indore daily while 430 trucks were through in nature
- The peak hour volume on some of the important city roads like A B Road and M G Road, Subhash Marg and Jawahar Marg varied between a minimum of 275 PCU to a maximum of 1132 PCU.
- Central area road network exhibited a higher traffic density in comparison to the network capacity.

3.1.2.The study highlighted the following problems and issues

- Central area suffered from inadequate circulation pattern
- Inter-mixing of traffic
- Misuse of road space and narrow width
- Accidents
- Lack of traffic regulation and enforcement
- Parking problems

3.1.3.The document presented the following recommendations to alleviate the problems

- Relocation and rearrangement of various activities which generate parking.
- Recommended or conceptual circulation plan comprising of system of ring roads and

- approach roads for central area.
- Preparation of traffic operation plan.

3.2.Traffic Flow Study For Indore City (1997)

In 1997, the Indore traffic police commissioned a traffic flow study that was carried out by Sh. G S Institute of Technology & Science, Indore. The study aimed at understanding the traffic issues and recommending improvements to facilitate smoother traffic flows. Population growth, vehicle ownership, socio-economic characteristics, and public transport facilities were among the parameters analyzed in the study.

3.2.1.The study identified the following as contributing issues to the traffic problem

- mixed traffic conditions
- encroachment resulting in reduction of capacity of roads
- lack of enforcement measures
- lack of engineering measures
- inefficient and inadequate mass transport system

3.2.2.The broad recommendations emerging out of the study included

- Planning should focus on reduction of the traffic load on existing road network through various travel demand management measures.
- Emphasis should be placed on mass transport system.
- Concerted efforts are needed in removing encroachments, bottlenecks, improving traffic signal, road condition and geometrics at intersections.

3.3.Comprehensive Traffic And Transportation Study (2004)

A Comprehensive Traffic and Transportation Plan for Indore (CTTPI) have been prepared in 2004 by CES in association with ICF Kaiser and Anil Verma Associates. The study area was over 214 sq-km and covered Indore Municipal Corporation and 16 other adjacent villages and settlements. After evaluating the existing traffic and travel characteristics of the Indore city, the study: (1) provided projections of travel demand up to the horizon year 2021, (2) identified short term transport improvement measures, (3) prepared medium and long term transport improvement plans, (4) developed a plan for Integrated Mass Transport System (IMTS) that included economic and financial analysis, and (4) suggested implementation mechanism and organizational structure for the CTTSI recommendations.

3.3.1.The following are some of the findings for the base year (2004) of the CTTPI

- In the base year, on an average, 88423 vehicles move in and out, daily, at the outer cordon while 5,28,558 vehicles enter and exit, daily, the inner cordon.
- An estimated 2, 84,161 passengers enter and exit the city daily by various modes. Minibuses and buses put together contribute to a share of 60 percent of passenger trips.
- Majority of trips are made for the work, business and education purpose together accounting for nearly 76% of total trips performed.
- An estimated 20,321 freight vehicles move into and out of study area daily.
- On an average, 31,056 tones and 26,676 tones move into and out of the city daily. Apart from building materials, food grains and vegetables are the major commodities moving in and out.
- The speed distribution reveals that 71 percent of road length in central area had speeds less than 20 km-ph.
- The average journey speeds on A B Road and Ring Road were observed to be 32.2 km-ph and 40.1 km-ph respectively.
- The study area is presently being served by an estimated 300 minibuses along with estimated 150 tempos, with minibuses carrying the most passengers.
- An estimated 61,192 rail users use the station daily. In all, 49 trains service the rail movement needs.
- Analysis of household socio-economic data reveals that the average household income in Indore is Rs. 7524.
- The average vehicle ownership rate in the study area is 0.88 vehicles per household with two wheelers and bicycles being the most commonly owned vehicles.
- An estimated 22.7 lacs trip takes place in the study area of which central area contributes 19.4 percent, while the rest of Nagar Nigam area contributes 76.4 percent and extension area's share being 4.3 percent only.
- The overall per capita trip rate (PCTR) was 1.49 while the vehicular PCTR (excluding walk) was 1.09.
- The shares of personalized vehicles (cycles, two wheelers & cars) and public/IPT transport in the total trips were 51.1 percent & 16.4 percent respectively.
- Work /Business trips accounted for maximum share (38.1 %) followed by education trips (37.6 %). Shopping trips share was 28.4 percent.

- The average trip lengths observed were 3.8 km and 4.4 km including and excluding walk trips respectively.

3.3.2.The following are some of the estimated findings for the horizon year (2021) of the CTTPI

- A population size of 42 lacs was estimated for the city by the year 2021.
- The forecasted estimate was 62, 85,950 passenger trips for the year 2021, comprising 55, 03,000 intra-city trips while the rest comprise of inter-city passengers. An estimated 27, 51,825 trips by public transport have been forecasted for the horizon year.
- Nearly 416 km of road network is proposed to be developed in phases by 2021. Of this, 133.8 km would be 2 lane roads, 13.1 km – 3 lane roads, 122.7 km – 4 lane roads and 146.3 km – 6 lane roads. Eight railways over bridges (ROBs) have been proposed all over the city.
- By year 2021, at modal split of 50% and with an estimated average trip length of 6.02 km, it is estimated that 16.5 million passenger km would be performed daily by public transport.
- According to traffic estimates, a total of 5.5 million person trips would be generated every day by 2025, of which the share of public transport trips would be 2.75 million trips.
- In all 478 buses are required to service the demand of 1.22 million passengers in the year 2021.

3.3.3.CTTPI proposes financially viable integrated mass transit system (IMTS) comprising of 44.75 km length with 27 stations

The study's recommendations for the ITMS were:

The Indore Mass Transport System (IMTS) was proposed to include 277 km of bus network and 44.75 km of rail network (IMTS) comprising three corridors:

- Green Corridor (East-West Corridor) comprising of 12.3 km length, having eight stations along it, starting from Khajrana in the east and terminating at Namod in the west.
- Red Corridor (A B Road) comprising of 15.25 km length, having nine stations along the corridor, starting from Niranjanpur in the North and terminating at Rajendra Nagar.
- Blue Corridor (Ring Road – W) comprising of 17.20 km length, with 10 stations along it, starting from Niranjanpur and terminating at Rajendra Nagar running along the Western Ring Road.

3.4.Traffic And Travel Pattern In Indore City (2008)

A study was conducted in May 2008 to establish the baseline traffic data before the implementation of the BRT corridor. The study is intended to evaluate the improvements in traffic flow and modal-shift of road users by establishing a baseline scenario of traffic parameters. Following surveys were conducted:

- One-day classified traffic volume counts at 15 locations: The study concluded that two wheelers are predominant mode in Indore City with a share in the range of 40 to 70% at various locations. Cars (big and small put together) are the next significant mode with generally 15 to 30% share. Since the cycle traffic is quite significant in Indore City, the study recommended providing cycle lanes to enhance the safety of cyclists as well as enable smooth flow of vehicular traffic.
- Vehicle occupancy surveys at all the above 15 locations on 7 corridors: In the study, for private vehicles the vehicle occupancies were observed along with classified traffic volume counts. For buses and minibuses, vehicle occupancies were estimated by boarding and alighting counts of buses. Rough estimates of occupancy show that the car occupancy is 1.6, scooter occupancy is 1.4, auto rickshaw occupancy is 4.0, minibus occupancy is 22, and bus occupancy is 38. According to the study, buses carry about 26% of the total passenger trips.
- O-D surveys at 13 locations: The study identified the major corridors in Indore City that service the maximum passenger trips by Public Transit and private vehicles. These include:
    - A.B. Road Corridor (Mangliya to Rau)
    - Eastern Ring Road Corridor
    - M.R.10 Corridor (Bypass to Ujjain Road)
    - River Side Road Corridor
    - Western Ring Road Corridor
    - RW-2 (Ujjain Road to Airport)
    - M.G. Corridor
- Bus boarding and alighting counts on all existing bus corridors: About 26% of the person-trips is being carried by mini and regular buses.

4.BRTS Network Description

The studies show that by 2021, Indore has to cater for 5.5 million person trips with about 50% of person traffic to be carried by transit. From Environmental, economic and social impacts perspective, transit (buses) always provides the best alternative among the various road infrastructure development alternatives. The CTTPI analysis also provided a detailed, feasible, Indore Mass Transit System (IMTS). Based on extensive studies and evaluation of a number of alternate development scenarios in the detailed project report, the

Bus Rapid Transit System for Indore has been identified. This includes the High Capacity Bus Based Rapid Transit System and the Standard Bus Service System planned, operated and managed as an integrated system. The Indore Bus Rapid Transit System comprise of 306.5 km of Bus network and 109 km of High Capacity Bus Based Rapid Transit System (BRTS). In this chapter a brief description of the BRT system that is to be implemented in Indore is provided. This network description sets the stage for the ITS technologies, in the next chapter, that will best improve the operations in the corridor.

4.1. High Capacity Bus Based Rapid Transit System (Indore Brts)

The Indore Bus Rapid Transit System is in-principal approved with an estimated cost of 868.15 Crores, by the Central Sanctioning and monitoring Committee through sub- mission Urban Infrastructure and Governance under Jawaharlal Nehru National Urban Renewal Mission (JNNURM). On the basis of Travel Characteristics, Travel Impedance Matrices, Trip Assignment Transport Plan 2021 Proposals in CTTS Indore 7 corridors were identified for developing the Bus Rapid Transit System within the city, which can be developed in Phases. Other Public Transport Routes, which would serve as Feeder Routes to BRTS, were also been identified as per the Comprehensive Mobility Plan. Figure X below presents the identified corridors:

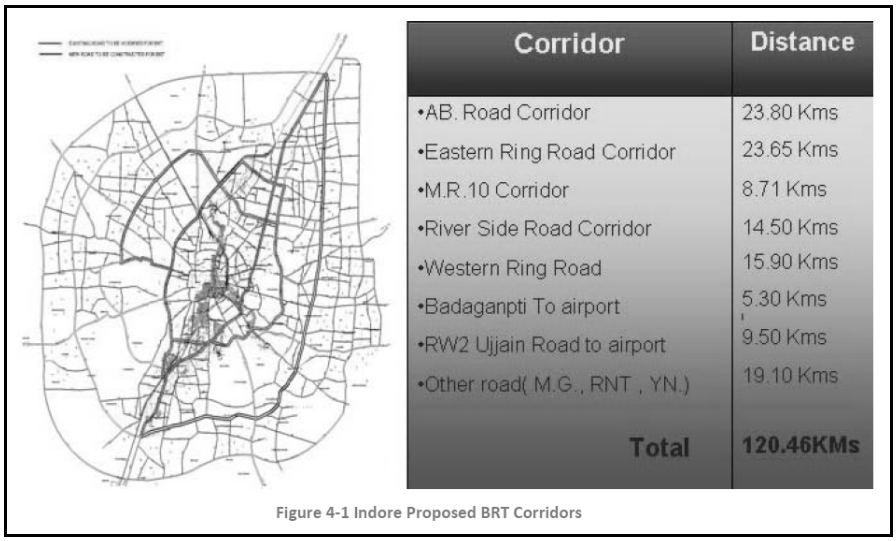

Figure : 3

Indore developed a systems approach to implementing the BRT system consisting of planning, management, and control through the establishment of Indore City Transport Services Ltd (ICTSL).

Figure : 4

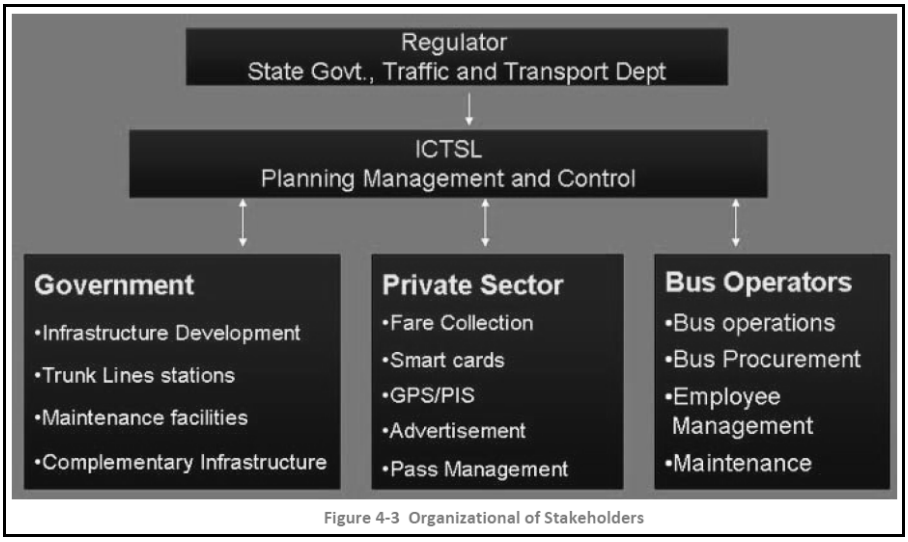

Figure : 5

4.2.The Pilot Corridor AB Road (Mangliya To RAU)

The A B Road pilot project is being implemented in the first year. The AB Road Corridor starts from Bypass Junction on AB Road at Mangliya; it runs through the Northern Suburbs of Indore City crosses other BRTS corridors Eastern Ring Road Corridor at Niranjanpur Square and MR-10 (East West Corridor) at Vijay Nagar forming a BRTS Interchange Station. From there on it runs along the AB Road itself with densely Developed Mixed Use Development up to the MG Road BRTS Corridor forming another Interchange Station at Palasia. It continues further along the AB Road with institutional areas Commercial Establishments up to the Rajeev Gandhi Square where it forms a BRTS interchange with Eastern Ring Road BRTS Corridor. It continues to run along AB Road, and crosses Western Ring Road BRTS Corridor at Rajendra Nagar forming the Last BRTS interchange along this AB Road, further it enters the newly Developing Southern Suburbs of Indore and Ends at Bypass Junction at Rau.

The Length of the Corridor is 27.50 Kms with 55 Bus Stops and 5 BRTS Interchange Stations identified along the corridor. The Stretch 1 from Mangliya to LIG Square and Stretch 3 from Navlakha to Rau has Right of Way of 60m, thus facilitating Development of two dedicated Bus Lanes, four lane main Carriageway, segregated Cycle Track, Pedestrian Paths and two lane Service

Roads on either side, while the Stretch 2 from LIG Square to Navlakha has Right of Way of 30 Mts thus only facilitating Development of two dedicated Bus Lanes, four lane main Carriageway, segregated Cycle Track, and Pedestrian Paths on either Side. ICTSL Buses are currently running on the AB Road Corridor. Generally 30 buses move on various sections of the corridor during the day.

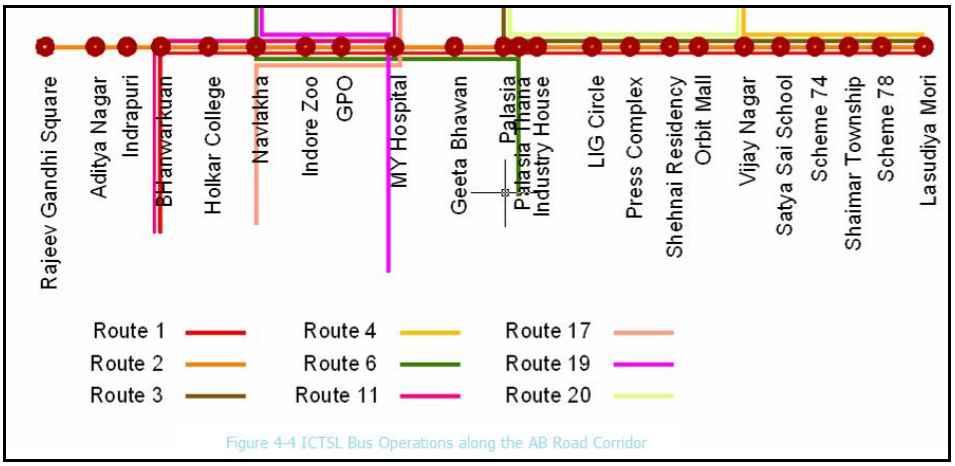

Figure : 6

It is proposed that the Current Routes operating on the Pilot Corridor will continue Operating with increased Frequency as per the growing Demand.

While the Route 2 will be converted to BRTS A1 Route to make it Closed BRT Option with Up-Down Movement along AB- Road. ICTSL will run High Capacity semi articulated/articulated Buses for the BRTS A1 Route. The Routes Proposed for BRT and Non BRT operations on the AB Road pilot Corridor.

It is proposed that 82 Non BRTS ICTSL Buses will run along the AB Road Corridor, While 30 High Capacity Semi-Articulated/Articulated Buses will run along the Pilot Corridor up and down. The Peak Hour PT Passenger Trips per Direction demand on the Pilot Corridor will vary from 1000-6000 passengers on various links in 2013 with a modal PT share of 30%. The same is estimated to be increased up to 2500-10,000 by 2015 with a modal PT share of 42%, while it is expected it to be 6000-25000 by 2021 with a modal PT share of 50%.

5.Services Development Plan Intelligent Transportation Systems (ITS)

The city of Indore is developing an integrated infrastructure development plan for the city through the comprehensive development plan. One of the main developments is the implementation of the seven BRT corridors. In this section, the associated services are identified that will enhance and enable the effective utilization of the infrastructure development.

5.1.Its Why?

Current day demand for mobility is increasingly confronting economic, social, and physical constraints on transportation infrastructure. These constraints include funding limitations for transportation projects, social and environmental impacts of infrastructure expansion, limited physical space to devote to such projects. Rapid advances in information processing and communications technology have created new opportunities for transportation professionals to deliver safer and more efficient transportation services, and to respond proactively to increasing demand for transportation services in many areas and mounting road user expectations. Promotion of mass transit and implementation of traffic, event and incident management tools are emerging as solutions. One of the most effective roadway improvement solutions is the improvement of public transit service so that more travelers will utilize transit freeing up space on the streets, diminishing dependence on fossil fuels, and improving air quality.

While a BRT corridor improves the safety and performance of the traffic flow, in arterial corridors the BRT system is limited by the efficiency of the signalized junctions on the arterial. The Delhi BRT system is a good example of the limitation of a BRT system without the signal control technology to efficiently move buses through the junctions. ICSTL recognizing this early, has commissioned the usage of various Intelligent Transport System (ITS) components to further make the BRT transportation mode attractive to the road users. Indore is planning the application of ITS to improve the safety, efficiency, dependability and cost effectiveness of the city's transportation system. The sections below discusses the elements of Indore's ITS System.

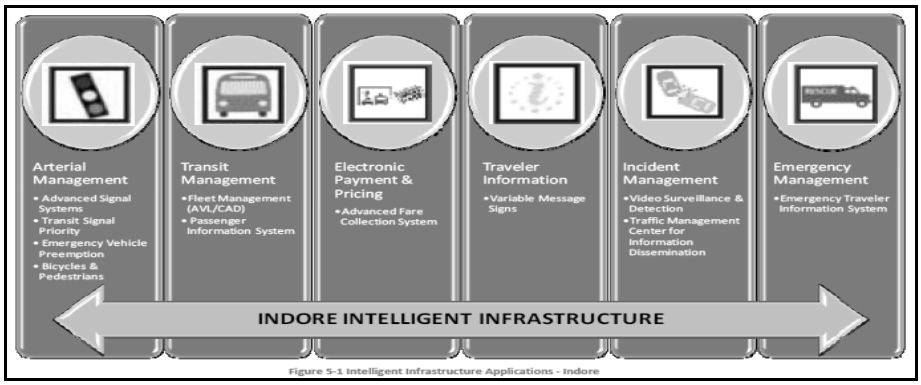

Figure : 7

5.1.1.Potential benefits of the ITS system includes

- Increased productivity: If the transit rider can be told when the coach will be at their stop in real time, they are less likely to leave their work site earlier than necessary to allow for the perceived wait time needed to assure catching the coach of their choice.
- Reduced stress: If the transit user can be assured that the coach she/he is planning to ride has not passed their chosen stop and that it will be arriving in a timely manner, the stress level associated with the lack of information will be reduced Increased public safety: Providing timely information to transit riders will allow them to spend less time in potential dangerous waiting situations.
- Increased ridership and mode change: The above benefits would lead to a perception that transit is responsive to public needs and that transit is an attractive alternative to SOV travel. This would reduce congestion as well as have a beneficial impact on environmental pollution.

5.2.Intelligent Transportation Systems Operations Plan

This section will describe the architecture and ITS implementation plan for Indore. Since the hardware and software from the various ITS component systems are generally integrated at the Traffic Management Center, this section provides the integrated architecture of the system. Many of the ITS management plans are integrated at the Traffic Management Center (TMC), hence the TMC architecture is first provided and then the other ITS systems are described.

6.Central Control Room/ Traffic Management Center

The central control room serves as the hub for all ITS system activities. The objectives of the TMC are to:

- Maximize the number of vehicles the corridors can handle.
- Minimize congestion.
- Provide traveler information.
- Manage incidents and special events.
- Provide aid to stranded motorists.

The various elements of TMC are

- Hardware
  - Video Wall
  - Workstations
  - Servers
  - Monitors
  - Satellite TMC Locations
  - Communication
- Software for Center
  - Advanced Traffic Management Software
    - Traffic Signal Operations Software
    - VMS Linking Software
    - CCTV Linking Software
  - Micro simulation Software
  - Signal Optimization Software

The cost of implementing TMCs varies depending upon the size and functions of the TMC. Overall costs involves

- Conception, design and implementation of TMCs.
- Yearly operational costs including the cost for co-hosting the number of agencies present.
- Implementation and Operational Challenges
  - The TMC planning, design, and implementation involve not only several departments within the implementing agency (or agencies), but also the efforts of a variety of private sector product and service providers. This requires both significant coordination and ongoing effort to build and maintain consensus.
  - The challenges that a modern transportation management center face are not confined to implementation alone, equally challenging is its operation and maintenance.
  - The TMC may be in planning, design, and implementation several years, requiring it to deal with multiple technology generations. The agency owning the TMC faces a daunting challenge of implementing, operating, and maintaining not only a complex transportation environment, but a mass of complex and rapidly evolving technology.

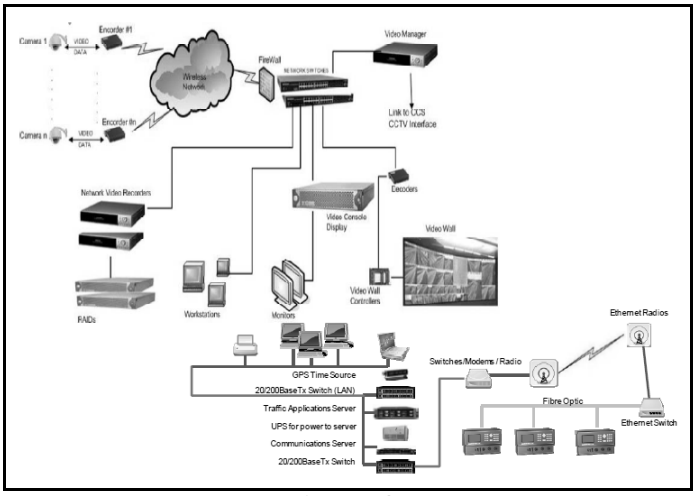

Figure : 8

6.1.Advanced Signal Systems

In India, many new signal systems are being run in the adaptive mode. Adaptive implies that the signal will automatically find signal timing parameters that will improve the traffic flow on the corridor. The applicability of adaptive control for heterogeneous traffic is

still unproven, hence it is not recommended for Indore. The controller is still proposed to be an adaptive capable controller so that in the next few years when adaptive technology matures for Indian conditions, the AB corridor in India can be put on an adaptive system. Currently, an Advanced Signal System consisting of Area Traffic Control (ATC) from a centralized location is proposed for the AB Road corridor. The signals in the corridor will be run in the actuated coordinated mode. This will allow skipping or truncating minor street phases based on demand, and providing progression on AB road. Transit signal priority will be placed in such a manner that it does not impact the coordination of the signals.

6.2.Transit Signal Priority & Emergency Vehicle Preemption

Transit Priority is a form of preferential traffic signal control strategy that facilitates the passage of transit vehicles. Transit priority requests are often conditional and may, for example, be granted on one or more conditions such as the absence of a pedestrian phase, the presence of a green interval, and a prescribed level of bus occupancy or degree of bus lateness. Emergency Vehicle Preemption on the other hand is generally unconditional except for the safety requirements (i.e., pedestrian phases are not preempted, minimum greens are provided) of the junction. While both TSP and EVP utilize similar equipment, signal priority modifies the normal signal operation process to better accommodate transit vehicles, while preemption interrupts the normal process for emergency vehicles and heavy-rail. Emergency vehicle preemption results in reducing response time to emergencies, improving safety and stress levels of emergency vehicle personnel, and reducing accidents involving emergency vehicles at intersections. Provision of transit signal priority leads to improved schedule adherence, improved transit efficiency, contribution to enhanced transit information, and increased road network efficiency.

In India, currently, preemption is being used by transit in the guise of priority. Emergency vehicle preemption requests, on the other hand, are usually only conditional on the absence (or completion) of the pedestrian phase and may involve either a green extension or a red truncation. A trend taking place is to coordinate the planning and deployment of emergency vehicle preemption and transit priority strategies for the purposes of developing a single, integrated traffic signal control system.

6.2.1.Transit Signal Priority-Strategies

Priority can be provided by applying various strategies at a traffic signal. Some of the strategies are signal controller specific. The descriptions of some of the common strategies are provided here:

6.2.1.1.Green Extension

In green extension, if a TSP request is received within a certain time before the yellow onset, the green will extended. This is the most effective TSP strategy since buses do not have wait a whole cycle before getting the green.

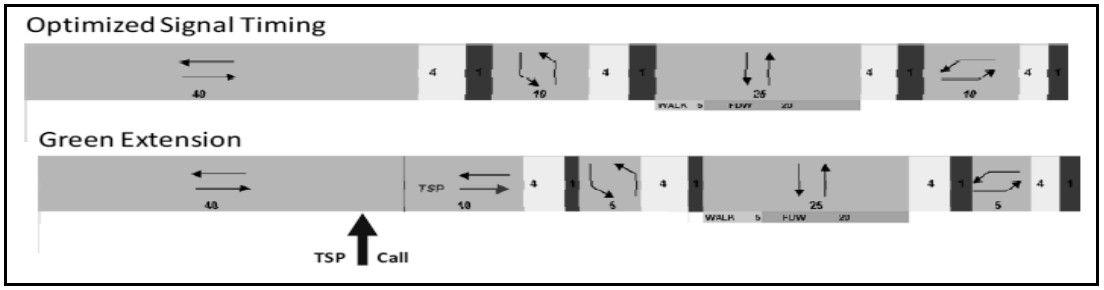

Figure : 9

6.2.1.2.EarlyGreen (Red Truncation)

In early green, if a TSP call is received after the TSP phase is timed out, the non TSP movements are provided only minimum green to provide early green to the bus movement.

6.2.1.3.Phase Swapping

In Phase Swapping, the transit phase can be introduced immediately after the current phase is time out. The disadvantage of this strategy is that road users have an expectation of phase sequencing once they get acclimatized with the location, which might result in accidents.

6.2.1.4.Phase Skipping

In this strategy, in response to a TSP call the minor phases will be skipped to provide green to the transit vehicle. This is generally not a preferred strategy since all the minor street vehicles have to wait another cycle to get a green.

6.2.1.5.Conditional Priority

Since granting TSP interrupts the normal operations of the corridor, in this strategy TSP is granted only when a bus is behind schedule by a certain amount of time. This is usually a preferred strategy for TSP.

6.2.2.Transit Signal Priority Concept Of Operations

TSP Operations is generally comprised of two primary elements, the Priority Request Generator (PRG) and a Priority Request Server (PRS). The transit vehicle (bus in Indore), through its agent, the PRG, submits a request for priority to the PRS. These two elements can be thought of as a logical process that could be physically implemented in more than one way, as discussed further in the document. The two primary interfaces are (1) between PRG and PRS and (2) between PRS and the traffic signal controller coordinator, which implements special coordination operation. Another element TSP operations which directly relates to the traffic signal software, is the concept of granting priority while maintaining coordination with adjacent intersections.

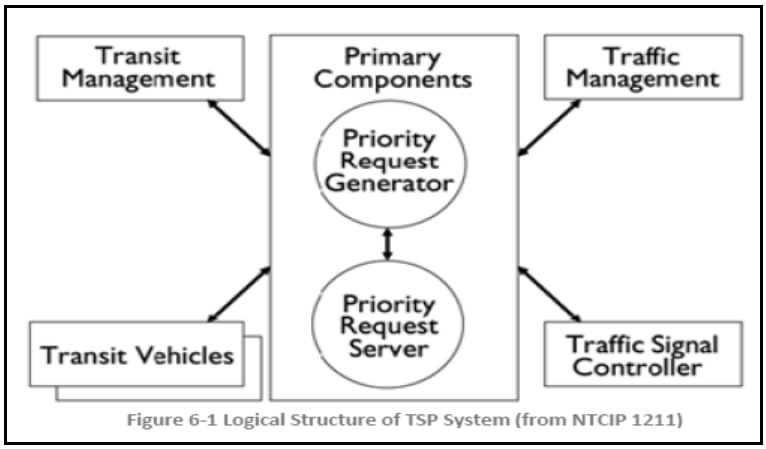

Figure : 10

Since the buses in Indore are equipped with AVL system, it is logical to use the technology for granting transit signal priority. An AVL based TSP system is shown in figure below.

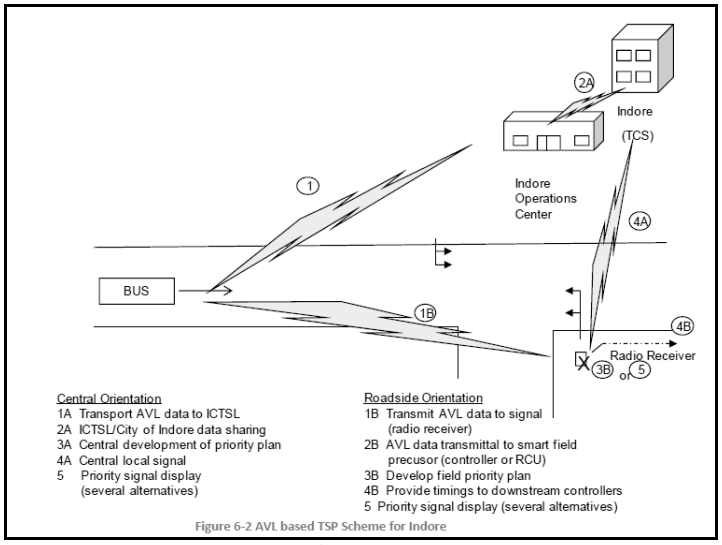

Figure : 11

6.2.3.To have the outlined system to work, the following elements are needed

- Transit signal priority and actuation of selected traffic movements.
- Ability to adjust nature of transit priority movements.
- Ability to detect presence of transit vehicles.
- Communications between the vehicles, central control room dispatch, and traffic signal system.

7.Project Execution Strategies

The project execution strategy includes the following parts:

- Hardware Equipment Procurement
- Installation and Commissioning
- Systems and Software Integration

- Operations.
- Managing staff during development/installation and Operation phases.

The entire project is handed over to Indore Municipal Corporation, and through a process of competitive bidding, it further subsided to SKM RAMDIN ULTRATECH PVT. LTD. & B.R. GOYAL, INDORE.

8.Conclusion

The present paper represents the study of traffic and travel pattern of Indore city; it includes the present transport scenario and strategic development plan. Further it deals with the comprehensive study for the various years with advanced signal system. It also highlights Planning and Execution of the design of BRTS Project.

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