Challenges and Prospects of Modern Traffic Management: An Agartala Perspective

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Abstract

Agartala, the capital city of Tripura, serves as a vital economic and administrative hub in Northeast India. However, the city's rapid horizontal expansion and population surge have placed immense pressure on its legacy transportation infrastructure. This case study examines the current traffic system, characterized by a transition from manual management to AI-driven Adaptive Traffic Control Systems (ATCS). Despite these technological advancements, the city continues to grapple with severe congestion, narrow road widths (averaging 3.5–5 meters in many sections), and an unorganized public transport sector dominated by rickshaws and auto-rickshaws. This paper analyzes data from key intersections like Paradise Chowmuhani and Durga Chowmuhani, identifying bottlenecks such as inadequate parking, encroachment, and the "Smart City" implementation gaps. The findings suggest that while technology reduces wait times by up to 60% in specific pockets, long-term sustainability requires a multi-modal approach, including the proposed ring roads and stricter regulatory enforcement of paratransit vehicles.

Key words: Traffic management, Agartala, Adaptive Traffic Control System, Intersection.

1. Introduction

Agartala's geographical positioning is not merely a point on a map but a critical determinant of its traffic architecture. Situated in a plain land surrounded by the hills of the Baramura range and the international border with Bangladesh, the city's expansion has been primarily horizontal rather than vertical. Historically, the city's core was designed during the princely era of the Manikya Dynasty, particularly under Maharaja Bir Bikram Kishore Manikya, who is often called the architect of modern Tripura. During his reign, the "Great Square" plan was envisioned; however, the influx of refugees post-1947 and the rapid urbanization of the late 90s led to unplanned "ribbon development" along the major highways. This historical baggage means that today's traffic administrators are forced to manage 21st-century vehicle volumes on a 20th-century street layout.

The city serves as the gateway for the "Act East" policy, making its traffic system a matter of national strategic importance. The completion of the Maitri Setu (Bridge of Friendship) and the Agartala-Akhaura rail link has transformed the city from a dead-end terminal into a bustling transit corridor. This shift has introduced a "mixed-traffic" environment where heavy-duty logistics trucks from the Integrated Check Post (ICP) must compete for space with school-going cycles and slow-moving e-rickshaws. This heterogeneity in vehicle speed and size is the primary catalyst for the "friction" observed at major junctions like Battala and Post Office Chowmuhani.

Furthermore, the psychological dimension of traffic in Agartala cannot be overlooked. For a city that once prided itself on a slow-paced, serene lifestyle, the sudden onset of "metropolitan-style" congestion has led to increased commuter stress and a rise in aggressive driving behaviors. The "Chowmuhani culture," where people gather at intersections for social and commercial activities, further complicates traffic management. These intersections are not just transit points; they are the heart of Agartala's socio-economic life. Consequently, any traffic intervention—whether it is installing a flyover or declaring a "No-Parking" zone—becomes a sensitive issue that balances technical necessity with social habit.

The current transition towards a "Smart City" framework is, therefore, more than just a technological upgrade; it is an attempt to reorganize the very social fabric of the city. By introducing the Integrated Command and Control Centre (ICCC), the administration is attempting to replace human-led, discretionary traffic management with data-driven, objective decision-making. This paper explores whether this digital "overlay" is sufficient to solve the structural deficits of a city constrained by borders, history, and a rapidly changing economic

identity.

2. Literature Review and Methodology

Urban traffic management in small and medium-sized Indian cities often suffers from a lack of data-driven planning. Literature on Northeast Indian urbanization highlights that terrain and historical layouts often restrict road widening. Previous studies on Agartala's urban sprawl suggest that the city has expanded mostly towards the north and south-east, following the NH-8 corridor. However, the inner-city roads remain largely unchanged since the 1980s.

The methodology for this case study involves a mixed-methods approach. Primary data was collected through site observations at ten major intersections during peak hours (8:00 AM – 11:00 AM and 4:30 PM – 7:30 PM). Secondary data was gathered from the Agartala Smart City Limited (ASCL) reports, the Tripura Transport Department, and recent police records regarding traffic violations and accidents.

We also conducted qualitative interviews with traffic police personnel and paratransit drivers to understand the "ground reality" of enforcement. A comparative analysis was performed to evaluate the "Before and After" scenarios of the Adaptive Traffic Control System (ATCS) implementation. This methodology ensures a holistic view of the system, combining hard statistical evidence with the social nuances of commuting in a culturally rich but geographically constrained city. By focusing on "dwell time" and "queue length," the study aims to quantify the level of service (LoS) provided by the city's current road network.

3. Existing Infrastructure and Road Network Analysis

The road network of Agartala is primarily a radial-circumferential system, though many of the arterial roads lack the necessary width for modern traffic volumes. The city's main spine is the North-South corridor connecting the Airport to the city center, and the East-West corridor connecting the border to the hills.

3.1 Road Classification: The roads are categorized into Major Arterials, Sub-Arterials, and Collector Streets. Most arterial roads have a width of 7 to 10 meters, but the effective width is often reduced to 4 or 5 meters due to illegal on-street parking and street vending. The sub-arterial roads, which penetrate residential neighborhoods, are even narrower, often preventing two four-wheelers from passing each other simultaneously.

3.2 The "Chowmuhani" Phenomenon: In Tripura, an intersection is called a 'Chowmuhani.' These junctions are the vital nodes of the city. However, they were designed for pedestrian and animal-drawn traffic. Intersections like Battala, which serves as the gateway to the city from the south, handle over 4,000 passenger car units (PCU) per hour during peak times. The geometry of these junctions is often irregular, making it difficult to implement standard signaling patterns. For instance, Post Office Chowmuhani and Colonel Chowmuhani are so close to each other that the tailback from one often blocks the other, creating a "gridlock" effect that can paralyze the central business district for hours.

4. Public Transport and Paratransit Ecosystem

Agartala's public transport is unique because it is heavily reliant on paratransit—small, flexible vehicles that operate on semi-fixed routes. While the Agartala City Bus service provides affordable transit, the frequency is low, and the large size of the buses makes them unsuitable for the narrow inner-city lanes.

4.1 The Dominance of Three-Wheelers: Auto-rickshaws and e-rickshaws (locally called 'Totos') are the backbone of the city's mobility. There are estimated to be over 15,000 such vehicles operating within the AMC area. While they provide excellent last-mile connectivity, their sheer numbers cause significant friction. They often stop randomly to pick up or drop off passengers, which halts the flow of traffic behind them.

4.2 Color Coding and Zoning: To manage this, the transport department recently introduced a color-coding system. Auto-rickshaws are assigned specific zones (Green, Yellow, Blue) to prevent vehicles from the outskirts from crowding the city center. This study finds that while this has reduced the total number of vehicles entering the core, enforcement remains a

challenge.

4.3 E-Rickshaws and Sustainability: The rapid rise of battery-operated Totos has been a double-edged sword. On one hand, they provide zero-emission transport; on the other, their slow speed (max 25 km/h) creates "moving bottlenecks" on roads where the speed limit for cars is 40-50 km/h. The lack of designated charging stations also leads to unregulated parking in residential pockets.

5. Smart City Interventions and Data Analysis

The implementation of the Smart City Mission has brought the most significant change to Agartala's traffic system through the Integrated Command and Control Centre (ICCC). The center uses AI-enabled cameras to monitor traffic and manage signals dynamically through the Adaptive Traffic Control System (ATCS).

Statistical Impact Analysis: The following table shows the average wait times recorded at ten major junctions before and after the implementation of ATCS. The data clearly indicates a significant reduction in congestion.

Junction Name	Before ATCS (sec)	After ATCS (sec)	Reduction (%)
Paradise Chowmuhani	125	55	56.00%
Durga Chowmuhani	110	42	61.82%
Battala	160	75	53.12%
Lake Chowmuhani	95	38	60.00%
Fire Brigade Chowmuhani	80	30	62.50%
Post Office Chowmuhani	105	48	54.29%
Colonel Chowmuhani	115	50	56.52%
North Gate	90	40	55.56%
GB Hospital Junction	85	35	58.82%
Radhanagar	100	45	55.00%

6. Challenges and Socio-Economic Impact

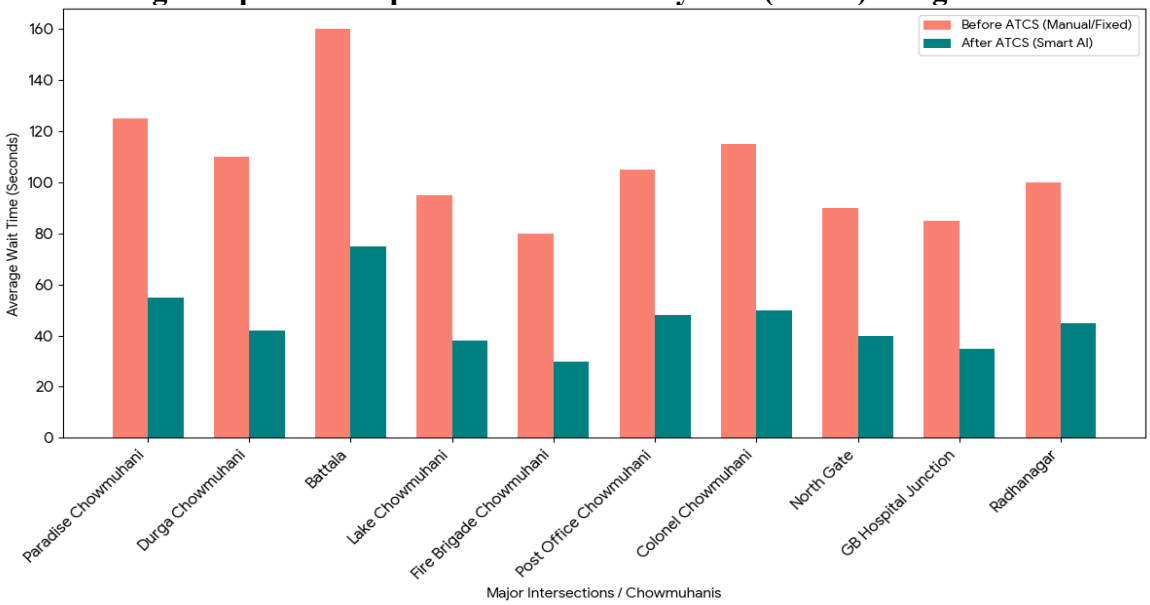
Despite technological progress, several systemic challenges persist that technology alone cannot solve.

6.1 Encroachment and On-Street Parking: A major deterrent to smooth traffic flow is the encroachment of footpaths by permanent shops and temporary vendors. When footpaths are blocked, pedestrians are forced to walk on the road, which significantly slows down vehicles and increases the risk of accidents. Furthermore, because most commercial buildings in Agartala (built before 2000) lack basement parking, owners and customers park on the main road. This "theft of road space" is estimated to reduce the city's traffic capacity by 40%.

6.2 Environmental and Health Concerns: The "stop-and-go" nature of traffic in Agartala leads to high levels of localized air pollution. Idling at signals for long periods increases the concentration of PM2.5 and PM10 in areas like Motor Stand and Abhoynagar. Noise pollution is another critical factor. The cultural habit of "excessive honking" is prevalent at intersections, with decibel levels often crossing 85 dB, far exceeding the 55 dB limit for residential/commercial zones.

6.3 Economic Productivity: The average Agartala commuter spends approximately 45 minutes to 1 hour daily in traffic for a journey that should take 15 minutes. This time loss translates to a significant hit on the city's economic productivity. For businesses, the "logistics cost" increases as delivery vans are stuck in the narrow lanes of the city's central markets.

Fig.1 Impact of adaptive traffic control system (ATCS) in Agartala



The graph reveals that Fire Brigade and Durga Chowmuhani saw the highest improvement, with wait times dropping by over 60%. This is attributed to the AI's ability to detect lane-specific density and clear the "heaviest" lane first, rather than following a rigid timer. However, junctions like Battala still show high wait times (75 sec) even after ATCS, due to the high volume of heavy vehicles entering from the national highway.

7. Conclusion and Future Recommendations

This case study concludes that the traffic system of Agartala is in a state of transition. While the Adaptive Traffic Control System has successfully optimized signal timings, the physical limitations of the road network and the lack of a mass transit system are the primary hurdles to achieving a "frictionless" city.

Strategic Recommendations:

1. **Ring Road Implementation:** The completion of the Agartala Ring Road is essential. This will divert all "through-traffic" and heavy commercial trucks away from the city center, leaving the inner roads for local commuters only.
2. **Multi-Level Parking (MLCP):** The city must fast-track the construction of MLCPs at Battala, Old Motor Stand, and GB Hospital. Once completed, on-street parking should be strictly banned and penalized.
3. **Pedestrianization of Heritage Zones:** Areas around the Ujjayanta Palace and Maharaj Ganj Bazar should be converted into pedestrian-only zones during evening hours. This will promote tourism and reduce congestion in the historic core.
4. **Strengthening Public Transit:** The city needs a "Mini-Bus" fleet that can navigate narrow lanes, reducing the dependency on e-rickshaws for medium distances.

In summary, a "Smart City" is not just about smart signals; it is about smart space management. By integrating physical infrastructure improvements with digital tools, Agartala can transform its traffic system into a model for other medium-sized cities in India.

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