



# Role of 5G Technology in Enhancing the Performance of Smart Traffic Management System (TMS)-Review

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**Abstract:** In most of cities due to rapid urbanisation traffic congestion is very critical problem which also affect economy. So, here is actually a great necessity of smart traffic management system, which can handle the current developing problems in urban traffic management system. So as emerging technology concern 5G network, may be a solution maker platform regarding these all concern. This paper delivers a literature evaluation regarding 5G network technology and its contribution for enhancing urban traffic management. The demonstration of some loop wholes in current traffic management system (TMS) methods and give confirmations about the competences of 5G technology in pertaining vastly competent traffic management system. Through this paper we focus the current potential of 5G network is with respect to 5G enabled traffic management systems.

**Keywords:** TMS, 5G Technology, MIMO, P2P.

**1. Introduction:** In current Scenario of developing word, traffic management emerged as one of the most crucial problems for the urban cities. In continuation of the of development of urban cities the vehicles are increasing rapidly resulting the traffic management problem with more complexity. infrastructure development may be a probable key but it will need more time and effort with respect to cost. in place of making additional lane technocrats give their concerned to one common point to improve the city traffic as designed traffic light and intelligent traffic system [le 2019]. Intelligent traffic light manages the smooth flow of vehicle across the junction of road and provide safe scheduling [Ghazal 2016]. With this concern the world is trying to find the efficient TMS with the use of ICT technologies. The brainy TMS has been strengthening with advancement in wireless sensor network (WSN) and with using less cost and less power consuming sensors. [2]. It is prominent aim of any country now to analyse the present computing, networking and communication technology and make try to provide a optimal system which can improve performance of the road traffic conditions. And apart from this coming scenario of IoT -Internet of Things and cloud resources are also improving parameter of road traffic management system by pertaining automated transport system with use of optimal utilisation of present available infrastructure. [4]. Across the world in approx. every field like surveillance, health, home and industrial automation tiny sensors are used. Entire city can be mapped through a network of such sensors and can gathered every passing minute information with optimal time and cost, popular IPv6 used to allocate tinny nodes with IP address for traffic and localisation system. [12]. With the use of such sensor nodes the Traffic systems can collect real-time data related to traffic status: stream of traffic, traffic congestion, and making classification of vehicles and their counts. [5]. The collected data through these is varied in nature and massive in size. Data science methods as ML can be used for pull out statistics or we can say facts from these large amounts of data. It is well known that Data science methods as ML can make predictions about the stages of traffic congestion in a certain extent of a city. Certain pattern can be derived related to traffic stream and advise dealings that authorities who can make corrective measures to solve the problems of traffic control. A smart TMS may be fruitful only when all its components working and communicating in synchronise manner with each other. Through this paper we present a Smart Traffic Management System (TMS) which can provide all traffic correlated difficulties in a smart city. Our proposed review can advocate an optimal route in which travel time, travel cost and travel distance. Can be taken into account. This model can depict the various levels of congestions at different time elapses with the use of Data Science algorithms as ML can forecasts stages of traffic congestion at numerous time intermissions. With real time for casting, we may create green corridors for emergency vehicles. Various studies say about theoretical and potential of 5G network to

enhance the traffic, especially traffic light system. 5G network may improve the urban traffic by optimised arrangement between link and infrastructure as well as traffic light system.

**2. Founded Major problems:** With rapid change of technology various problem and challenges have been developed into metro traffic managements system. Various authors focused common raised problem like real time traffic status and its perceptions, low latency, communication, less efficient traffic prediction and unavailability of real time response. Ning, Huang [2019] Projected some major issues in smart traffic management system that is presented through table 1. The column of table expresses the reported papers and second column represent the issues reported.

**Table 1. Founded Major Problems**

Major Problem's	Reported Papers
[2] [6] [7] [11] [12]	Lack of traffic prediction
[2] [3] [11]	Real-time responsiveness
[7] [16] [17]	Communication over road network
[2] [7] [13] [14]	Ultra-low latency contest
[2] [3] [7] [11] [12]	Less efficient real-time traffic condition perception

### 2.1 Less efficient real time traffic status and its perceptions:

One of the most common issue current smart traffic management systems is lack of real time status of current traffic reported by Le [2019] Some other author Zang Le [2020] reported that lack of synchronised communication with current traffic status in instant time response will affect traffic management. Lieu [2020] projected that such problem may provide low integration with low intelligence in smart TMS. Zang Le [2018] given some solution like high resolution traffic infrastructure having road side and on road sensors that can detect real time conditions of traffic like position of vehicles and their speeds and per unit time passing traffic. but on the other hand, these solutions are not cost-efficient in implementations and its maintenance will also have adequate cost.

### 2.2 Communication over road network

Present traffic management system has less facilitated with free communication over road network sated by Zang [2019] Some author also stated that there is less efficient communication among smart devices in context with traffic infrastructure and in range vehicles influences the network and required communication in smart TMS for making smart cities. Wireless communication is most important part of smart traffic and it is unavailable in continuous communication and coordination between vehicles, specially at junction and cross sectors when a number of vehicles coming into same directions.

### 2.3 Ultra-low latency contests:

Most demandable and important factor now a days in real time TMS to develop smart cities is to achieve ultra-low latency. Lang [2017] stated that various sensors sued in smart traffic management system has variable speed of data processing in accordance with bandwidth. So, it deemed to be limitations and need more improvement and development. Niang [2019] also stated device to device communications and vehicle to vehicle communication is always affected due to intermittently synchronisations in network connecting in context to ultra-low latency in signal transmissions.

### 2.4 Lack of traffic prediction:

Conventional traffic management system is not capable for real time traffic predictions as traffic light were not dynamic as they have only fixed time slot given by management system so it does not consider traffic flow [ghazal et al 2016]. Traffic management system is static in nature it has no adaptation capability according to the flow changes traffic stream and at time of congestion real time forecasting system of traffic lights may lead to make smart traffic management system.

### 2.5 Real-time responsiveness:

Current traffic need is real time responses from various component in traffic network in smart traffic control system mentioned by Le et al [2016]. Real-time responsiveness provide capacity to traffic system to monitor and real traffic

status with events in traffic management system. The information of congestion does not retain more than one hour and does not give direction about congestion to vehicle coming toward congestion point. hence real time responsiveness declares major concern before making smart traffic management system stated Liu et al. (2017). Therefore, real-time responsiveness is most important parameter to attain efficient traffic management.

### 3. 5G technology as a solution for Key persisting issues:

**Potential wireless technology may play a major role in making smart traffic management more and more fruitful. Various authors [ Ni et al. 2019; Gupta et al, 2015] presented discussed different technology having good potential in context of making traffic management more efficient are:** such as Peer-to-Peer (P2P) communication, millimetre waves, massive-MIMO, small cell, and beamforming.

#### 3.1 Peer-to-Peer (P2P) communication:

5G network has given tremendous improvement in peer-to-peer communication traffic management system. Intelligent devices and set-ups are capable to communiqué with separately other in P2P communication simultaneously as not necessary requirement communication-based infrastructures like access points and base stations [Shen, 2015]. Furthermore, Shamganth and Sibley (2017) presented as from starting peered centred technology was the major concerned in 5G technology resulted that network data process is executed by the devices used in network. Hen, this method was attained by P2P communiqué. So, in this way P2P communiqué in 5G technology networks may have major chances to improve smart traffic management system capacity, enhanced spectral efficacy, improved throughput, adequate decrement in latency.

#### 3.2 Millimetre Waves:

Millimetre-wave lies between frequency bands ranging from 30 GHz to 300 GHz. Various authors, technocrats and Federal Communications Commission (FCC) states that such waves have excellent potential which can provide high speed troupe and several research groups from variously domains recommend that the millimetre-wave attitude noteworthy proficiencies that empower a high speed (Gbps) throughput. So, millimetre waves have large amount of unused spectrum which can provide high speed data rate and adequately reduced low latency communication and flexible communication to all types of users. Akyildiz et al 2016 stated that millimetre wave can provide high speed data transmission that can deliver data to smart devices up to 1 Gbps speed.

#### 3.3 Massive-MIMO:

Alternatively Massive-MIMO counted as good solution for persisting problems using 5G technology networks (Akyildiz et al., 2016), MIMO produce and empowers the longitudinal dimension of communiqué between the base station and moving units through the use of numerous antennas is stated by Le et al (2019). So, this fact declares that the Massive MIMO or “large-scale” MIMO are intends to achievement all of the profits of MIMO but as on large level of scale (Larsson et al., 2015). Generally, massive-MIMO is rapidly changing technology in the 5G technology network that can premeditated to optimized energy and band securely and strongly. Additionally, massive-MIMO pertains numerous benefits when using the 5G technology network such as increment in spectral efficacy, adequately reduced communiqué latency, and billions of devices can be used in real time response manners.

#### 3.4 Small Cell:

5G network provide small cell technology networks as most emerging technology as a solution for traffic network (Yang et al 2017). Main objective of small cell network is to provide expansion of 5G network in term of volume and efficacy by decreasing the middling remoteness from the source to the destinations. Furthermore, the learning of Chen et al. (2016) projected that small cell network enhanced the computational power of 5G network and strengthen the transmitter capacity of base station in 5G network. Consequently, by the use of small cell technology, the 5G network may have the capability to come up with speed of 1 Gbps to 10 Gbps, resulting can provide high data rate transmission at highest busy time.

#### 3.5 Beamforming:

In 5G network technology Beamforming plays major role in traffic-signalling system for cellular base stations. To find most efficient path from source to destination and shrinkages any probable interruptions in the network for each adjacent in traffic signalling process is the major task of beamforming stated by user The main purpose of beamforming in (IEEE Spectrum, 2017). This technology focused on various types of problems in current network system. For example, certain object may easily block the mobile signals resulting this may weaken down the strong signal over long distance. For this persisting problem in place of broadcasting the signal in any direction, beamforming technology played an

empowered role by considering the signals on specific location and direction of the points for user where no interruption may arise [IEEE Spectrum, 2017]. In this way beamforming technology can create a clear path to specific device by reducing the interference. So, with advent of beamforming and supplementary above mentioned of major 5G technology network, it is desirable to have strong wireless network where various devices and technologies like smartphone, Augmented reality and Virtual reality, autonomous vehicle may enjoy in full swings. Due to countable benefits form 5G network technology various researchers and technocrats counted high expectations such as ultralow latency and never before data transmission speed that can handle the persisting problems and tests in smart TMS.

**Table 2 key requirements empowering solutions of 5G technology**

Empowering solutions	Necessities	Specifications
Millimetre Waves, Massive MIMO	High Data Rates	Up to 10 Gbps high data transmission rate at highest busy time
P2P, Millimetre Waves, Small Cells	Low latency	Very low latency up to 1 ms end to end
Massive MIMO	High Scalability	May contain up to 50 billion devices
P2P, Beamforming, Small Cells	High Connectivity	Highly-rated improved connectivity for cell -edge users

table 2, depicted the permitting significant technology solutions of the 5G network and its requirements in order to achieve highly rated efficient traffic management. 5G technology containing major key technologies are able to handle in optimal manner all the motioned commonly reported problems and challenges in section 2 of this paper in the current smart TMS such as deficiency of real-time traffic status and its sensitivities, ultra-low latency encounter, less efficient traffic predictions, and lack of real-time responsiveness. For illustration, massive-MIMO and millimetre waves technology of 5G network can provide real-time traffic status and its perceptions, as they can pertain high data rates up to 10 Gbps at highest busy time that can help out to achieve real time communication and perception. furthermore, ultra-low latency problem in smart traffic management can now be able to handle through P2P communications, millimetre waves, and small cell, Further high scalability real traffic prediction is attained with the capabilities of Massive MIMO as this technology has capacity to contain up to 50 billion devices including smart traffic infrastructure and smart vehicles.in continuation P2P , small cell and beam forming technologies in 5G are able to handle the real-time responsiveness problem in smart traffic management and they are also able to pertain high connectivity for edge users.



Table 3. 5G network as compared to other approaches:

Required Features	Traditional Solutions	VFC	C2C	ATSC	SDN based	5G Network
Computational Efficacy	Good	Lesser	Good	Lesser	Lesser	Lesser
Latency	N/A	Lesser	Medium	Lesser	Lesser	Ultra-Low
Deciding	Centralised and resident	Distributed and resident	Distributed and remote	Distributed and remote	Distributed and resident	Distributed and remote
Implementation Cost	High	Lesser	Lesser	Medium	Lessor	Lessor
Communication	Bandwidth Constraints	Real time	Bandwidth Constraints	Real Time	Real Time	Real Time
Reliability	N/A	Lesser	High	Medium	Medium	High
Optimality of Resource Use	Resident	Resident	Resident	Resident	Resident	Universal
Flexibility Management	N/A	Rigid	Easy	Easy	Average	Easy

Above table described that the outdated traffic management approaches have a restricted offer in terms of services. Additionally, P2P communiqué has bandwidth-inhibited which distress communiqué. But to accomplish low latency is a crucial point in P2P. Moreover, the ATSC strategy achieves few wanted structures, though, the ATSC is dealing with enormous tests in phrases of trustworthiness aside, the positioning fee for ATSC is incredibly greater as in contrast to the different approaches. VFC on the different hand was once going through challenging tests in phrases of agility managing. Clearly 5G technology networks satisfy most of breaches and obstacle into the diverse traffic optimization methods and tactics by attaining most of mentioned noteworthy qualities in table. Hence, as stated by Liu et al. [2017], these features are mandatory to be in smart traffic monitoring apparatuses to highly rated efficient TMS. Consequently, modern and intelligent traffic management system has all the capabilities to create a new era of the TMS by the use of 5G technology network.

In few past decade various traffic optimizations tools and tactics have developed for making solutions to the problems and challenges in the prevailing TMS like the outdated traffic lights. In spite of advent of these methods, these methods have also some limitations that pointedly disturbs their efficiency. Consequently, some of the noteworthy problems and challenges still play role of obstacle to achieve highly-efficient smart city traffic management. Nevertheless, 5G network technology emerged as break through solutions may possibly resolve these problem and challenges. When 5G is in contrast to the different tactics, it indicates that the 5G community has huge potential, rewards, and skills for urban TMS. Thus, the development of the key techniques on 5G networks such as P2P, millimetre waves, large-MIMO, small cell, and beamforming reports the troubles and necessities in accomplishing adequately-intelligent TMS. Additionally, 5G key technology network provide flexibility whenever it is cohesive into variously traffic management mechanisms. For this occurrence, it is crystal clear that 5G technology network defiantly emerging as a novel means to delivers an intelligent TMS resolution.

**Conclusions:** In smart city development smart traffic management is key domain of research in order to make smart Traffic management system. This research domain can provide the current persisting problems and to traffic management of smart cities. With the advent of 5G network is the most emerging network technology these days that that is capable to fulfil the gaps and breaches in the existing traffic management system. Nevertheless, notwithstanding the progress, the appreciation involving the 5G network as an achievable and shrewd answer for city traffic congestion is presently limited. Therefore, in this paper, we discussed of the up-to-date in 5G technology network and TMS. Firstly, the we studied the various problems and challenges in the present urban TMS; secondly focused on various resolutions for intelligent traffic handling systems, along with the persisting problems and at the end discussed how the 5G network pertains a smart TMS.

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