# Issues in Wireless Sensor Networks for Intelligent Transportation System

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***Abstract*** – **The Intelligent Transportation Systems (ITS) application uses wireless sensor networks, which are made up of small sensing devices with low power and low cost that are also equipped with processors and memory. These networks, along with limited wireless network communication, have transformed external transportation networks into the in-vehicle and roadside traffic transportation infrastructure through advanced communications and computing technologies. Through cutting-edge applications like electronic toll collecting works, wireless sensor networks for ITS technologies have increased the mobility, safety, dependability, security, traffic, parking management, and reliability of the transportation network. ITS can use real-time traffic data to address the issue of increasing road traffic. Traffic system planners can efficiently manage traffic by creating alternate routes in reaction to accidents or road closures thanks to traffic data such as speed and volume of traffic. In this work, we examine and talk about a few of the privacy, security, and safety-related difficulties that arise while creating an intelligent transportation system. Several remedies are offered in response to potential issues like as tampering, criminal activity, car and tracking system safety, and unauthorized access to the system.**

***Keywords: Wireless sensor networks, sensor node, intelligent transportation systems, ITS Issues***

## I. INTRODUCTION

Recent years have seen a tremendous increase in academic research and industry growth in intelligent transportation systems (ITS) due to the rapid development of modern sensing, communicating, analyzing, and computing techniques and devices. These advancements have a profound impact on all facets of our lives, providing safer, more convenient, and smarter transportation facilities and vehicles. But rather than exhibiting the predicted intelligence, ITSs nowadays have shown a high degree of social complexity, which has left many long-standing problems unresolved or even worsened. This is due to the ecosystem's ever-increasing diversity, uncertainty, and complexity of behavior, mechanisms, and strategies.

The development of a sustainable, intelligent transportation system has been made possible by advancements in information and communication technologies (ICT) in fields like communications, software, and hardware. A better, safer travel experience and the transition to Intelligent Transportation Systems (ITS), which are based on four key principles—sustainability, integration, safety, and responsiveness—will be made possible by the integration of ICT with the transportation infrastructure.

These guiding concepts will be essential to accomplishing the access and mobility, environmental sustainability, and economic development that are the primary goals of the Intelligent Transportation Systems.

Intelligent Transportation Systems (ITS) based on wireless sensor networks (WSNs) are small in size, low maintenance, low power consumption, and extremely inexpensive to acquire traffic-related data that can be utilized to automatically generate security alerts at vulnerable areas on the road network. There is a picture on recent ITS challenges and WSN-based difficulties. The economics, human health, parking, and environment are all severely impacted by traffic congestion and the high rate of accidents that occur in urban areas. After delays, it becomes more challenging to pinpoint the reasons or project arrival times. Congestion and traffic are a growing challenge for the motor vehicle transport system. It becomes quite difficult to prepare for optimization and development when a well-deployed screen structure is absent. By tracking traffic patterns and analyzing them to deliver relevant information to bus operating authorities as well as travelers, the operations of intelligent transportation systems can be significantly enhanced. Security issues brought on by the ITS's developing trend toward centralization are one serious concern. The majority of data, analyses, and decisions are processed by centralized authorities or cloud-based platforms, which are referred to as ITS, thanks to rapidly developing technologies like cloud computing and the Internet of Things (IoT).

## II. ITS APPLICATION: REQUIREMENT CHALLENGERS AND ISSUES

This section introduces WSNs as distinct from other sensor networks and surveys various ITS methodologies. Although the majority of ITS technologies have been successfully implemented in industrialized nations, there are significant obstacles to putting these cutting-edge technologies into practice, some of which are given below. WSNs improve safety and fuel efficiency to make life better by cutting down on travel time and causing less traffic in cities. There are some major concerns and challenges with ITS that will be highlighted.

a. *Base station:* Base stations have a single sink, even if they are connected to the majority of sensor nodes; requirements and applications may vary depending on the number of sinks. WSNs should be able to support multiple sink nodes or base stations with intelligent transport systems.

b. *Coverage and connectivity in ITS:*. In terms of intelligent transport system requirements, ad hoc wireless sensor networks fall into two distinct groups. The intelligent transport system (ITS) plays a crucial role in sensor deployment, particularly with regard to the degree to which each point in the sensing area is covered. However, because of source limitations, traffic, parking management, and environmental conditions, a creative development plan was created to reduce costs, power consumption, computation, node-to-node or point-to-point communication, and computation, as well as to increase coverage area. This is a necessary function for WSN applications, which can be quantified in terms of coverage area. For its use, precise measurements of resourceful coverage that affect system performance as a whole must be defined.

c. *Traffic incident:*. When an issue occurs, Traffic Management notifies the local media, who then broadcast on local public television. We also suggest making public announcements through the local police department, the urgent situation management offices in the region, and the governments and agencies in metropolitan areas. Even if the service is free, make sure to inquire about any costs from your specific cell/pad service provider. Locations that are displayed in the notifications are included in incident single notifications.

d. *Traffic congestion:* Congestion on the street arises from increased usage. It is distinguished by slower moving traffic, longer travel durations, and longer lines of cars. There are three main causes of traffic congestion. Counting the number of vehicles on a road stretch is the first step towards solving the problem. By informing the departments of road planning, traffic management, and drivers on current traffic conditions using just traffic patterns, ITS reduces traffic congestion. The least congested roads can be used to design a driver's alternate route. Town planners can design more effective road networks and traffic management with the use of intelligent transportation systems.

e. *Freeway Management System:* The Intelligent Transport Systems (ITS) and technology created by the Traffic Techniques Coalition enable the provision of highway Management Systems, which promote the safe and effective operation of a regional highway network. sensors positioned on the road that record data on the axle loads, gross weight, speed, and classification of vehicles.

f. *Reliability:* Given the information obtained, a sensor-based intelligent transportation system must make numerous important judgments. Thus, an unexpected system behavior may result from a missing data packet. Reliable communication protocols are necessary because of the challenging environmental conditions and wireless link failure modes, which increase the likelihood of connectivity failure.

g. *Security:* Security is crucial for wireless sensor networks because there are numerous security concerns with these networks when it comes to ITS and other applications. The majority of the wireless sensor network's significant applications remain unattainable. The opponent can capture a sensor node quite easily. It is relatively easy to read out the sensor node's memory. As a result, a single occupied sensor node has the ability to take down a wireless sensor network. On the other hand, sensor nodes communicate individually over radio. Relatively easy eavesdropping or revision by others revealed the messages. There are numerous attacks at the network layer [5] [6]. To preserve the communications and establish a trust structure, the safety routing protocols need employ some cryptography.

h. *Real-time:* Developing practical and effective long-distance door-to-door information systems requires the use of integrated, real-time systems. Well-publicized, readily available real-time information is necessary for seamless planning and communication transitions. More sophisticated metadata is starting to appear for the primary problem of fusing disparate databases, which makes coalition data sources easier and less expensive. Around the world, numerous initiatives have been launched to develop transportation ontologism. Application of intelligent transportation systems. In the technique, a static sensor node that detects the arrival of a vehicle activates the next static nodes in order to determine the state of the ensuing sections of the road.

## III. ITS SECURITY AND PRIVACY CHALLENGES

The three most challenging issues are ITS, security, and privacy; privacy should be investigated in addition to security. Each and every ITS member ought to be verified. Similar to this, each beacon needs to be confirmed in order to lower the possibility of privacy and security breaches in ITS. The location and true identity of an ITS user are protected by ITS vehicle privacy. False identities serve to satisfy security and privacy needs. Because of its wireless nature, high speed mobility, dynamic topology, sparse and crowded scenarios, and susceptibility to attacks when separated from other ICT-based networks, ITS are vulnerable to several forms of attacks. It is impossible to accomplish the goal of ITS, and sincere ITS users may make mistakes. An ITS vehicle should be removed from ITS if it is found guilty. There should be proper security and privacy approaches for registration and revocation of vehicles. Security and privacy issues are mainly categorized as feature, attacks and challenges as shown in Figure1. These issues are given in details as follows:

a. *Confidentiality:* This function makes sure that data is only accessible to authorize ITS users. Unauthorized users cannot intercept or impede the data. During the stages of registering and receiving a pseudonym, confidentiality is a crucial service provided by ITS. Therefore, maintaining ITS confidentiality is crucial. Thus, sophisticated cryptographic methods must to be taken into account.

b. *Integrity:* Integrity ensures that messages are delivered precisely. Integrity in ITS is crucial because

distorted or false communications have the potential to mislead sincere ITS users. Integrity prevents anticipated or unanticipated interruptions in communication. It is necessary to create robust security systems in order to achieve fair integrity in ITS.

c. *Availability:* This ITS feature ensures that authorized ITS users can always access the servers and data. Real-time ITS services are required. So, the availability feature must to be taken into account. The most serious risk to ITS service availability is an attack. In order to guarantee availability, ITS should take additional security measures into account.

d. *Identification:* This function helps prevent unapproved ITS vehicles from being connected to an ITS. Every ITS is identified. As a result, efficient methods for vehicle identification must be designed and developed.

e. *Authentication:* Using authentication, you may make sure the messages you receive are real. Nonetheless, ITS authentication can be performed without disclosing the vehicle's true identity. Effective strategies are required to address this characteristic.

f. *Non-Repudiation:* This function makes sure that the parties involved in the communication are unable to retract their earlier exchanges. A non-repudiation element must be taken into consideration to prevent hostile attacks in ITS.

g. *Privacy:* An ITS privacy feature ensures that the anonymity can only be controlled by authorized servers. Encrypting data is the goal of confidentiality, whereas privacy makes sure that communications or data cannot expose someone's true identity. The most crucial component of an ITS is the legal vehicle's privacy. It is imperative that security and privacy procedures be designed and developed in order to prevent tractability of an honest information technology user.

h. *Trust:* Trust can ensure that the previous security and anonymous communication features are carried out throughout the exchange of ideas between different entities. The aspect of trust in ITS that is achieved during the exchanges between different entities. Applications and entities can be classified according to their level of trust in ITS.

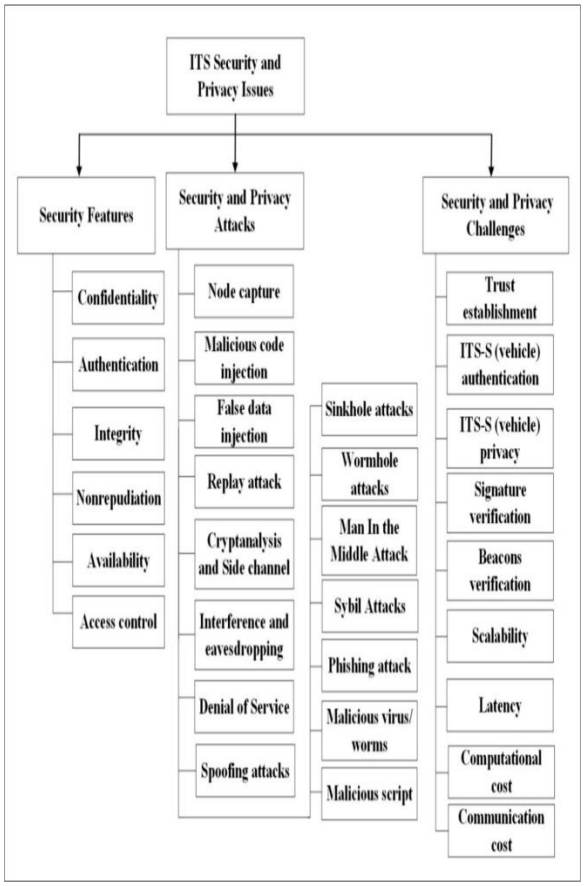


Figure 1: ITS security and privacy

## IV. INTELLIGENT TRAFFIC MANAGEMENT SYSTEM

In order to improve mobility, dependability, security, and road safety, infrastructure connected to intelligent transportation systems must be provided by the government and road agencies. Highways operate on a different system than other types of roads. Following are some ITS systems that are related to infrastructure.

a. *Lane management:* Dedicated lanes for trucks, busses and High-Occupancy Vehicles (HOV) are commonly used in the developed world to improve the road system

b. *Incident management:* Incidents have a negative impact on the traffic flow handling of a road. Improved incident handling measures can limit factor of an incident. In predicting the danger of an incident will also help to clear the incident earlier

c. *CCTV cameras:* Closed Circuit Television (CCTV) cameras receive video or photo shots of before identification condition. The universal plan is to smoothen‘traffic flows. Virtual loops are often used to analyze video material automatically

d. *Traffic control:* Traffic controllers are used to regulate traffic flows at intersections

e. *Parking management:* Parking management systems, based on direction finding systems, provide drivers

with information regarding the availability of parking space and display system

f. *Real-time information systems:* real time information system use collected data by traffic management centers or transportation agency to inform road users of incidents, traffic police, emergency phone call and delays

g. *Weight in Motion (WIM):* These systems are currently used in India, under which technology assists to Checking up trucks with regards to overloading

## V. CONCLUSIONS

There are difficulties and problems with wireless sensor networks for intelligent transportation systems that affect various ITS features. In order to meet ITS standards, systems and services related to fuel consumption, safety, security, on-road and in-vehicle entertainment, traffic management, and/or effective passenger transport must be used. To lessen the problems associated with transportation, information exchange standards between public institutions, transportation operators, and ITS providers should be developed and put into place. Scalability, security/privacy, computing cost, latency, and communication overhead are taken into account when evaluating the security and privacy systems in ITS. A single framework is necessary due to the device's growing complexity, which includes both hardware and software, as well as the variety of safety and security-related scenarios that may occur. Future work will mainly focus on defining such a framework, and proactively implementing it in future versions of our system.

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