The main features of the creation and operation of the service band of the ITS integration platform

Oleg Pilipets[1*]

[1] Don State Technical University, 1, Gagarin Sq., 344003, Rostov-on-Don, Russia

Abstract: This paper outlines the main structural features of the creation and development of the service lane of the integration platform of the intelligent transportation system (hereinafter referred to as ITS), as well as the main aspects of the functioning of the service lane of the ITS integration platform. The main purpose of this article is to conduct analysis in the context of integration and development of the service lane of the ITS integration platform in the transport complex of Russia In this paper the decomposition analysis of the components of the ITS service lane is carried out in the context of its application within the framework of the ITS integration platform, and the key existing approaches in the field of structuring intelligent transportation systems, which are the key indicators (criteria) of qualitative and effective development of all spheres of the economy, both at the level of the Russian Federation and the Eurasian Economic Union. This study is limited to the scientific field of intelligent transport systems, ITS standardization. The methodological basis of this study is analysis, inductive analysis, as well as synthesis.

1 Introduction

Intelligent transport systems (ITS) are one of the main elements of transport infrastructure that are essential for improving safety, reducing traffic jams, reducing travel time, and improving the comfort and efficiency of the transport system as a whole. ITS development is proceeding at a high speed, primarily due to the emergence of new technologies such as the Internet of Things (IoT), cloud computing, artificial intelligence (AI) and machine learning (ML).

One of the notable trends in the development of ITS is the increase in the level of automation of the traffic flow. In particular, automation of the traffic management process improves road safety, reduces the cost of maintaining transport infrastructure and increases the efficiency of using road space. In addition, information technologies are increasingly being introduced in ITS, which improve the quality of user service, strengthen control over compliance with traffic rules and reduce travel time.

Considerable attention is also paid to the development of "smart" transport networks to optimize the flow of goods and passengers. This includes the use of various traffic

* Corresponding author: pilipec.oleg@gmail.com

management methods and systems that, based on data, ensure more effective coordination of traffic flows on roads, airports and seaports, which reduces the time spent on transporting goods or passengers.

However, the development of ITS also involves several challenges and problems that need to be addressed. First of all, it is ensuring the security and protection of users' personal data, improving the performance of the system when scaling and expanding it, as well as limiting the negative impact on the environment. [1]

The current stage of society's development, the peculiarities of the introduction of economic models and mechanisms have a pronounced trend towards "compression" of space, which manifests itself in an increase in population concentration and, as a result, economic activity in urban agglomerations. In this regard, the issue of creating and developing a service lane of an Intelligent Transport system is being updated, coupled with the issue of widespread implementation of the ITS integration platform, especially for agglomerations.

The task arises of creating a unified and standardized way to create both a service lane and an ITS integration platform, while the ways to solve this problem, as well as the ITS sphere itself, are in the plane combining the industrial, economic, socio-infrastructural and regulatory spheres of activity. Taking into account the identified problem and current trends, the relevance of traffic monitoring of the road network in the context of the functioning of intelligent transport systems (ITS) seems high. [2]

2 Materials and methods

In this study, the main method used to obtain the results is data analysis and decomposition. When analyzing the components of the integration platform and the functional features of the ITS service band, we used the official sources listed below.

In addition, this study provides an analysis of existing data flows and the formation of proposals for structuring, streamlining and unifying information flows in the context of improving the efficiency of using software for the ITS service band, in the context of using the ITS integration platform. [3]

This article suggests one of the possible options for the structure of data flows, which can be used to create methodological recommendations for structuring data flows within the ITS integration platform, to increase the level of optimization of the use of ITS service breakage. Using this approach, it will allow you to analyze big data in streaming mode (online) and also to monitor transport and predict the possibility of congestion and traffic accidents.

However, it should be borne in mind that, when working out the principles of creating such systems, it is necessary to be guided by normative legal acts and agreements, which can be expressed both in mandatory requirements and in a pre-structured action plan for a particular field of activity. [4]

3 Discussion

Due to the fact that the optimization of the management of the transport complex through ITS should be implemented and implemented through the introduction of technologies for organizational management of the transport system using modern information, telecommunications and telematics technologies, the basis of the service lane of an intelligent transport system (ITS) should be formed on the basis of several factors and components. [5]

Thus, the following main components of the formation of the service lane can be distinguished within the framework of the functioning of the integration platform of the intelligent transport system:

First of all, in order to create a service lane and its subsequent effective functioning within the framework of the functioning of the ITS integration platform, an appropriate infrastructure is required, including sensors, cameras, road signs and other equipment, the above components collect data on the condition of the road, traffic and other parameters. In more detail, it is possible to characterize the necessary infrastructure for the creation of a service lane of an intelligent transport system (ITS) with the following features:

• Sensors and detectors. Installing sensors on roads is a key component of any ITS, the principles of operation of sensors and detectors can vary: motion sensors, speed sensors, car presence sensors, traffic sensors and other types of sensors. At the same time, the number of sensors must be calculated based on the results of preliminary traffic monitoring in a particular transport area. Data on the state of the road and traffic flow should be collected on a regular basis.

• Cameras. The function of monitoring traffic and collecting visual information, including the function of detecting transport through the use of image recognition software, as well as the implementation of the functionality of the subsystem for monitoring and supervision of transport are assigned to cameras located within the framework of the UDS. The principle of calculating the number, as well as the location, is common to sensors (detectors) and cameras.

• Communication systems. The transmission of data from sensors (detectors) and cameras to the ITS integration platform, necessary to change the ITS management mode (regular, freelance), is a priority for the functioning of the communication system. In essence, the communication and communication system can be implemented through both wired and wireless networks that provide real-time data transmission.

• Information boards and communication systems with drivers. This component is designed to provide drivers with quick and convenient information about the current state of the road, traffic jams, recommended routes and other data. In addition, mobile applications or navigation systems in cars can be used to communicate with users of the road network and the road network. All these infrastructure components work together to create ITS service lane, which ensures more efficient use of the road network and improves road safety.

The integration platform in this system is a control center, providing all participants of the organization, ensuring road safety, as well as government agencies responsible for ensuring the safety of highways with the necessary information and traffic management tools. Data from sensors (detectors) and cameras are processed and analyzed, algorithms offer solutions to individual problems, as well as form recommendations for optimizing traffic flows.[6]

As part of the functioning of the ITS integration platform, all data on traffic flows, speed, traffic density, the presence of accidents and other events are collected. It should be noted that data collection for decision-making within the framework of ITS management is carried out using various sources:

• Sensors and detectors on the roads. Sensors (detectors) collect information about the condition of the road surface, traffic density, speed, presence of obstacles and other parameters. These can be motion sensors, inductive loops, radars, or other types of sensors.

• Surveillance cameras. Cameras located on roads and important sections capture visual information about car traffic, road conditions and other events. They can be used to detect traffic jams, analyze driver behavior, and recognize license plates. In addition, cameras can duplicate the functionality of sensors and detectors, thereby providing the possibility of operational control in case the sensor or sensor circuit is not functional.

• Mobile applications and navigation systems. Mobile applications collect data on the movement of users, navigation systems, depending on whether they are mobile applications or integrated into the car, can collect information about the technical condition of the car and the driver's condition, this data can be used to analyze traffic flows, determine popular routes and provide recommendations to drivers.

• Fare payment systems. Electronic tolls or automatic fare collection systems can also provide traffic data, they can be used to analyze traffic flows and determine traffic density on various sections of the road.

• Public transport systems. Data on the movement of public transport, such as schedules, delays, number of passengers and other parameters, can be used to analyze the traffic flow and manage the mobility of citizens on demand.

• Traffic light control systems. Traffic light status information such as signal duration, switching periods, and signal coordination at different intersections can be used to analyze and optimize traffic flows. In addition, the traffic light control system is one of the traffic management tools.

ITS integration platform accumulates data from various sources, performs processing and analysis. The algorithms determine the optimal options for traffic management, traffic light regulation, warnings about possible traffic jams or accidents, ensuring priority travel, as well as other functions provided by the existing subsystems of ITS. In this case, the Intelligent Transport System Management Center (ITS), as well as the integration platform, plays an important role in collecting, analyzing and managing data to optimize traffic flows.[7] There are a number of key aspects of the functioning of the ITS integration platform:

1. ITS platform should be able to integrate data from various sources, such as sensors, cameras, public transport systems and others, which will provide the most complete picture of the road condition and traffic flows.

2. Data analysis should be carried out by equipment having the necessary characteristics to generate algorithms and use analytical tools for processing and analyzing the collected data. Algorithms can be used to identify traffic jams, predict traffic, optimize traffic lights, and provide recommendations to drivers.

3. Decision-making should take place in real time based on data analysis, which will allow responding to changes in traffic flow, the state of the road network and taking measures to optimize.

In particular, at the moment, the strategic task of managing the transport mobility of the population is to increase the capacity of the already formed sections of the UDS. ITS services are the first stage towards the emergence of a high–tech level of ITS development, while the emergence of ITS services is associated with the development of vehicle automation and optimization of transport complex management and is based on the function of user connectivity to the services platform.

Optimization of the management of the transport complex through ITS should be carried out through the introduction of technologies for organizational management of the transport system using modern information, telecommunications and telematics technologies, while the expression of this set of criteria in the structure of ITS is an integration platform.

4 Conclusions

Thus, the features and structural patterns presented in the work allow us to determine the structure of the service band and ITS integration platform for further unification and standardization of the application of these structures. At the same time, the study identified problems, in particular, among others, the problem of duplicating the description of the ITS structure can be highlighted.

The data structure given in the study allows you to visually identify the necessary data flows that can be sent to the integration platform, which will increase the efficiency of ITS application. In this context, the system's performance, provided by a high level of data unification and structured information flows, makes it possible to make effective and timely decisions aimed at reducing the time of one trip, reducing the level of accidents, and reducing the load on the road network.

The continuous improvement of intelligent transport systems and the expansion of the list of functions implemented by them will reduce the risks arising in the process of traffic to a minimum. The increasing number of vehicles, people, the constant increase in the length of the road network, federal, regional, intermunicipal, local public roads, in conditions of an ever-increasing amount of data, it is necessary to structure and analyze large amounts of data. Such circumstances imply the involvement of a large amount of computing power, as well as equipment that will allow traffic monitoring in order to assess existing risks. The use of modern big data tools and machine learning is the tools that will need to be operated on in the near future at the level of the entire transport sector.

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References

1. Zyryanov V.V., Semchugova E.Yu., Skrynnik A.M. *Application of information technologies in improving mobility and ensuring transport safety* Engineering bulletin of Don. 2012. **№4.** 1.
2. Zyryanov V. V., Semchugova E. Yu. A. *Improving the efficiency of urban passenger transport management in Rostov-on-Don* Vestnik SSTU. 2013. **№2** (71).
3. Lazutin Y. M., Chertov G. A., Rodikov A.. V., Rogozhkin V. A. *Methodology of data flows construction in complex hardware-software complexes* Software Products and Systems. 2011. **№4.**
4. Egorov, S.V.; Shatsionok, P.V.; Erpyleva, A.I.; Zharkov, D.I. *World and Russian experience of intellectual transport systems application* /TDR. 2022. **№2.**
5. Minnikhanov R.N., Dagaeva M.V., Makhmutova A.Z. *Its Development: United Digital Platforms For Safe Management Of Transport System* Journal "Road Safety". 2022. **№3.**
6. Titov A.E., Chebyshev A.E. *Approaches to the assessment of readiness for digital transformation or digital maturity of the sphere of road traffic organization in a region* Russia: trends and prospects of development. 2022. **№17-1**.
7. Solodkiy Alexander Ivanovich DEVELOPMENT OF INTELLECTUAL TRANSPORT SYSTEMS IN RUSSIA: PROBLEMS AND WAYS OF SOLVING THEM. NEW STAGE // Intellect. Innovations. Investments. 2020. **№6**.