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The Project of Intellectual Multimodal Transport System

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Abstract

The article present ways to design and develop intelligent multi-modal transport system capable of improving the safety of citizens, society and the state, protect their interests from the various types of threats. Its architecture is described herein which ensures implementation of main functional elements, strategic model of the telecommunication subsystem of the motor transport mode (as a component of the intellectual transport system). Architecture of the road subsystem to manage the intellectual multimodal transport system is described in detail. Its design and implementation are able to improve functional efficiency, general service quality, level of ensured safety and environmental functioning of both the Russian and international transport systems.

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Keywords: Safety, vehicles, transport infrastructure, information telecommunication system, Intellectual multimodal transport system.

1. Introduction

Transport safety of the Russian Federation means "the state of transport infrastructure and vehicles protection against acts of unlawful interference" (Federal Law "On Transport Safety" FZ-16 of 09.02.2007). The system of transport safety ensuring is regarded as a totality of functional subsystems [Asaul (2013)]: prevention of any and all dangers, counteraction and suppression of crime, including terrorism; prevention of natural and technogenic emergencies; prevention or minimizing material and moral damage caused by crimes and accidents; ensuring

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environmental safety of transport and transport system environmental sustainability; implementation of national security objectives *in the transport sector as a whole.*

The most important transport infrastructure functional element of Russia is also its information-telecommunication system ensuring navigation, information, telecommunication support, traffic management and vehicles safety.Rapid design processes distribution, built-up and development of automated, intellectualized and autonomous vehicles and various modality infrastructures (motor transport, railway, sea, air transport) and their integrated (multi-modal) use, explains the need for convergence of heterogeneous infrastructures, expediency of their development on the basis of intellectual information telecommunication system platforms [Asaul (2011)].

The project proposed by the authors is the Intellectual Multimodal Transport System (IMTS) which is a new type of information-telecommunication system, allowing for effective monitoring and management (technological and administrative) of intra-modal and multimodal transport flows. IMTS includes modal access networks and integrated trunk info-communication network, converted (by using interfaces, drivers and software (SW)) with various transport infrastructure elements. The following have to be taken into account while developing IMTS:

- stations mobility (components of the vehicles) which allows for rapid alteration of the network topology (stereology in air transport mode);
- the necessity to support a wide spectrum of telecommunication technologies and various types of application processes (multiserviceability), including global applicability of network elements prioritizing user service and execution of application process (taking into account rules and safety requirements and services rating in each transport mode);
- dynamic and flexible accountability of user demands (transfer rate and probabilistic time response characteristics preset by the applications); reliability, availability, confidentiality and security of info-communication processes and hardware and subnet hosts modular design.

In the way of IMTS development it is important to remember that transport is a critically needed technology in Russia, therefore the transport infrastructure is among the most critical infrastructure projects in the Russian Federation and the countries of the Eurasian Economic Union [Asaul (2013)].In addition it is important to also consider the following:dynamic pattern of potential transportation threats, tending to increase as a result of increasing transportation volume of hazardous cargoes (nuclear weapons, petroleum, chemical hazardous substances, radioactive materials, nuclear waste to a site of disposal); high degree of wear and accidents risk of transport complex objects; traffic intensity increase in line with economic development of the country, development of new territories, operations adjusting of the international transport corridors; growth of road traffic accidents, which is one of the most crucial social – and – economic problems (according to expert estimates the damages resulting thereof reaches 4-5% of the gross national product worldwide and the number of killed and wounded reach up to 1.5 million persons annually); facts to improve the methods and ways of unlawful activity of criminal groups (especially terrorist organizations) relating to the transport sector, strengthening of the dangerous tendency to unite and coordinate their activities, including the same at the international level.

Stratified IMTS project architecture description in the Russian Federation reflects its basic functional elements [Komashinskiy (2014), Zulkarnain and Leviakangas (2012), (Figure 1 gives detailed presentation of architectural subsystems and functions thereof). The first lowest level reflects functionality of the telecommunication protocol stack OSI: modal access networks (wire and wireless) and integrated trunk network. The second layer (data stratum) reflects functionality of the shared data space, composed of modal context data and the data required to support multimodal transport control and management. The third level is the information level (information stratum) represents functionality of converting big data into context information reflecting the current state of modal and trans-modal transport facilities and infrastructures. The fourth level supports derivation functions of contextual knowledge from time sequence of contextual information at the query of the application processes (ensures request-based provision of knowledge). The sixth layer includes application processes (modal and transformer-modal), that can use data, information and knowledge through direct and cross-layer interfaces.

The control plane (refer to Figure 1) ensured agreed management of all functional architecture layers and inter-strata interaction. The safety plane ensures protection of the processes running in each stratum against accidental or intended impacts.