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THE ROLE OF ITS ARCHITECTURE IN THE DIGITIZATION OF TRANSPORT IN SMART CITY

Key Words
Intelligent transport systems; Smart city; Digitization; Transport

Abstract
The development of the smart city concept requires digital transport infrastructure and the deployment of intelligent transportation systems. Successful development of the smart city concept requires ITS architecture. The ITS architecture creates a technical and technological framework for the development and implementation of ITS services that support the smart city's digitized environment.

1. INTRODUCTION

The smart city concept includes digital transport infrastructure. The new mobility paradigm focuses on user needs, their priorities, data flows and dynamic responses. Digital transport infrastructure includes information and communication systems and associated equipment used to store, generate and transmit information related to human and freight transport processes.

ITS systems must be open, offering on the one hand the application of different technologies of interactive and multimedia features, and on the other hand, must ensure that they operate in a specific geographical area from micro-locations, cities to regions, countries and continent [2]. Intelligent transportation systems play an important role in the development of a smart city. The ITS architecture is a framework for the successful development and implementation of an ITS system. It is not possible to integrate the transportation system with other smart city features without ITS architecture. The ITS architecture provides opportunities to develop

new innovative customer-oriented transportation services and sustainable mobility as one of the important functions of a smart city.

2. DIGITAL MOBILITY TRANSFORMATION

Intelligent mobility is a new way of solving the problem of moving people, cargo and information, from starting point to destination, using all modes of transport. The transport service in the ITS environment should be a personalized, flexible service tailored to customer requirements. It integrates all types of mobility and offers them to the user in a fully integrated way [4]. Mobility as a Service is an innovative operational model that generates passenger mobility and customer-oriented freight services based on an unobtrusive, cooperative and sustainable transportation system. Mobility will increasingly be viewed through the timeliness of services and less through the ownership of assets (vehicles).

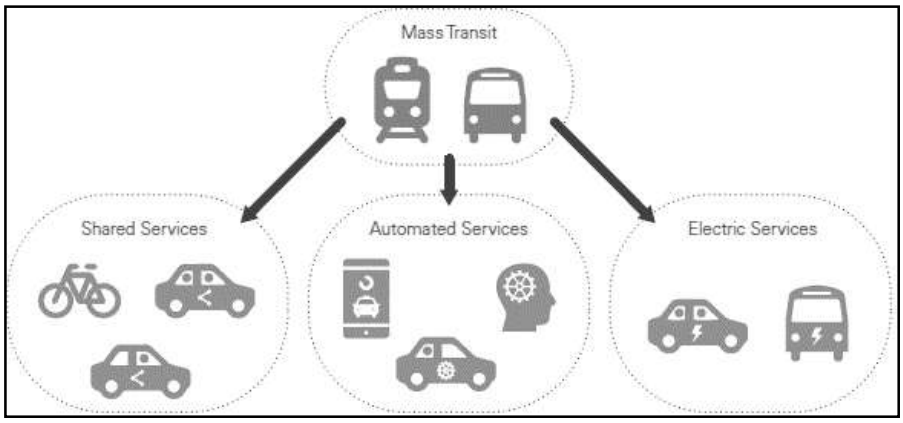

Figure 1. The concept of mobility as a service [3]

The availability of information throughout the transport network in the ITS environment opens up new possibilities for using the transport network in an efficient and user-oriented way. The new approach to mobility as a service in smart cities will depend on ITS services that enable integrated travel planning, integrated billing systems and the development of new mobility business models such as car sharing and on-demand mobility services.

Digitalized transport systems will have the following features:

- mass networking characterized by pervasive connectivity throughout the Transport system through the interaction of vehicles with V2V vehicles, V2I vehicles and infrastructure, and infrastructure with I2V vehicles.
- customer orientation is a paradigm focused on user needs, their priorities, data flows and dynamic responses to changes in system behavior.
- dynamic tariffs that contribute to balancing supply and demand
- integration of processes aimed at easily moving from point of departure to destination regardless of transport mode, service provider and service time

- new models of public-private partnership in the transport system.

Customers are looking for multiple integrated ITS solutions that will meet their communication needs through a single device (smartphone, trip computer) with intermodal terminals and connected networks.

3. BASIC GOALS FOR THE DEVELOPMENT OF INTELLIGENT TRANSPORT SYSTEMS

The development of modern society is accompanied by a steady increase in the demand for transport, which has resulted in the congestion of the transport network, a decrease in safety and an increase in adverse environmental impacts.

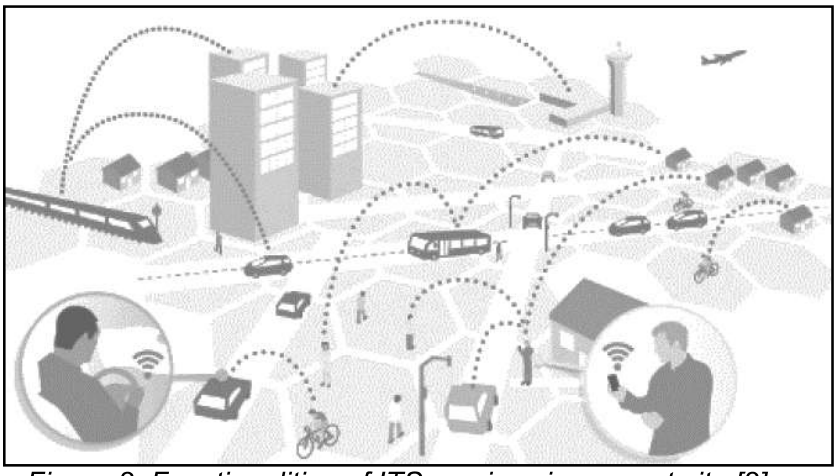

Figure 2. Functionalities of ITS services in a smart city [2]

The growing demand for transport is accompanied by customer demands for an increase in the level of service (safety, comfort, travel time), which are often contrary to the requirements of the transport and transport network operators for sustainable mobility and better use of the existing network. New approaches and new solutions are needed to ensure sustainable mobility and meet customer demands.

Intelligent Transportation Systems have been recognized as a new concept that will enable improvements in the transportation and transportation systems, but also ensure sustainable mobility. **Intelligent transport systems are the application of information, communication and management technologies, artificial intelligence and transport and transportation engineering methods to better plan, design, operate and use the transport and transportation system to enable safer, more secure, efficient, economical and environmentally friendly movement of people , freight and information on the transport and traffic** networks [3]. New solutions are needed to enable the transport of people and freight in an efficient, secure, efficient, environmentally friendly and sustainable manner to ensure a more efficient use of existing infrastructure.

4. DEVELOPING THE CONCEPT OF A SMART CITY

A smart city is a new concept for the development of an urban structure whose citizens are influenced by its changes to be effective, interactive, attractive and adaptable. It differs from the existing monofunctional and conventional cities of a monolithic structure.

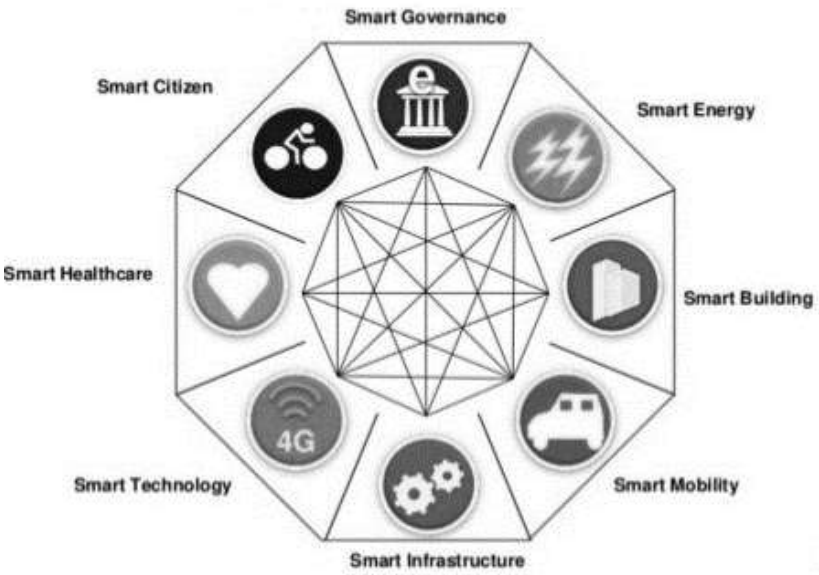

Figure 3. Smart city concept [3]

Although there is no single definition of smart city, it implies the application of ICT that enable better management of systems that improve living conditions and facilitate urban problem solving. The concept of a smart city includes the transport system that will enable the movement of people and cargo in an efficient (efficient), safe (protected), effective (efficient), environmentally friendly and sustainable way.

The differences between the dynamic structure of a smart city and a traditional city are reflected in the following:

- smart cities use an intelligent infrastructure that includes devices and equipment to collect data from the environment
- smart cities use new analytical tools that enable the analysis of large amounts of data and tools that encourage citizens to connect and change their behavior
- smart cities, through intelligent infrastructure and programmable systems, enable efficient management in a dynamic environment.

Improving the traditional transportation and transport infrastructure in the urban area enables it to evolve from a passive to an intelligent, self-monitoring and self-managed infrastructure. The smart city's intelligent infrastructure components, connected via the Internet, allow the collection of data from a variety of sources and contexts and the execution of integrated functions.

5. THE ROLE OF ITS ARCHITECTURE IN THE DEVELOPMENT OF INTELLIGENT TRANSPORT SYSTEMS

The ITS architecture is a conceptual framework that defines the structure and behavior of an ITS system. ITS architecture can be defined as a basic system organisation consisting of crucial components, their relations and connections to environment, as well as principles for system design and development during the whole lifecycle [1]. The ITS architecture describes the functionalities of the ITS subsystems and the ways in which they are interconnected at the functional (logical) and physical levels used to plan, develop and deploy ITS applications [5].

In order to harmonize the development of ITS, the European Union has developed The European ITS Framework Architecture is designed for use as the starting point for the development of National ITS Architectures. The European ITS Framework Architecture defines and describes what needs to be included in ITS that can fulfil the requirements of the European ITS User Needs. A Functional Architecture defines and describes what functionality needs to be included in ITS.A Physical Architecture defines and describes how the functionality created in the European ITS Functional Architecture can be grouped to form Systems that can be produced. A Communication Architecture defines and describes what kind of communication links needs to be used in a System in order to support its physical data flows. **National ITS Architecture** is developed to cover the application of ITS within a EU Member States. It can be based on those parts of the European ITS User Needs that are relevant to the EU Member States and be developed from the European ITS Framework Architecture (figure 4.).

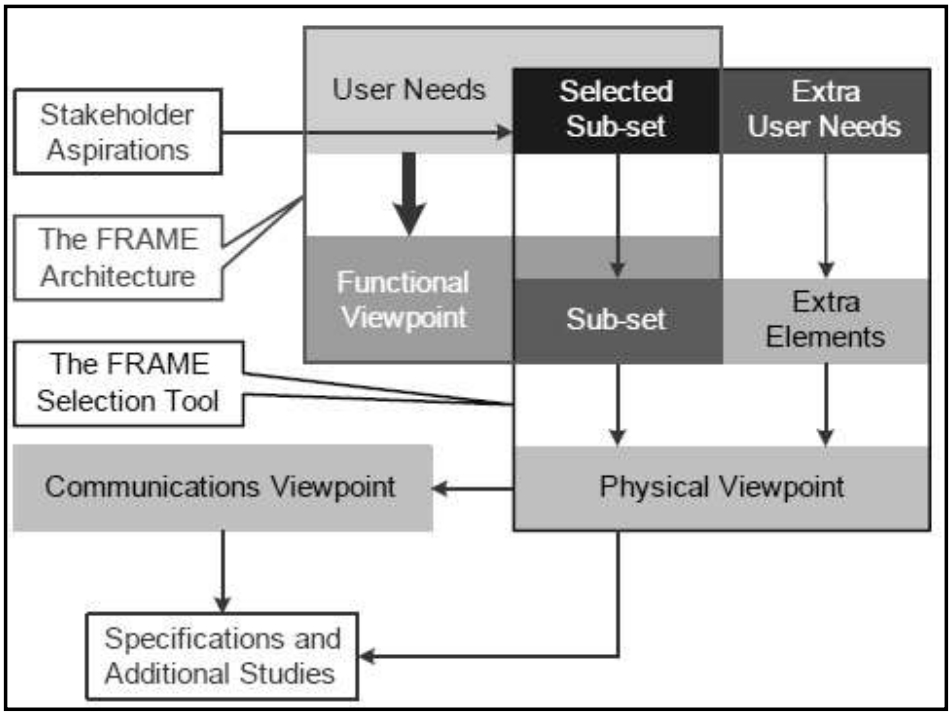

Figure 4. Creating a national ITS architecture based on the European ITS Framework Architecture [6]

The European ITS Framework Architecture is designed to provide a flexible framework that individual countries can tailor to their own requirements. National ITS Architecture projects based on the European ITS Framework Architecture, have a common approach and methodology, but each Country can able to focus on the aspects of local importance and develop them in more detail.

Some Southeast European countries (Slovenia, Hungary, Croatia, Greece) have made significant strides in developing national ITS architectures, while other countries (BiH, Serbia, Montenegro, Macedonia, Kosovo, Albania) are conducting preparatory research that will result in the development of national ITS architectures. Harmonizing the development of ITS in Southeast Europe would significantly reduce ITS implementation costs, create a larger ITS services market and ensure interoperability. This would create a stable framework for digitizing transport and developing smart cities in this part of Europe.

6. CONCLUSION

The development of the Smart City concept entails the digitization of the transportation system. The development of intelligent transportation systems is a complex long-term process. The ITS architecture creates a framework for the stable development of the transport system and the successful application of new information and communication technologies in the transport system and the successful integration of the transport system with the digitized environment. To ensure the interoperability of ITS services, standardization of solutions through the development of the ITS architecture is required.

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