DOI: 10.7251/JTTTP2501023S
UDC: 656.1.08:656.1.053(497.11Niš)

PRELIMINARY REPORT

Integration of the public transport system using the example of the Niš Administrative District

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Received: June 23, 2025
Accepted: July 26, 2025

Abstrakt: Public (regional) transport, which is carried out between territorial units of one or more neighboring administrative districts in the Republic of Serbia, is based on the concept of deregulation and relies mainly on one means of transport – the bus. It is a system of intercity and municipal timetables, i.e. bus lines operated by private bus operators. On the other hand, these public transport services are not considered communal activities, they are not subsidized and are provided by private operators in accordance with commercial interests.

This paper investigates the public transport system on the territory of the Niš Administrative District. The research focus is on analyzing the current state of the system, identifying key challenges and problems, assessing public transport needs and developing recommendations for improving the system. The aim of this research is to provide a comprehensive insight into the current state of public transport in the Republic of Serbia and to identify opportunities for improvement in order to meet the needs of the population, improve mobility and contribute to the economic development of the region.

The research includes discussions on topics such as deregulation, reliance on one mode of transport and integration of public transport. The analysis provides deeper considerations of the challenges facing the system and possible strategies for addressing them.

Based on the collected data, analysis and conclusions, this paper will offer relevant recommendations for improving the public transport system and contribute to improving the quality of services, efficiency and accessibility for service users.

Key words: integration, public transport, administrative districts, mobility.

INTRODUCTION

Public passenger transport between neighboring municipalities has all the characteristics of public transport system, while its organization operates according to the rules of classic intercity transport. Therefore, carriers register timetables, define prices and ticket systems, determine the traffic regime at their own discretion - complete deregulation. There is increasing public pressure to influence the quality of municipal public urban transport services, on the one hand, and the multiple interest of the authorities to make the public transport system as economical and efficient as possible, so that it has created a need for legal regulation of the public transport services market in Serbia. Therefore, some systems have experienced significant changes in the way of organization and management over the last decade, which were inspired by current developments in the EU.

The way of organization and management of the public transport system varies significantly from country to country, and even from city to city. There are many influential factors: the way in which national and local authorities entrust the service; the way in which public transport financing is organized; the nature of the relationship between the authorities and the operator and the manner in which this relationship is established; the ownership and structure of the operator; the use of the principle of competition, etc. The management of such public transport encompasses all activities and processes necessary for the efficient management of public urban passenger transport. This includes planning, organisation, monitoring and control of all resources in order to provide the safest and highest quality services for passengers. Planning and organisation are key aspects of the

management of public regional transport. The aim is to achieve optimal use of resources and to ensure that public urban transport is accessible and reliable for all users. Planning and organisation are continuously adapted to changes, needs and demands of passengers, as well as to conditions observed during monitoring and control systems. A particular challenge is posed by developing countries, where the process of uncontrolled urban sprawl and the influx of rural population is still present, which leads to the development of industry, rising standards, mobility and population movement, as well as an increase in motorization, whose position has been increasingly favored over other modes of transport in recent years.

Vuchic (2005) explains three key problems faced by public transport systems in developing countries:

- *Avoidance of public transport obligations* – private companies, concerned about their economic efficiency and profits, avoid public transport services in poor areas and areas of low population density. They also avoid suburban lines, as well as transport in the evenings and on weekends.
- *Unfair competition* – financially stronger companies eliminate competition in their area through pricing policies, and then use their monopoly positions to increase profits (the price of the service increases, while the quality and quantity decrease).
- *Decreased efficiency* – uncontrolled competition has created duplicated and uncoordinated services on many lines, which is not an efficient way of providing services. Passengers are forced to make multiple transfers, wait longer for transportation, pay different prices for the same routes with different carriers, and have difficulty obtaining information about the transportation itself.

One of the consequences of the deregulated system, characteristic of bus modes of transport, is the so-called "on route competition" where carriers compete with each other to take on passengers along the route. This type of competition is especially present on profitable routes with high passenger flows, while the negative effects on traffic safety, the environment and the quality of service are immeasurable.

EU TRANSPORT POLICY

The European Union's transport policy is a set of strategies, objectives and measures aimed at improving the efficiency, sustainability and competitiveness of the transport system in the European Union. It covers all modes of transport, including road, rail, air and waterborne transport. It is implemented through cooperation and coordination between the European Commission, the Member States and other relevant stakeholders in the transport sector. The European Union's transport policy is defined as a set of measures, policies and regulations aimed at improving the efficiency, safety, sustainability and competitiveness of the transport sector within the European Union (Đorđević, 2023). The main objectives include improving infrastructure, increasing energy efficiency, reducing emissions of harmful gases, encouraging sustainable mobility, improving economic competitiveness, reducing pollution and improving the quality of life, connecting and integrating European regions, as well as creating jobs and economic growth. The European Union plays a key role in transport policy by enacting legislation, setting standards, providing financial support, promoting innovation and research, and supporting international cooperation in the transport sector. The European Commission is responsible for developing and implementing transport policy, while member states have a role in implementing regulations and measures at national level.

EU White paper

The EU White Paper, which adopted the comprehensive Transport 2050 strategy in 2011, states that a greater share of public transport in the modal split of travel, combined with minimum service obligations by the competent authorities, will enable an increase in the density and frequency of services, thus creating the basis for generating different models of public transport, primarily integrated ones (Višković, 2024).

Also, the basic objectives are defined as safe, efficient and high-quality passenger transport services through limited/regulated competition, while taking into account factors of social development, environmental development and regional development or providing special tariff conditions to certain groups of passengers such as pensioners, students and pupils, etc.

The objectives of the EU White Paper are to present the current state and challenges facing the European Union in the economic, social, political, legal and security domains, the book defines key problems through analysis and research and can provide recommendations for improvement in each of the above areas. The aim is to use this book as a guide for making informed decisions and improving the situation in the EU. The White Paper research methodology is based on careful collection of data from relevant sources, such as the latest reports, case studies and statistical data. For each area of analysis, different data collection methods were used, including quantitative and qualitative methods.

The structure of the EU White Paper has the following parts: introduction, overview, challenges, recommendations and conclusion. In the first part, i.e. the introduction, readers will be introduced to the objectives of the book, the research methodology and the general structure. This is followed by a state of play that anal-

yses in detail the economic indicators, social situation, politics, law and security in the EU. In the third part, the book will focus on the challenges in each of the above areas and provide recommendations for improvement. Finally, the main conclusions are summarized and the importance of further actions for the further development of the EU is highlighted.

PUBLIC TRANSPORT SYSTEM INTEGRATION

Public transport system integration is a strategy that aims to make it easier for public transport users to move efficiently between different modes of transport within the same city, region or urban area. This integration allows passengers to switch from one mode of transport to another without too much complication and without the need for multiple tickets or tickets from different carriers. An integrated public transport system aims to provide better connectivity, convenience and efficiency for passengers. Public transport system integration has many benefits, including reducing traffic congestion, improving accessibility and reducing air pollution. It provides passengers with greater mobility and ease of use of public transport, making sustainable transport more attractive and efficient.

Figure 1. Integration of urban and local passenger transport (source: https://constructive-voices.com/connecting-the-city-vancouvers-success-with-public-transit-and-urban-integration)

Public transport system integration typically involves several key elements:

1. *Intermodality* - This involves connecting different modes of transport, such as buses, trams, trains, subways, bicycles and pedestrian routes, to allow passengers to easily transfer from one mode of transport to another. This is often achieved by installing transfer stations where different modes of transport meet.
2. *Single ticket* - An integrated system typically uses a single ticket or smart card that allows passengers to pay for their journey without the need for multiple different tickets. This ticket can be used on all modes of transport within the system.
3. *Single timetable* - System integration also involves coordinating the timetables of different transport operators to reduce waiting times at transfer points. Passengers should be able to easily transfer from one mode of transport to another without long waits.
4. *Price coordination* - For the system to be attractive to users, the price of transportation should be competitive and easy to understand. An integrated system often includes price coordination between different carriers to provide affordable rides.
5. *Information system* - A good integrated system should provide passengers with accurate information about different routes, departure times, transfers and other details to facilitate trip planning.

The main goal in article (Kłos, et al., 2021) is to propose a model for integration of different transport services which could support those who intend to travel in the decision-making process. Therefore, the parameters of a model of urban sharing services were identified and classified. The parameters discussed in the paper with reference to an extensive literature review describe how individual sharing services are functioning. What has also been identified is the location-specific factors as well as those related to the potential area of operation which affect the integration with public transport.

In public transport (PT) operations planning, timetable synchronization is a useful strategy to reduce inter-route or inter-modal passenger transfer waiting time and provide a well-connected service. This paper (Chen, et al., 2017) addresses the integrated PT timetable synchronization with vehicle scheduling problem for a given PT network. A new bi-objective integer programming model is developed for the problem.

Growth of towns is a result of citizen's social and physical division. Urban planners and scientists have increased the number of links between urban transport and urban development. Public transport has been in the focus of attention as a sustainable and environmentally sensitive transport that brings environmental benefit and possibility to serve mobility needs of citizens without private cars and reduces social division. Burinskienė, et al. (2011) identifies the main factors that affect the use of public transport in town: land use planning; local government policy; extent of economic resources; implementation of modern technologies; social tendencies. Analysis of the scientific literature has revealed four main models of towns of sustainable urban forms: neo-traditional development, urban restrictions, compact town and ecological town.

Analysis of the number of passengers between Niš and neighborhood municipalities

According to the 2022 census, the population of the City of Niš was approximately 249.501, while the population of the settlement itself was approximately 178.976, making Niš the third largest city in Serbia (after Belgrade and Novi Sad). The average population density in the City of Niš is 300 inhabitants/km^2. The population of the City of Niš is an important indicator for measuring the population size of this area.

The Niš Administrative District consists of several settlements: Aleksinac, Svrljig, Merošina, Ražanj, Doljevac, Gadžin Han and City of Niš.

Figure 2. Municipalities in the Niš Administrative District

All of these municipalities have a developed network of urban or intercity lines, which residents of these municipalities can use daily. Public transport in the Niš District plays a key role in maintaining the mobility of residents and connecting different settlements. For this reason, it is important to investigate the current state of public transport and identify the problems that accompany it. The overview of public transport in the Niš District includes the various modes of transport available to citizens. This includes buses, taxi services and suburban transport. Each of these modes of transport has its own characteristics and role in meeting the needs of passengers.

Local public transport between the city of Niš and its neighboring municipalities is a system of intercity departures - bus lines, on which private transport operators operate. These lines are not subsidized and are maintained according to a regime defined exclusively by the transport operator in accordance with operating costs. In order to more realistically view and analyze the local public transport system between the city of Niš and other neighboring municipalities within the Niš Administrative District, data obtained from the most dominant transport operator in this area - „Niš Ekspres", were taken into account. The data obtained refer to the number of single and monthly tickets sold between Niš and neighboring settlements/municipalities. The months of October (2023) and May (2024) were defined as characteristic time periods. Five directions - corridors were taken into account: Niš-Gadžin Han, Niš-Aleksinac, Niš-Merošina, Niš-Svrljig and Niš-Doljevac.

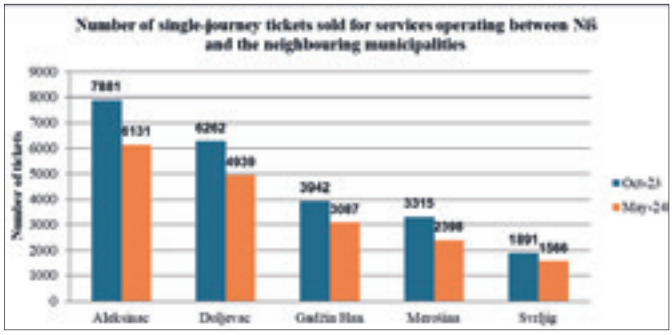

Chart 1. Analysis of the number of trips made between Niš and neighboring municipalities based on the sale of individual tickets (source: Niš ekspres)

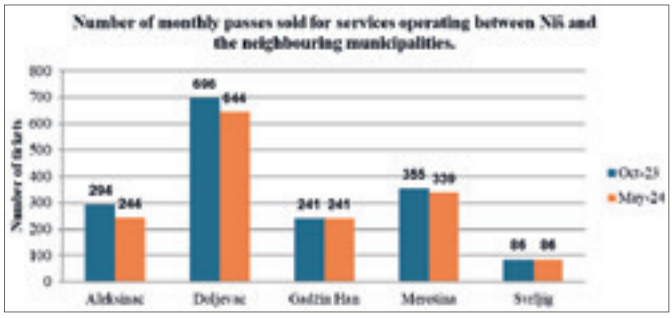

Chart 2. Comparative overview of monthly ticket sales for October 2023 and May 2024 by defined routes (source: Niš Ekspres)

By analyzing the submitted data on the number of monthly and individual tickets sold, it can be concluded that in the local transport system, on the routes between Niš and some of the neighboring municipalities, slightly more than 1,500 residents use a monthly ticket. If we multiply this number by a minimum of two rides during the day, this is about 3,000 passengers/rides in one day. About 20,000 individual tickets are sold on a monthly basis, which is about 600 to 700 passengers/rides in one day. Therefore, based only on the most dominant sample, we arrive at the data that more than 3,700 passengers/rides are realized daily in the local (regional) public transport system in the Niš Administrative District. The Niš-Aleksinac and Niš-Doljevac corridors are the largest in this system in terms of the number of transported passengers, but also in terms of the number of inhabitants and the development of the public transport network.

The municipality of Doljevac is the second largest in the Niš Administrative District and the number of monthly tickets is three times larger than the municipality of Aleksinac. This data shows that public transport on this corridor is more accessible and more adapted to the

daily needs of the local population.

However, it is characteristic that the municipality of Doljevac also borders the municipality of Žitorađa and the city of Leskovac, which territorially belong to the Toplica and Jablanica districts, respectively. Passenger movements within and between these territories do not have a classic inter-city character, but arise as a consequence of daily existential migrations of residents (employees, students, retired people, etc.).

A similar specificity applies to the municipality of Merošina, which is located between the city of Niš and the municipality of Prokuplje. The number of tickets sold (single and monthly) in the municipality of Merošina has decreased significantly in recent years as a result of special scheduled transport that is organized not only for the transport of students to the "Jastrebački Partizani Primary School" but also for the transport of workers. Taking into account the previous analysis of the Niš Administrative District based on the data obtained from the most dominant local road transport company - Niš ekspres, characteristic points were observed for all corridors included, i.e. settlements located along the edge of the zone reached by the JGPP (Figure 3). These settlements are located at a distance of one to three kilometers from the defined border, and since they belong to a neighboring municipality, they are not part of the public transport system.

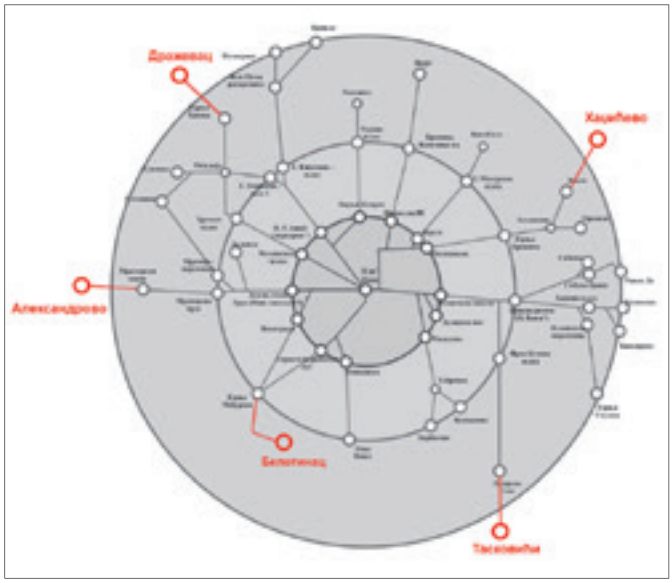

Figure 3. Position of the first settlements located along the edge of the PT zones in Niš

In the direction of Aleksinac, the residents of the village of Draževac are only 3 km away from the subsidized public transportation, and they do not have a quality network of intercity departures. The village of Belotinac, on the other hand, has a certain network of departures that is adapted to basic needs, namely going to work and school, which, in accordance with the population, results in a slightly higher frequency of travel compared to similar examples from neighboring corridors. Only from these characteristic, border points, 70 to 90 passengers/rides are realized daily (Table 1).

Table 1. Data on the volume of ticket sales from/to settlements along the edge of the PT zone in Niš

Settlement	Month	Distance from the PT Service area boundary	Monthly passes	Single tickets
Draževac	October -23	3 km	4	6
	May - 24		4	8
Hađžićevo	October -23	1.6 km	6	2
	May - 24		6	6
Aleksandrovo	October -23	1 km	3	62
	May - 24		3	25
Taskovići	October -23	1.3 km	0	191
	May - 24		0	123
Belotinac	October -23	1.4 km	36	337
	May - 24		34	310

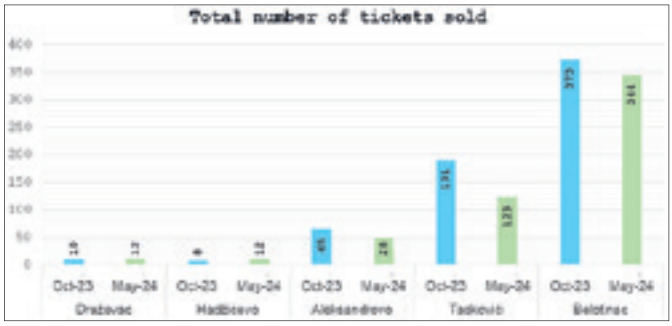

Chart 3. Total number of tickets sold from/to settlements along the edge of the PT zone in Niš

CRITICAL POINTS FOR IMPROVING THE PUBLIC TRANSPORT SYSTEM IN THE NIŠ ADMINISTRATIVE DISTRICT

Daily migrations of the local population within the territory of the Niš Administrative District are realized in several mutually uncoordinated and independent ways that may represent an obstacle to the further development and improvement of public transport in the Niš District:

1. By using intercity and municipal bus lines maintained by private car carriers,
2. By the model of special scheduled transport,
3. Individual transport by passenger car,
4. By alternative modes that rely on the passenger car - sharing of transport and travel costs,
5. By illegal modes of transport - scheduled taxis and van transport.

Individual transport by passenger car

The main advantage of a passenger car is its flexibility and accessibility. Public transport may never be able to match the flexibility of a passenger car, but appropriate measures can be taken to strengthen its competitiveness. Practice has shown that the greatest influence on system users when choosing a mode of transport is the price policy (fuel price, parking price and supply, ticket prices).

In other words, public transport must be a more accessible and economically viable means of transport than a passenger car from the user's perspective, otherwise:

- A transfer of a part of users to a passenger car occurs;
- Illegal forms of public transport that are basically based on a passenger car, such as regular taxis and the so-called van transport, develop.

Within the Niš Administrative District, in the last ten years alone, the number of registered passenger cars has increased by 28.8 %, while the number of residents living in this area has decreased by 8.6 %. It is symptomatic that the most devastated municipalities in the district have the largest increase in the number of registered cars (Chart 4). The municipality of Gadžin Han lost slightly more than 8.000 residents in the period between the two censuses, which is a decrease of 30.3 %. At the same time, there are 267 more registered passenger cars. This fact speaks in favor of the state of public transport in the devastated areas.

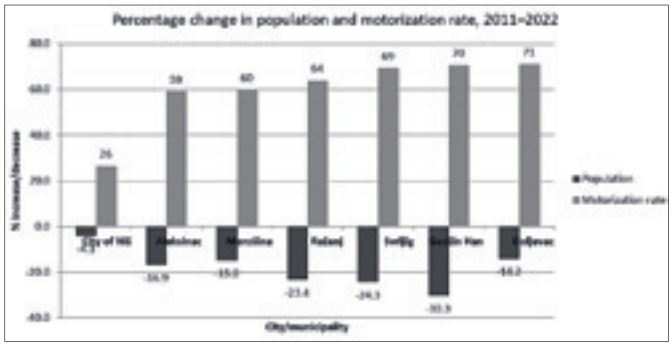

Chart 4. Comparative overview of changes in the number of inhabitants and the degree of motorization in the Niš Administrative District in the period 2011-2022

Sharing of transport and travel costs

When it comes to alternative modes, sharing transportation and travel costs is very popular among employees who join forces to go to work together in one passenger car. The habits created in this way should be used wisely, integrating transportation sharing into the regional transport system and stimulating the use of green vehicles.

If we take the example of the Niš Administrative District, whose seat is the City of Niš, which has organized public urban and suburban transportation, transportation sharing is particularly attractive to citizens who live in settlements of neighboring municipalities, but are on the very border of the PT zone (Figure 8). For example, in the direction of Aleksinac, the last settlement reached by the PT is Gornja Trnava and the price of a monthly ticket for workers on the Niš-Gornja Trnava route is 4410,00 RSD (I+II+III zone). The next settlement is the village of Draževac, which belongs to the municipality of Aleksinac and is only 3 km away from Gornja Trnava. Depending on the road transport company that provides intercity transport through the settlement of Draževac, the difference in the price of a monthly worker's ticket on the Niš-Draževac route, compared to Niš-Gornja Trnava, can be up to three times higher.

The main difference is that the price of a monthly ticket for the Niš-Gornja Trnava route is subsidized within the PT system in Niš. The price of a monthly ticket Niš-Draževac is formed on the basis of the real operating costs of the road transport company that provides intercity transport on this route.

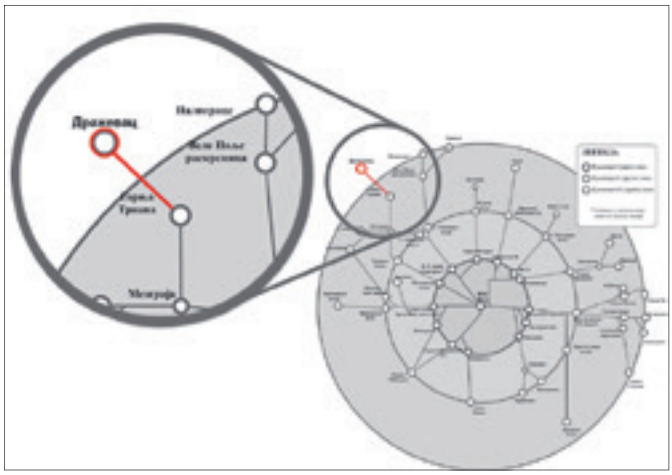

Figure 4. Position of the village of Draževac in relation to Gornja Trnava – the border of the third zone of the PT in Niš

Given that Niš is a university city, one of the characteristic situations when it comes to students and high school students is that their parents often opt for renting an apartment rather than purchasing a monthly ticket for a specific local route because the price ratio is of the same order of magnitude.

CONCLUSION

For many years, efforts have been made to improve the public urban and suburban transport system due to its key role in the social, economic and economic development of modern cities. The development of new, smart technologies has made public transport more accessible, transparent and comfortable. However, rapid urban development and its monocentric character are expanding the influence of cities to wider geographical areas,

making the classic territorial division inadequate for the needs of public transport. Therefore, it is necessary for neighboring municipalities or municipalities within one district to join forces in order to jointly organize and operate public urban transport.

The paper examines the state of public transport in the Niš Administrative District and the general position of the city of Niš within the district itself. The legal framework regulating the public transport system in the Republic of Serbia is also reviewed and analyzed, and compared with examples from the European Union. The conclusion is that local (regional) public transport in the Niš Administrative District has the same character as suburban public transport that connects settlements with the narrower urban area. Therefore, it can be seen as public suburban transport in larger cities. And similarly to other municipal activities, local (regional) transport does not have standard economic characteristics and as such cannot function on a commercial basis.

The city of Niš has organized public urban and suburban transport, according to the public-private partnership model, but when its position is viewed from a geopolitical and socio-economic perspective, it can be concluded that it represents a regional center in a wider geographical area to which the local population gravitates.

Finally, critical points have been defined that need to be worked on in order to further improve the system of local, i.e. regional public transport, thus creating conditions for the implementation of a fully integrated system of local public transport on the territory of the Niš Administrative District.

Integration involves physical, i.e. network integration, then information, tariff and broader planning – the one that should be included in urban plans. In order to implement integration, there are a number of obstacles that need to be overcome in relation to the legal framework, political environment, business models of private road transport operators, the method of revenue distribution, but before that, focus on obstacles related to operational problems that are defined as key.

The next step is the association of municipalities and the joint performance of public transport, which is prescribed by the Law on Communal Activities. Two or more local self-government units may, by agreement, regulate the joint performance of communal activities, unless otherwise regulated by another special regulation.

If they determine the interest in the joint performance of communal activities, the municipal or city council of each local self-government unit makes a decision to prepare a feasibility study.

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