

ADVISEMENT OF COORDINATION OF RAILWAY PASSENGER TRANSPORT AND BUS TRANSPORT IN THE SELECTED TRACK SECTION

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Summary: Parallel paths (concurrency) of connections in the public passenger transport has a negative impact on the distribution of subsidies for different types of public passenger transport. In coordination of connections the railway passenger transport and bus services should be assessed several aspects, such as the profitability of operation, time availability, spatial accessibility and continuity of connections, also need to take into account the extent of the transport infrastructure in the specific area.

Key words: coordination of connections, concurrency of connections, public passenger transport.

INTRODUCTION

Ensuring of all public transport requirements is based on the fulfilment of the tasks of the city or the territory that is populated. For the development of cities and adjacent areas, transport requirements and the environment must be constantly maintained and improved. At present, public passenger transport in the monitored section is provided by regular bus and rail passenger transport. By improving the serviceability of this area by public transport, it can be achieved modal shift from individual car traffic to rail passenger transport or regular bus services.

The issue of coordination of rail passenger transport and bus transport remains an unresolved issue in subsidizing public passenger transport services. The coexistence of parallel public passenger transport links has a negative impact on the efficient use of funds, which results in a reduction in the quality of the services provided in public passenger transport and the loss of the customer (passenger). (5), (6)

Coordination of rail passenger and bus services needs to be assessed in a number of respects such as availability of the service provided, linking, shortening of travel time, reasonable travel costs, and so on. (1)

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1. ASPECTS OF THE COORDINATION OF RAILWAY PASSENGER TRANSPORT AND BUS TRANSPORT

The basis for the proper functioning of any system is the purposeful coordination of the activities of its individual subsystems. The aim of the co-ordination is to bring the system to work in the final phase and its results to the social optimum. In passenger transport, it is a transport system that allows for reconciliation between the needs of the population, the economy and the technical capability of the company, satisfying these needs in the required quantity and quality (4).

The elimination of the coexistence of rail passenger and bus services has to be assessed from two points of view:

- Carrier (cost of travel, use of means of transport and travel time),
- Passenger (cost of transport, travel time, quality of service provided, etc).

Aspects that affect the coordination of transport connections are:

- Service availability,
- Performance (use of passenger services),
- The timing of connections of the type of passenger transport,
- The timing of connections of another type of passenger transport,
- Spatial sequencing of one's own mode of transport,
- Spatial sequestration of another type of passenger transport,
- Total travel time using one link,
- Total travel time using cross-over transfers. (2)

Successful co-ordination of rail passenger transport and bus transport links should serve as a basis for the creation of a functional integrated transport system while at the same time increasing the quality of the services provided and reducing the cost of operating public passenger transport. (6)

2. CASE STUDY - COORDINATION OF RAIL PASSENGER TRANSPORT AND BUS TRANSPORT IN THE SECTION TRENČÍN - POVAŽSKÁ BYSTRICA

As an case study of co-ordination of rail passenger transport and bus transport, we can introduce the section Trenčín - Považská Bystrica (Trenčín County, Slovakia), where we can use different aspects of the coordination of individual types of passenger transport, taking into account the spatial and temporal continuity at the given tariff points.

The road infrastructure in the global segment includes 808.347 km of highways, motorways and the roads of the first, second and third classes in the districts of Trenčín, Ilava, Púchov and Považská Bystrica.

There are 66.062 km of highways, 1.693 km of motorways, 142.297 km of roads of first class, 135.003 km of roads the second classes and 463.292 km of roads the third classes.

Table 1 shows the lengths of motorways, roads I, II, III. classes in individual districts in the monitored section.

Tab. 1 - Road length overview in Trenčín - Považská Bystrica.

Road infrastructure class	District	Length (kilometers)	Number of road
Highway	Trenčín	25.534	D1
	Ilava	16.160	
	Púchov	7.612	
	Považská Bystrica	15.530	
Highway feeders	Trenčín	1.226	PD 5
Highway together		66.062	
Motorways	Púchov	1.693	
First class roads	Trenčín	68.554	I/50, I/57, I/61
	Ilava	19.548	
	Púchov	37.828	
	Považská Bystrica	16.367	
First class roads together		142.297	
Second class roads	Trenčín	54.559	II/507, II/516, II/574
	Ilava	28.557	
	Púchov	16.560	
	Považská Bystrica	35.327	
Second class roads together		135.003	
Third class roads	Trenčín	171.963	
	Ilava	82.003	
	Púchov	86.545	
	Považská Bystrica	122.781	
Third class roads together		463.292	
Road infrastructure together		808.347	

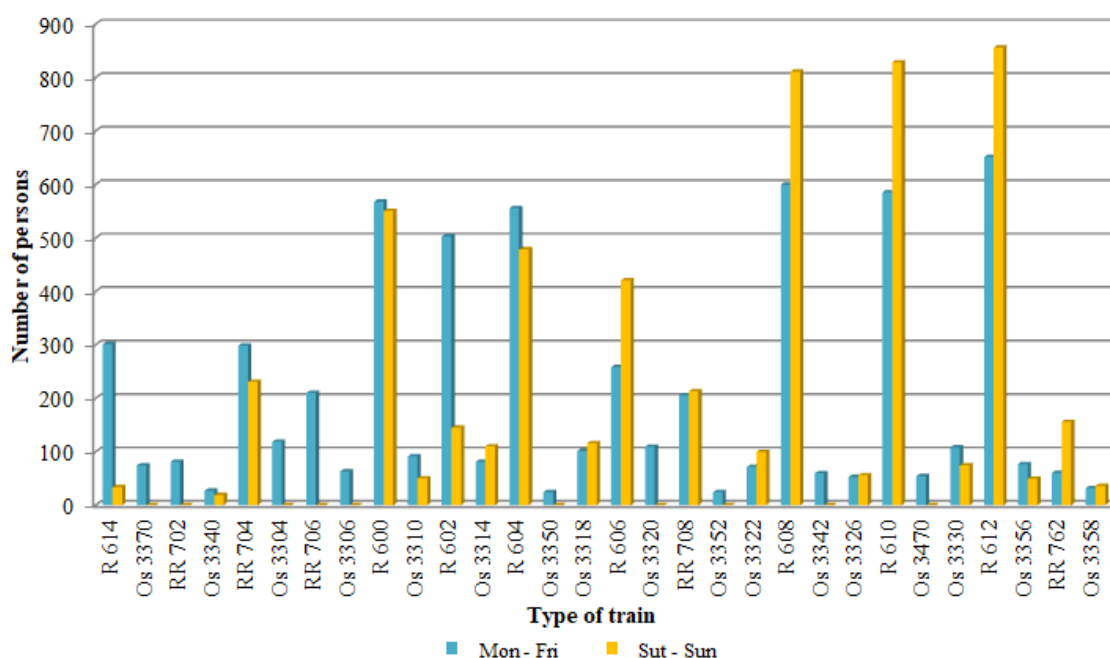
Source: Authors

The railway infrastructure includes the railway section Trenčín - Považská Bystrica with a total length of 47 kilometers (led by the territory of the Trenčín Region). Railway infrastructure Manager of this line is Železnice Slovenskej republiky. All the length it is electrified by two power supply systems. In the Trenčín - Púchov section, there is AC system 25 kV 50 Hz t and in the section Púchov - Považská Bystrica the track section is electrified with a DC traction voltage of 3,0000 volts. Track section Trenčín - Považská Bystrica is double-tracked and its gauge is 1,435 mm. (7)

There are a total of 13 operated points for the arrival and departure of passenger in rail passenger transport. The railway stations and stops on this track include Trenčín, Opatová nad Váhom Trenčianska Teplá, Dubnica nad Váhom, Ilava, Košeca, Ladce, Beluša, Dolné Kočkovce, Púchov, Nosice, Milochovo, Považská Bystrica.

Frequency of passengers was provided by Železničná spoločnosť Slovensko (ZSSK) and contains data such as train number, train departure date, station sequence, code and station name, distance after the next station, number of passengers who entered and arrived at the station and passenger numbers located in train. (7)

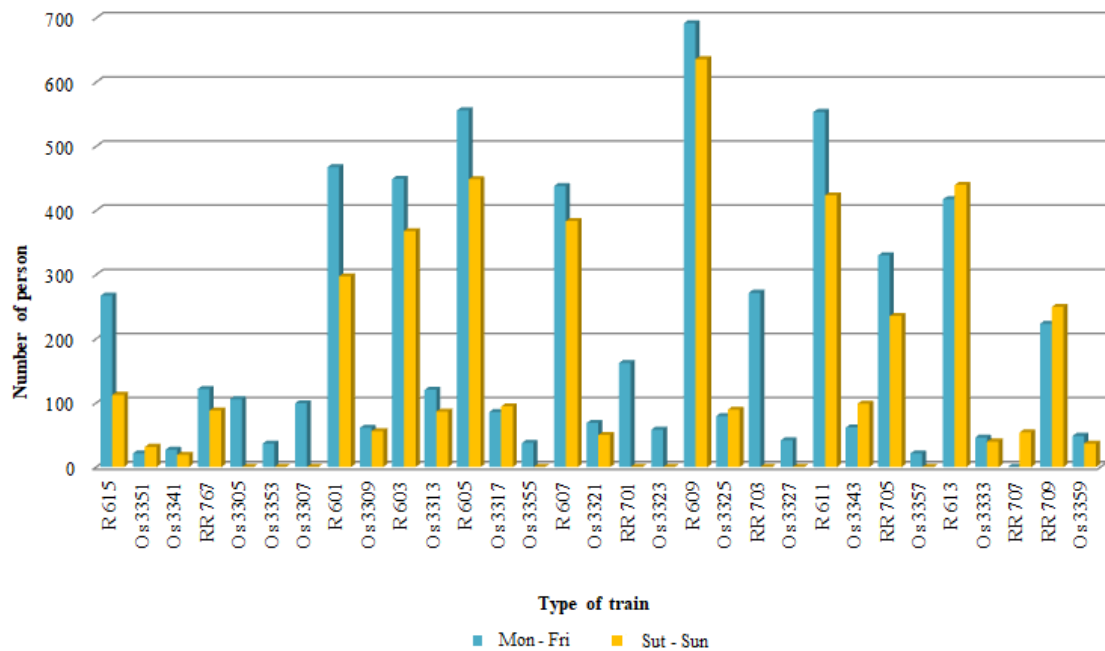
The average train occupancy in the direction of Považská Bystrica - Trenčín is shown in the Figure 1, where the trains are introduced according to the time table. It can be seen on the chart that the most occupied were fast trains in the evening. Over the weekend, the number of passengers on trains is increasing. This is especially caused by getting students to the hostels and the like. For regional passenger trains, a significantly smaller number of trains can be tracked compared to fast trains. It is also possible to observe that the less frequent trains in the morning were Os 3370, RR 702, Os 3340, Os 3304, RR 706 and Os 3306. The most occupied were fast-trains in the evening, R 608, R 610 and R 612 (7).



Source: Authors according to ZSSK data.

Fig. 1 - Average train occupancy in the section Považská Bystrica – Trenčín.

Figure 2 shows the average occupancy of trains in the direction of Trenčín - Považská Bystrica. The chart shows that R609 was the busiest train during working days, and this train was also the busiest during the weekend. The for at least occupied regional trains in this direction during the working days and during the weekend were Os 3341 and Os 3333.



Source: Authors according to ZSSK data.

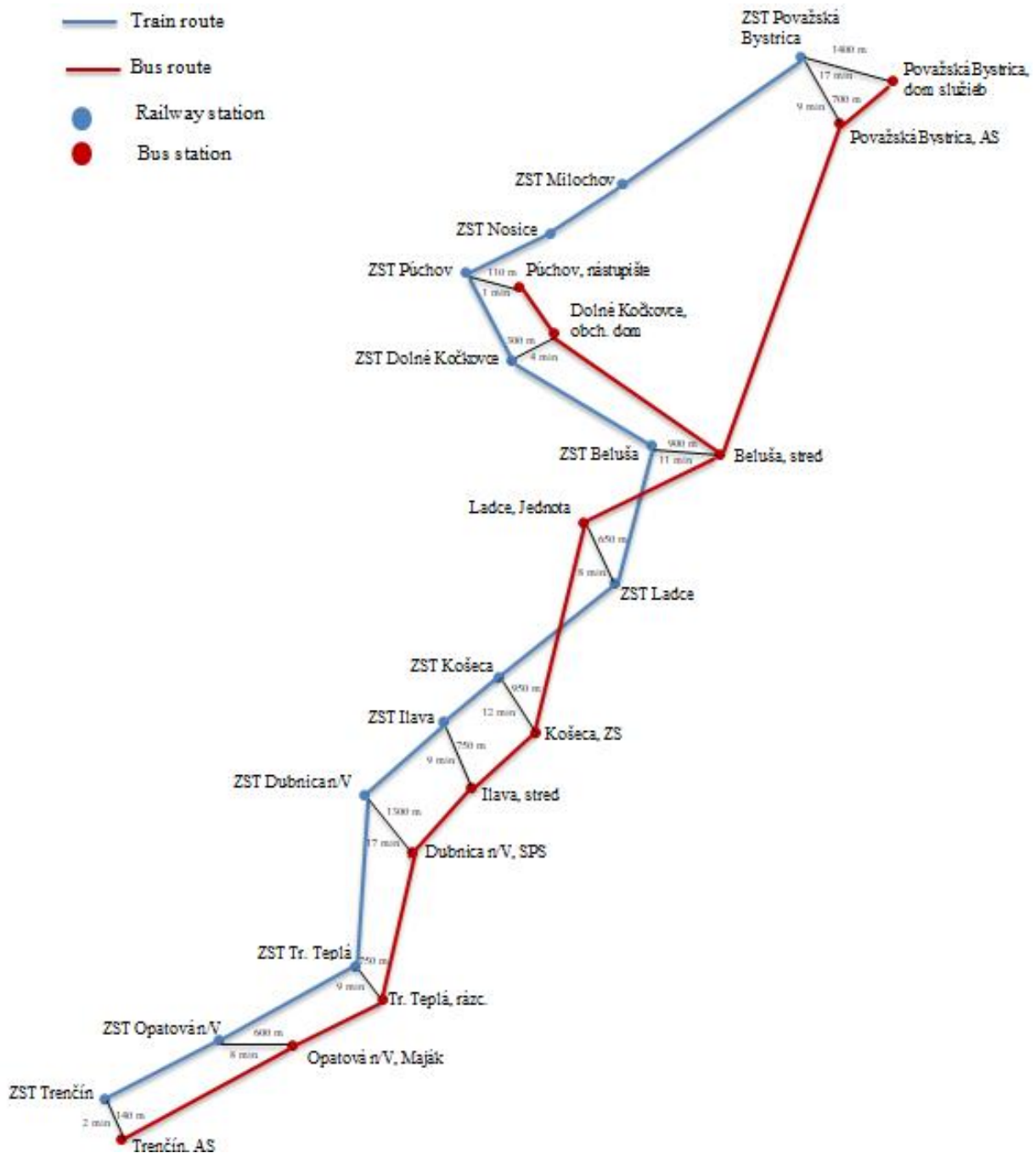
Fig. 2 - Average train occupancy in the section Trenčín - Považská Bystrica.

The location of individual railway stations (stops) and bus stops on the Trenčín - Považská Bystrica line is different.

There is no contemplation of the parallel links of suburban bus transport with rail passenger transport between Púchov and Považská Bystrica. Concurrency in this segment is only by long distance buses, because from a geographically point of view the bus and railway transport connections are not parallel. (7)

Figure 3 shows the isochrons of availability between railway stations (stops) and bus stops in Trenčín - Považská Bystrica section. Railway station distances (stops) from bus stops range from 110 meters to 1,400 meters. This means that at 110 meters, the passenger will get from the railway station to the bus stop in 1 minute, in Púchov at all. At a maximum distance of 1,400 meters, this distance is surpassed by walking in 17 minutes, in Považská Bystrica. In order to increase the quality of integrated transport with using multimodality, the distance between the tariffs of each mode of transport would be minimized. (7)

When coordinating the connections, it should be placed emphasis on bus or rail passenger transport services should be conducted with a time-out in advance, whereby the transfer from one means of transport to the other means of transport is possible. The length of time should take into account the length of time that passengers and passengers with reduced mobility have to overcome the distance when switching from one means of transport to the other means of transport (3).



Source: Authors

Fig. 3 - Distances between railway stations and bus stations in the section Trenčín - Považská Bystrica.

3. CUTTING OF COSTS AND TIME AFTER COORDINATION OF CONNECTIONS IN THE SECTION TRENČÍN - POVAŽSKÁ BYSTRICA

For each section of the trip, the cost savings from the passenger's point of view or the time savings calculated on the basis of the proposed co-ordination of bus and rail passenger services in the section Trenčín - Považská Bystrica.

In co-ordination of connections, it has been suggested that some concurrent bus lines will be abolished at some point. This means that, for example, in the section from Trenčín to Záhumenská, Dedík, Gašprik, Blaho: Advisement of coordination of railway passenger transport and bus transport in the selected track section

Dubnica nad Váhom was proposed the abolition of parallel bus connections with the railway transport and the operation of this territory will be performed by rail transport. As this section of the bus line departs to Nová Dubnica, it was proposed to transfer from Dubnica nad Váhom from railway to bus. The bus lines, which will be canceled from Trenčín to Dubnica nad Váhom, will subsequently get a new mission, to carry passengers from Dubnica nad Váhom to Nová Dubnica.

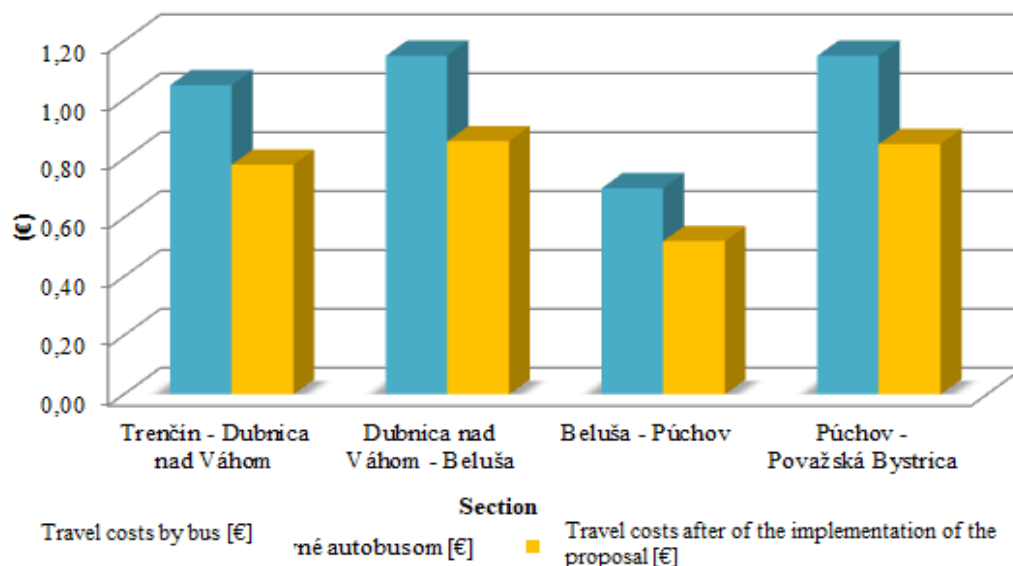
Table 2 shows cost savings from the passenger's perspective, as well as the time savings that passengers can achieve on the basis of proposals for coordination of connections. The table also shows the difference in travel between bus and rail passenger transport, as well as the difference in travel times between the use of bus and rail passenger transport. (7)

Tab. 2 – Cuttnig of costs from passenger perspective and time savings in the Trenčín - Považská Bystrica section.

Section of the road	Travel costs by bus [€]	Travel costs after implementation of the proposal [€]	Price difference [€]	Travel time [min]	Travel time after implementation of the proposal [min]	Transfer time [min]
Trenčín – Dubnica nad Váhom	1.05	0.78	0.27	27	14	5
Dubnica nad Váhom – Beluša	1.15	0.86	0.29	35	18	0
Beluša – Púchov	0.70	0.52	0.18	10	6	10
Púchov – Považská Bystrica	1.15	0.85	0.30	30	11	0

Source: Authors

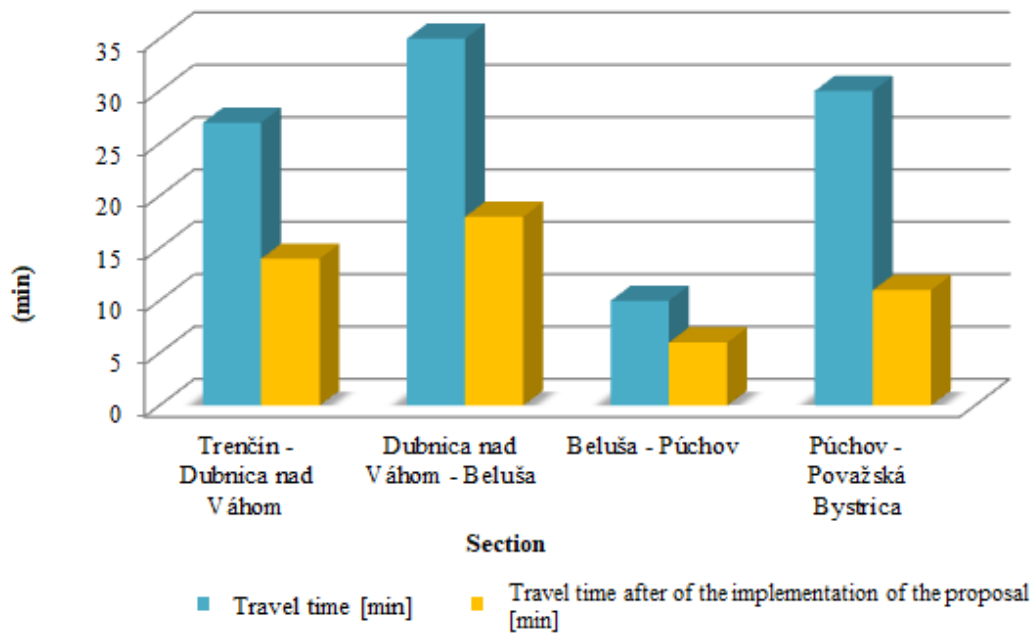
Figure 4 shows the travel in individual sections payable by passengers before and after the introduction of the proposal. It can be seen in the graph that after the introduction of the proposal, the passenger pays less than before it is introduced, since the introduction of the proposal involves the use of rail transport or the train-bus combination.



Source: Authors

Fig. 4 - Comparison of travel costs in individual sections.

Figure 5 shows the comparison of travel times in individual sections before and after the introduction of the proposal.



Source: Authors

Fig. 5 - Comparison of travel times in individual sections.

CONCLUSION

Taking into account the important aspects of the coordination of rail passenger transport and bus transport in Trenčín - Považská Bystrica, there is a saving of time and costs from the perspective of the passenger. It would therefore be appropriate to establish a coordinating authority to implement the coordination system to ensure effective coordination of rail passenger transport, bus transport and urban public transport. The designation of the transport authority is also a condition of the European Commission to continue the modernization of the ZSSK fleet in the 2014-2020 programming period.

More efficient co-operation of public bus and rail transport, as well as the emergence of a traffic authority that would cover the ordering of public service performances, is one of the Government's priorities in transport. The result should be optimization of individual connections in order to increase the availability and quality of public passenger transport, which could lead to the transfer of passengers using individual transport to public passenger transport.

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