



Suburban Public Transport Network Optimization and Operation Strategy of the New Bus Station in Bratislava

Tibor Schlosser^{1*}, Peter Schlosser²

¹Department of Transport Engineering, Faculty of Civil Engineering, Slovak University of Technology, Bratislava, Slovakia

²DOTIS Consult, Ltd. Bratislava, Slovakia

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Corresponding Author: Tibor Schlosser, Department of Transport Engineering, Faculty of Civil Engineering, Slovak University of Technology, Slovakia. Email: tibor.schlosser@stuba.sk

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Abstract

This article presented is aimed at identifying opportunities to improve the attractiveness of public transport, particularly that of the suburban bus service, thus providing for its precedence over individual car traffic in the city of Bratislava and its agglomeration in the Bratislava region. The subject is oriented to the impact of proposed changes in the transport operation and organisation from regional public transport point of view to the area adjacent to the city centre, especially in terms of the significant position of Mlynské Nivy Bus Station (MN Bus Station) which is now under complete rebuilding. The solution is shown how it is possible to be a part of the integrated public transport services and the mutually increasing competition among the operators especially state against private ones. Using the suburb lines as an express bus service on the area of the city is one of the possibilities to operate regularly during the all days in the city and not only to cover the rush hours.

Introduction

Passenger transport - mobility is an essential prerequisite for the efficient functioning of a country's economy and its agglomerations. Public transport (PT) in developed countries plays a primary role in promoting the development of society. It is included in all passenger transport oriented

documents that highlight the need and necessity to direct the movement of people from their sources to the goals of their activities using PT. The issue of preference especially for individual transport in a congested area can be addressed by the only correct solution - the intensive and rising use of PT.

Passenger transport, i.e. people commuting to work, schools, offices, medical facilities and places of other services or leisure time activities, is an important element of fulfilling the efficiency of society in both economic and social terms. We are witnessing steadily increasing volumes of passenger transport, which are based on the current trend of the life of city dwellers and their backgrounds. Passenger transport through constantly rising values of the use of individual transport is a source of environmental burden and reduction of quality of life, and therefore we must seek an optimal solution for sustainable transport in relation to the quality of service in the urbanized area. Mobility management (in our case, the management of passenger transport) is a demand-oriented approach aimed at influencing transportation habits and Behaviour of users of means of transport.

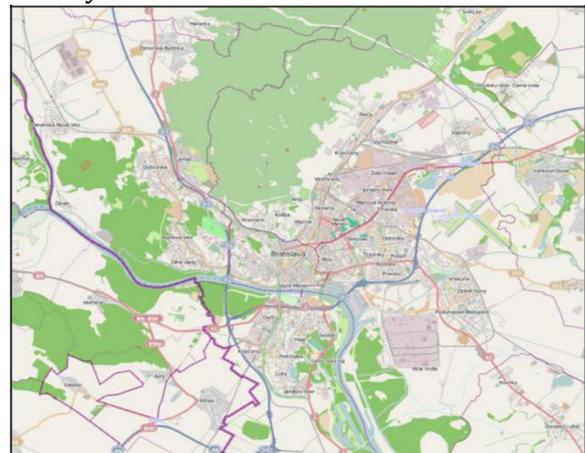
Suburb bus PT operation in Bratislava region

The base focus is to describe the need of service in the Bratislava agglomeration using transportation engineering methods in the PT sector through the suburban bus service, or determining its scope and structure to satisfy the needs of the population in Bratislava and/or the Bratislava region. The next steps have to be, to the greatest extent, possible and to optimally arrange urban public transport (UPT) and suburban bus service (SBS) to ensure the efficient use of public funds. Its resources begin in the background of the Bratislava region and in individual municipalities of satellite cities and villages, and naturally end in the Capital of Slovakia – Bratislava (Figure 1), the economic and social center. Success in improving the quality of public passenger transport depends on:

1. Scheduled lines and follow-up time-based mutual cooperation of several carriers in the territory served together,
2. Spatial use of interchange options in the communications network of the city,
3. Natural concentration on end terminals as was shown in the case of study of the central bus station [1].

The SBS is provided in the Bratislava agglomeration by Slovak Lines a.s. that provides a regular public bus service (suburban, long-distance, international), as well as a contractual chartered and special bus service when providing services to its clients with an emphasis on modernity, high quality and safety. A regular bus service is provided on 42 suburban routes, three long-distance domestic routes and nine international routes. The vehicle fleet of the company consists of 250 buses. Within the suburban bus service, the buses annually transport around 12.5 million passengers. Other major carriers are companies based in the Trnava region, especially SAD Dunajská Streda and Arriva Trnava. Long-distance and international regular bus services are provided by approximately 50 other carriers to passengers travelling to/from Bratislava.

Figure (1): Base scheme of street network of the city of Bratislava



In order to address the issue of public passenger transport in Bratislava and its agglomeration, there are many strategic documents that define priorities and needs only at the general (required EU) level. However, none of the documents include a complete system (technical, technological, infrastructural, financial) of proposals for a gradual solution to the development of so-called "sustainable mobility", supported by transportation engineering tools (which clearly and argumentatively) indicate how to progressively remove existing or worsening disparities in public passenger transport. Of course there are couple of „strategic“ documents (more oriented only as a political will with NGO's declarations without any responsibility) declares that Bratislava aims to develop as a modern and competitive European city with favourable conditions for the well-rounded and harmonious life of citizens of all generations and to create an attractive environment for visitors, students, and investors.

The results written in this article came from the study [1] and aim to contribute to fulfilling the base ambitions of Bratislava integrated transport (BIT), which contains the above mentioned political declarations and the no pending requests of NGOs. These are interlaced with the expert needs and are defined "in the first instance" as: to implement system solutions in PT that provide mobility, but also sustainable development - completion of urban transport infrastructure (modern bus and railway stations are an important part of the infrastructure); construction of transport infrastructure for capacity and environmentally-friendly modes of public transport, including urban public transport (UPT), as well as interchange terminals of public transport; construction of static transport infrastructure (park and ride, implementation of city parking policy, etc.

car-sharing operation); construction of non-motorized transport facilities (bike facilities, bike sharing, etc.) close and/or as a part of the PT nodes/stops.

Integrated public transport (IPT) in Bratislava

Transport integration in public passenger transport (IPT) in Bratislava region is in operation several years and means mainly the following:

- Transport coordination - the single coordination and optimization of timetables and scheduled lines between carriers;
- Tariff integration - as a uniform price list, a uniform ticket for all modes of transport, uniform tariff conditions and transport regulations;
- Building and operation of interchange terminals, including controlled connections to individual car traffic (ICT) like park-and-ride lots, i.e. and to non-motorised transport (pedestrian traffic, utility cycling - bike sharing, parking for bicycles).

In Bratislava region the effort is oriented for a unified customer solution - a single transport offer which is also the most attractive offer of public transport able to compete with ICT. The operation of individual modes of transport on a sufficiently dense network of public passenger transport is aligned so that passengers can easily transfer from a bus to a train or tram, from a car or bike to a means of public passenger transport. Timetables are designed so that time losses at interchange hubs are minimal, and lines and connections are managed according to demand to the greatest extent possible. A detailed analysis based on an extensive transport survey to assess the functioning of the current integrated transport is still missing.

The main principles of integration can be defined by implementing the integration of public transport in the region, so that different modes of transport do not compete with each other, but rather complement each other in performing passenger transport and create an attractive offer for passengers. These parameters are as follows:

- connected lines,
- Uniform labeling,
- Regular intervals,

According to suburb bus transport principles from operator point of view (which is in Bratislava region Slovak Lines, j.s.c.), IPT must be implemented throughout the Bratislava region by the gradual integration of all subsystems of public transport and the gradual integration of areas outside the Bratislava region (other private suburb bus PT operators). The introduction of the IPT system in the conditions of the Bratislava region should bring the following benefits (still in operation):

1. **To Passengers:** uniform tariff and transport conditions on all means of transport of the carriers involved in the project of Integrated Transport System (ITS) of Bratislava region (currently, the carriers are DPB, a.s. – Bratislava Public Transport Company, SL, a.s. – Slovak Lines and ZSSK, a.s. – State Railway Company);

2. **To Carriers:** appraisal of own capacities in a more economical way on a wider coherent space under clearly defined contract terms and conditions with a guarantee to cover losses economically incurred in providing performances in the public interest;

3. **To Transport Customers:** the use of public funds to provide for transport in the region and the city in a more economical way.

Priorities of SBS in Integrated public transport system

For the purpose of ensuring quality service **in the field of transport**, the following is required: efficient transport service and measures to ensure coordination within BIT - however, there are nowhere clearly defined tools (or resources) on how and through what it should be achieved;

Note: the term “transport optimization” often occurs; it otherwise means an administrative tool for mutual restraint on the performances of individual carriers at the expense of others. Unless and until quality transport service by any carrier in railway – suburb bus – city PT is achieved through demonstrable parameters, for example, according to EN standards and EU recommendations, it is not advised to administratively restrict the performances because passengers will start using ICT due to the elimination of their current customary Behaviour. Currently, unnecessary pressure arises between various PT operators to restrict transport performances, and first of all we have to introduce passengers to an attractive, i.e. wide enough, joint offer of public transport;

In the tariff area these principles of integration must be observed:

- Principles related to the introduction of one-time through tickets accepted by all carriers involved in ITS of Bratislava Region;
- amendments to the tariff and transport conditions of ITS of Bratislava region in accordance with alterations agreed upon with customers and carriers – missing system tools over time; they must be gradually implemented in introducing uniform season tickets;

Note: the state’s Transport Policy has introduced free fares on railways for certain groups of passengers. It is a decision where the PT tariffing system, unless designated across the entire scope of public transport services with respect to carriers, leads to further problems in the market system

currently existing in Slovakia. It concerns the financing of SBS and UPT from the resources of regions and municipalities in a way other than that of the state. In addition to the administrative decision on fares with zero tariff, the railways have a uniform price list throughout Slovakia or rail passenger transport. At the same time, the services of the private rail carrier should be involved in BIT integration. Otherwise the general system principles of integrated transport system (ITS) cannot be declared;

- To integrate card systems, marking machines and ticket machines with new technologies in the field of tariff information systems;
- To create a unified fare card and application for smartphones across the area of BIT operation in the computerization of comprehensive services;
- To provide for regular traffic surveys related to the needs for a survey of quality and passenger transport volume and the evaluation of the revenue distribution system;
- To continuously quantify the parameters of transport work division, i.e. the quantification of passenger-kilometers of carriers in the respective zones and on the radial roads of the agglomeration according to current timetables with correction based on actually realized performances – the survey data.

In the infrastructural area it is necessary:

- to put the dispatcher control system of BIT into operation, which will be an essential tool for monitoring the implementation of the transport process and in providing information services to the public (operation of information systems);
- To manage the information systems of stops at least on each terminal of integrated transport;
- To complete the implementation of the project of unified vending (ticket) machines and ticket marking machines;
- To announce the principles of integration along with their incorporation into

the project documentation of interchange terminals in Bratislava and its agglomeration.

Public Transport Model

For the complex analysis the aim was to use the city model of Bratislava from the Master Transport Plan (MTP) [3] which states: “According to the Assignment, the transport model will take several modes of transport and several time scenarios into account. These together form the modeled scenarios. These scenarios of predictive transport model are available for PT in the entire document: 24 hours, 7:15 a.m. to 8:15 a.m., which is the peak hour in the city for the entire transport and two periods of peak hours, namely 6:45 a.m. to 9:45 a.m. and 3:00 p.m. to 6:00 p.m.”.

The model consists of the model of transport supply and the model of transport demand. The transport offer comprises a transport network that works for five modes of transport:

- Individual vehicular traffic;
- Freight;
- Public transport;
- Utility cycling; and
- Pedestrian traffic.

The model contains 263 zones in the city of Bratislava and also 112 external zones in the area outside the capital. The model of transport demand is completely based on data from the household survey. It enables the model to retain a predictive value in the prospective scenarios. Thus, the model can reflect changes of a demographic, economic or infrastructural nature.

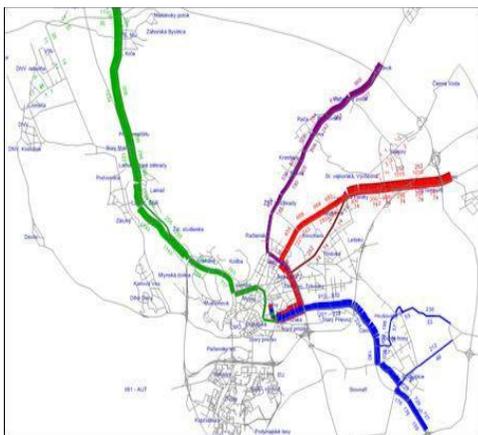
Based on the analysis of MTP can be stated that it does not contain with a high probability the scenarios of suburban public transport individually or cumulatively, and passenger volumes are not included in any of the UPT scenarios. Despite of the fact [3] states: “External origin/destination transport consists of journeys made by inhabitants from the surrounding area of Bratislava

which is included in the zonal system of the transport model. The area in the agglomeration of Bratislava is the original source or starting point of these trips. Then the zones outside Bratislava constitute the destination or origin. Return journeys, i.e. returns from the destination to the origin, are also included in external origin transport". The critical problem was that the MTP did not deal with suburban public transport (?!). Based on the information derived only from the survey of households in the city of Bratislava, we could state that the original text [3] does not include any reference to dealing with suburban PT. Please, it is not a fatal mistake? Who and where are the city decision makers?

Processing of Traffic Surveys of suburb public transport

Based on [1] it can also be stated that "the travel Behaviour survey (all the traffic surveys carried out for the MTP) and the zero scenario analysis have identified significant and strengthening tangential relationships between transport and urban districts or boroughs. The results from the huge traffic survey confirmed the logical suburb travelling in/out of Bratislava.

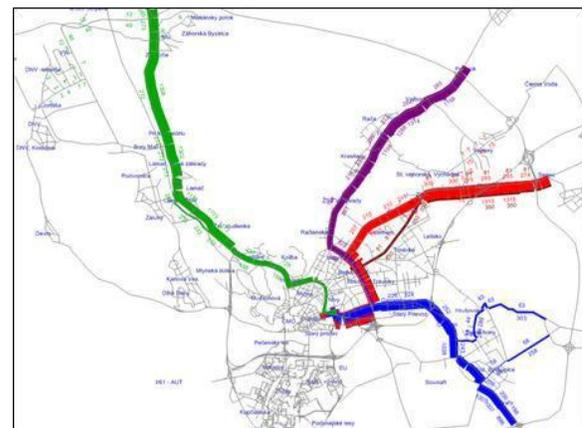
Figure (2): Flow map of travellers – average morning rush period 06:01 – 09:00 h in the city



The network was formed directly by SBS operation conditions and the stops. It

was based on the assumption that the logical centroids of UPT stops in the scenarios can be used and overlaid with own design of SBS network. It is assumed that each stop of the UPT scenario is covered directly by transport and urban zones. The statistical model for UPT has not been dealt with in [3]. Based on the analysis described above, this solution remained only at the level of own SBS network, what could be a problem for complexity for further integrated PT decision making. The creation followed up with SL linking, and individual stops were inserted into the transport model of [3]. The aim was also to preserve the respective transport zones. The future use can be based on the assumption of insertion of individual zones along with overlapping the existing zones of the transport model according to [1]. Figures (2-4). Show particular scenarios for morning and afternoon peak periods with a focus on the central Bus Station for average day volumes.

Figure (3): Flow map of travellers – average afternoon rush period 14:01 – 17:00 h in the city



Strategy of Suburban Bus Stops

The fundamental and very suitable principle for increasing the attractiveness of public transport use, in spite of the radical opposition of passengers to transfers between individual PT operators, is to create combined spaces for common PT stops that

would facilitate such transfers. At present, common services of SBS are already provided in simple form at certain stops. It is the suburban bus service along with UPT in the city of Bratislava.

In general, the issue of transfers is the basic negative for passengers using PT. What causes passenger's negative approach to using transfers when travelling by public transport? Basic issues include time losses and the variable convenience of transport resulting from:

1. Physically inappropriately-designed location of stops – separate embark edges of stops and the need to move from one stop to another, frequently with a distance longer than 100 m,
2. A non-uniform way of using tickets, and delays in getting on/off PT, especially the suburban bus service – it belongs to the past by introducing the 3rd stage of BIT as from 1 September 2016;
3. Failure to comply with timetables and loss of links to following connection;
4. Long waits for the next connection – applies mainly to transfers between railway – SBS/UPT;
5. Variations in travelling comfort, among others, by changing the means of transport at different quality levels and different levels of service.

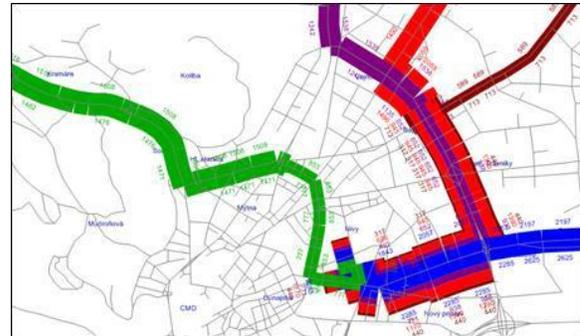
However, as part of the integration of public passenger transport, the basic principles to be accepted by each operator must be dealt with. Such principles must include:

1. A unified ticketing system – including the purchase of one-time tickets – a uniform ticket machine (not as complicated as in couple of German cities);
2. A unified system of electronic season tickets;

3. Optimization of performances between the operators through a system of strengthening quality service in the area.

In terms of public service in the territory of Bratislava which is covered by a dense network of UPT lines (average distance of UTP stops in the city is 187 m only), the capacity of SBS is sufficient with the operators can be utilized for an additional network of creating express lines. These should use their existing routes in the communications network with the current stops, and where appropriate also at other stops combined with the UPT network as demanded by passengers.

Figure (4): Flow map of passengers on an average working day at 3:01 a.m. – 11:00 p.m. in the City Centre and Central Bus station



SBS Stops in the City of Bratislava

The distribution strategy of SBS stops has its history and has undergone several optimization assessments, resulting in the current debugged state. Defining parallel PT lines in BIT is an important task. Ministry of Transport SR in railway transport promotes absolute priority to solely deal with suburban bus service which is complementary to the respective stops and stations of railway transport, without driving parallel to the railway. The analysis made in [1] according to the strategic document of the transportation master plan [3], as well as the analysis of IPT, cannot be objectified and the view of the ministry cannot be systematically and technically supported. The nature of most

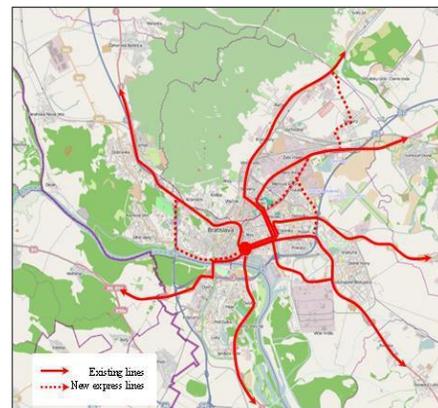
stops and stations of railway transport is not adapted to the fundamental principles of integrated public passenger transport. The base philosophy of the strategic nodes and terminals was presented in [4].

The fundamental principle still applies, i.e. the principle of the best possible services in the area and characteristics of the particular modes of PT that can continue to attract passengers to their mode of transport. The above-mentioned attributes of the legitimate demands of passengers (the issue of transfers, travel time from origin to destination, quality of transport, overall services, etc.) definitely constitute the fundamental principle of the “advantageousness” of public transport compared to the use of ICT. An administrative process which is inconvenient for passengers will undoubtedly lead to their re-shifting back to ICT. We can only subjectively state that the respective radial roads towards Bratislava (see Fig. 5), where mainly are operated the SBS, are characterized by large tailbacks and delays in traffic flows of car traffic, and therefore PT flows between carriers can be optimized – the right solution, however, is to restrict in rush hours by congestions of ICT. Characteristics of the issue of peak periods on the limits of Bratislava city, on specific radial roads in their sections of traffic flows – on cordons, are not mapped by special traffic surveys to the sufficient extent. Making transfers between individual modes of public transport upon an administrative decision would clearly be a wrong decision in coming years. Building a quality PT service is only gradual and is very demanding; in the case of a wrong decision (administrative one!), it is very difficult to return such service to its original level. Taking an improper administrative step can very easily cause an irretrievable loss of passengers, who go back to the ICT usage and are forever lost.

The regional suburban bus service is expected to remain the backbone of transport, mainly on radial roads which are not closely linked to railway transport, or

such service is not provided on a particular radial road. No need to transfer until reaching the city center at MN Bus Station is its major advantage. Its attractiveness is so natural and it also increases its practicality for families with children and persons with reduced mobility in accordance with EU laws (rights of passengers in bus service). The fact that SL is well-equipped with modern low-floor vehicles also contributes to the attractiveness.

Figure (5): SBS network for the public transport express lines on the area of the city



In terms of hierarchy of integrated PT, the main principles of interchange hubs and terminals are shown in [4]. SBS stops in the city can be classified as follows:

1. Definition of BIT in terms of ITS cannot be assessed positively with respect to the interchange of passengers in the direction from origin to destination in both the morning and afternoon peak periods;
2. The existing functions of the main railway station as well as other stations of public passenger railway transport in the city of Bratislava are also not addressed according to the principles of ITS;
3. The position and function of MN Bus Station is clearly defined, and limitation of its performances is not envisaged, especially in terms of a new investment, giving rise to an

all-inclusive and modern terminal bus station bordering the inner city ring road (fig. 5); indeed its importance will grow in connection with the development of the urban district and expansion of the international bus service;

4. The city lacks a clear strategy of defined functionality elements for the ITS of UPT for all its modes so as to preserve the definite principle of the advantageousness of transfers.

Express lines and higher quality of BIT

Bratislava has an ideal opportunity to create a network structure of urban public transport which must be represented by the Supporting System of UPT - a tram (or its future urban track version: a tram- train). A network of express buses which will improve the range of services provided in public passenger transport is a supplementary system combining terminals and tram stops. In terms of the city, a tram is defined as a high-capacity public transport mode - the supporting system of UPT are city bus lines and trolleybuses which has a very limited transport capacity at peak hours and besides, is dependent on transport conditions of ICT flows in the network of urban roads.

However, the analysis and design of the transport system according to [3] do not define the principles of functions of integration of several PT modes. In terms of SBS, the termination of SBS lines is not mentioned anywhere. The integration of the new bus station at Mlynské Nivy is not addressed, but it also means that reasonably and professionally it is automatically correctly considered an important transport hub. Transport model scenarios according to [3] do not deal with relations how during the time periods 2020 - 2025 - 2030 - 2040 passengers are redistributed between the respective modes of public transport, such as between railway and tractions of UPT, between SBS and trams, or trolleybuses and

buses of DPB. In this way, the “mobility sustainability” can be little assessed in the area of the city in the PT system itself by 2040. Similarly, it can be stated that the design of the P+R system at the terminals is also not reflected in the respective scenarios (at least it cannot be identified anywhere).

Creation by the carriers of an important level of service and in the parameters of a higher capacity and an appropriate time interval is the second factor of success in obtaining a larger “cake” in a modal split between ICT and PT. The PT infrastructure is not developed at all in the hierarchy from simple quality stops with functions, such as common parking of bicycles or transfers at one edge, up to terminals with comprehensive services and mainly with clearly designated non-collision pedestrian routes in the horizontal and vertical segregation, which would automatically lead to a reduction in PT performances in favor of ICT. The Bratislava region along with the city of Bratislava prepares a new plan of transport services, which should state the possibilities of transformation and redistribution of performances between the respective modes of PT. First of all it is not advisable to create a philosophy of competition between the PT operators, what was mentioned above by possible Ministry red-tape decision making.

Conclusion

The main principles of the development and improvement of the suburban bus service in Bratislava agglomeration should contain: sharing of traffic flows for all carriers of PT. Defining cumulative tools for reducing the share of ICT in modal split even with the tools to apply principles for a change of transport policy in the Bratislava agglomeration by implementing a parking policy in the city, which has been prepared since 2012, agreed by City Parliament in December 2016, but still not in deployment and operation, on no account should we create administrative principles to change preferences of

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redistribution of traffic flows among carriers of public transport.

This primarily reflects the state of the traffic situation on each radial road at the entrances to the city, where at present and especially in the next period of ca. 5 - 8 years congestion in the morning peak period causes traffic jams, and therefore passengers gradually transfer to means of public transport, in the case of peripheral boroughs and satellite villages and cities, the modal split should be reduced at least partially in favor of PT by building park-and-ride lots, there. These lots can be built not only in the city of Bratislava but also on the city limits, thus creating the opportunity to introduce express connections from these villages using SBS. However, the foregoing will require a funding system and a certain time due to land-use planning building procedures in terms of defining community service, it is necessary to strategically analyze the additional option to apply PT preference tools using examples of imposing a charge on access to the city, "Congestion Charging", which is already used in many EU cities, it is a necessity to analyze complexly the just finalized study of the Plan of mobility service done by Bratislava Region and wait on the results of the Feasibility study of Bratislava Railway Node guaranteed by the Ministry of Transport to get a new base for a decision making how to deploy the Integrated public transport services in Bratislava agglomeration.

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