

## Co-Modality as a Tool for Improvement of Public Transport

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### Abstract

The constantly increasing passengers' requirements on the quality of passenger transport services are forcing the authorities and public transport providers to develop and improve various solutions how to keep at least partially competitiveness of public transport with private car mobility. This article was financially supported by the European Union's Horizon 2020 research and innovation programme. The article contains the results from the ongoing Ride2Rail project and describes the benefits of the co-modality implementation through which door-to-door mobility will be reached, and it will contribute to the improvement of the quality of public transport. The article aims to analyse, propose, and evaluate the possibilities of integration of co-modality within public transport and its gained benefits and expected impacts on the involved stakeholders.

**KEY WORDS:** *public transport; co-modality; passengers' requirements*

### 1. Introduction

The changing of human behavior caused by worldwide globalization is reflected in their traveler habits. The jobs in rural areas are on the decline and there is a boom in job opportunities in big cities and it causes the increasing growth of big cities. People try to move closer to cities offering many job opportunities, which increases the attractiveness of the city and the cost of living there. Many residents cannot afford to pay such expensive rents, so they choose to live in rural areas around the large cities from which residents are forced to daily commute to work. Public transport is not as available there as in the large cities, therefore commuters prefer to use private cars to get to work. Commuters often use private cars on their own without any additional passengers. Statistics included in the Ride2Rail project shows that car occupancy rate for commuting trips in European countries is around 1,1 person per vehicle [6]. These commuters' travel habits have a negative impact on road traffic conditions, urban parking policy and increase the production of greenhouse gases. It is necessary to change these long-standing unsustainable travel habits [5]. One way in which these habits could be changed is co-modality. Co-modality encourages travelers to use public transport in collaboration with shared mobility for commuting from rural areas to urban areas, thanks to the increasing availability of public transport [14]. The main goals of co-modality are to connect all transport modes into the one, unified network system, to make the public transport more available and to decrease the production of green gas emission by transport. This concept will ensure the sustainability and effectiveness of all transport modes [12]. The possible way how to achieve the co-modality goals is to use a co-modal approach. Co-modal approach focuses on a global approach to transport where the combination of different transport modes is ensured. It does not take care about the negatives of transport modes, but it tries to find and use optimal and rational combinations of transport modes [14]. Public transport becomes more available for end users, which will decrease the number of private cars on the roads mainly in city centers. It also helps to cover the first and last mile and the closely related door-to-door mobility. One of the possible solutions, how to reach co-modality, is to integrate the shared mobility into the public transport [8, 9].

### 2. Ride2Rail Project Goals

Ride2Rail project partners tried to create the intelligent framework which allows to combine the shared mobility (ride sharing) and public transport. This solution supports the co-modal approach, and it should be used in low demand areas from which the travelers commute to bigger cities. Ride sharing is perceived as an effective and flexible feeder for high-capacity transport modes (bus, rails, etc.). Co-modal approach is going to be tested in a diverse urban and rural context in 4 demo sites [6].

### 3. Literature Review

The authors of article [13] compared the energy consumption between railway and passenger car transport. Particularly this article compared energy consumption on 1 person-kilometer in simulated condition between diesel train unit 813-913 and diesel and gasoline cars. Evaluation of article shows that the passenger cars can be also very effective in energy consumption, but mainly when the car is highly occupied (4 or more passenger in the car) also sometimes low occupied public transport vehicles should be greener-less than low occupied passengers' cars.

Author of the final thesis [8] described the factors that can influence the travelers during their selection of the

modes of transport. The factors are divided into two groups. First group is formed by economic criteria (acceptable price, multimodal travel ticket, comparison of cost of transports between different modes). The second group is formed by non-economic criteria (availability, quality of information and booking systems, travel time, number of transfers, safety, quality of transport means, environmental aspects).

With those articles is closely related the articles [3] and [7] where is the importance of the information provided to users during the trip planning described. The article also explains importance of mobile application which contains all relevant data in one place can make travelling by public transport more attractive. The smart mobile application could encourage travelers to use public transport if it contains all required and important data. The article contains description of Travel Companion application. Ride2Rail project deals with this Travel Companion application and it tries to find rational solution how to solve upper mentioned issues (low occupancy of all means of transport, implementation of co-modality, door-to-door mobility transport solution, necessary data for user in one place). One of the Ride2Rail project goals is to make mobile application allowing to connect the ride sharing and public transport (ride sharing is a feeder for high-capacity transport modes) and to provide all relevant information for travelers. Offers generated by Travel Companion application contains information for travelers about travel solutions, prices, environmental factors of selected transport solutions and many more. Besides this, the application also allows traveler to share their rides with other travelers as complementary for public transport. This solution helps to make the transport more sustainable and ecological friendly [6, 10].

#### 4. Implementation of Co-Modality into the Selected Region

Proposed and created solution of Ride2Rail project could be implemented across whole EU even globally across the countries of the whole World. For evaluation of the solution of Ride2Rail project was selected the region of Banská Bystrica located in Slovak Republic. The most famous center of this region is county city Banská Bystrica, which offers many job and education opportunities. The population is around 110 631 and is made up mostly of people in working age and this proportion is equal to a national level. However, this population group is expected to develop unfavorably, as the region is made up of a larger group of post-working age population than pre-working age population. There are 135 inhabitants of post-working age for every 100 inhabitants of pre-working age. 30% of mentioned population of this region live outside of Banská Bystrica, whom majority have to daily commute to this city. The Fig. 1 contains the distribution of population within the Banská Bystrica region and the Fig. 2 contains the distribution of job opportunities [8].

One of the most important visions of integration of ridesharing within the public transport is the expansion of mobility, in which ridesharing will create a so-called feeder for public transport, especially in areas with insufficient public transport with low number of provided services and from these areas there are no direct services to the larger cities and there is a need to transfer many times [2].

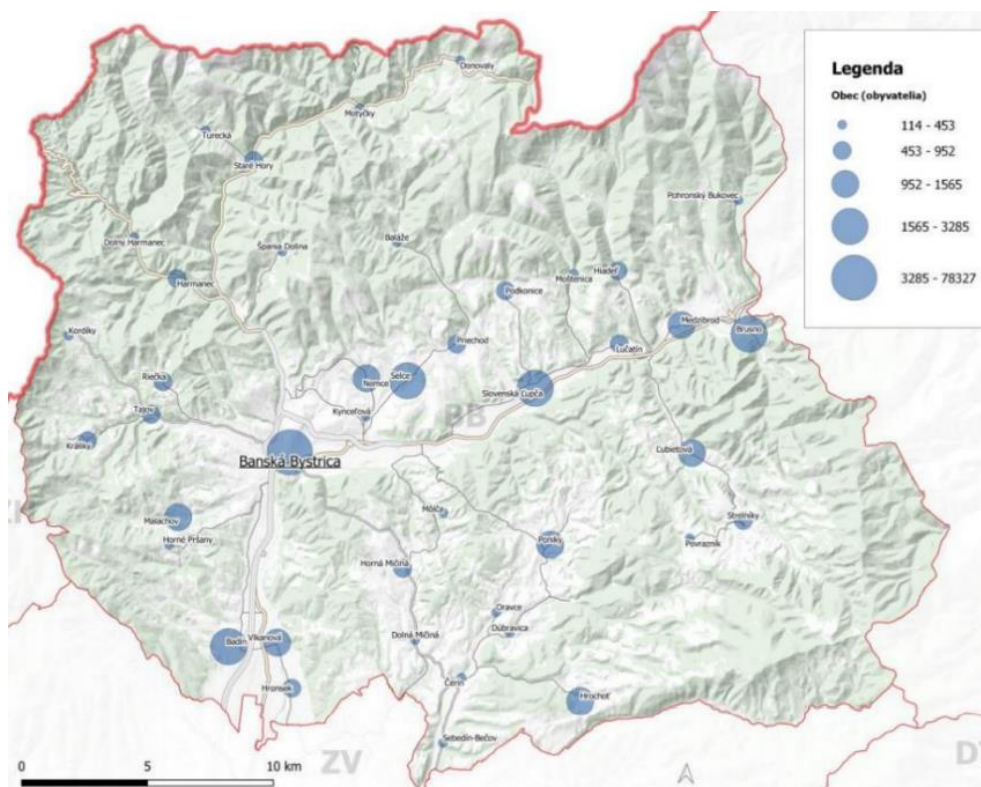


Fig. 1 Distribution of population within the Banská Bystrica region

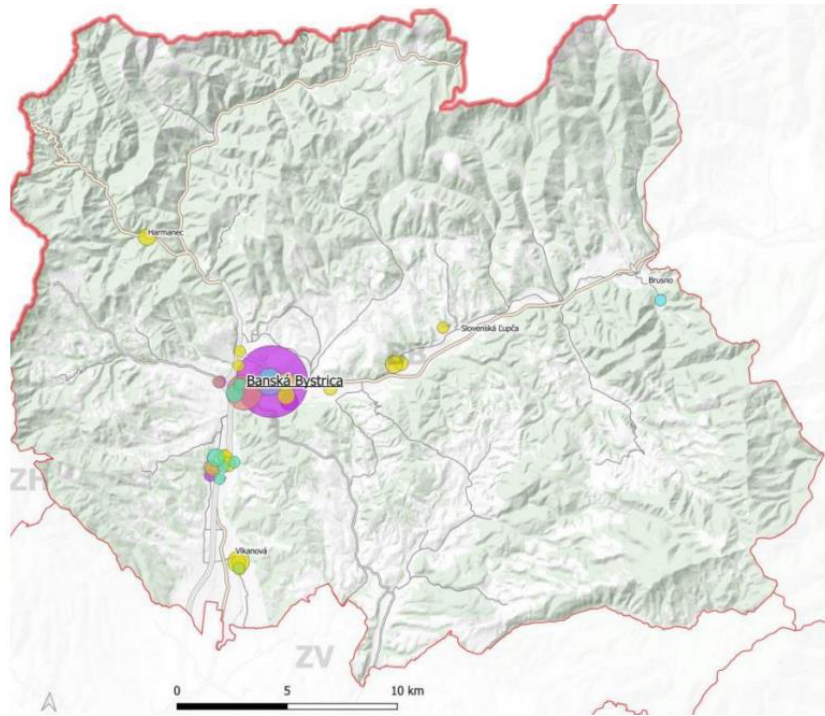


Fig. 2 Distribution of job opportunities within the Banská Bystrica region

The best way to integrate private cars into the public transport is by using the solution proposed in Ride2Rail, where the driver provides a shared ride to the nearest stop of the high-capacity transport lines and then all travellers (if any) complete their journey by public transport [4]. This method is acceptable within the BBSK because the intervals of the high-capacity transport lines are sufficient between each line during both peak and off-peak periods to transport passengers to and from that point throughout the day, while the complementary lines do not run at such frequent intervals. This way of using ride sharing also serves to cover the first and last mile. Ride sharing should ensure a reduction in transport distances by private cars, there will be a reduction of private cars on the roads, also a positive impact on urban parking can be expected, the occupation of all means of transport, including private cars, will increase. In terms of environmental impact, the unit CO<sub>2</sub> production from transport will be reduced [11]. Last but not least, public transport accessibility will be increased. Fig. 3 and Fig. 4 compare the isochrone distance of passengers to the railway stations, which are perceived as high-capacity lines in the Banská Bystrica region. Fig. 3 shows the 10 minutes commuting distance by walking, and Fig. 4. shows 10 minutes commuting distance by private car. It is clear from this representation that rail transport (among other things), by integrating individual modes of transport, becomes much more accessible also to the inhabitants of remote villages who would have no way of reaching these stations without the use of the private car, unless there is sufficient passenger transport operating in their territory [8].

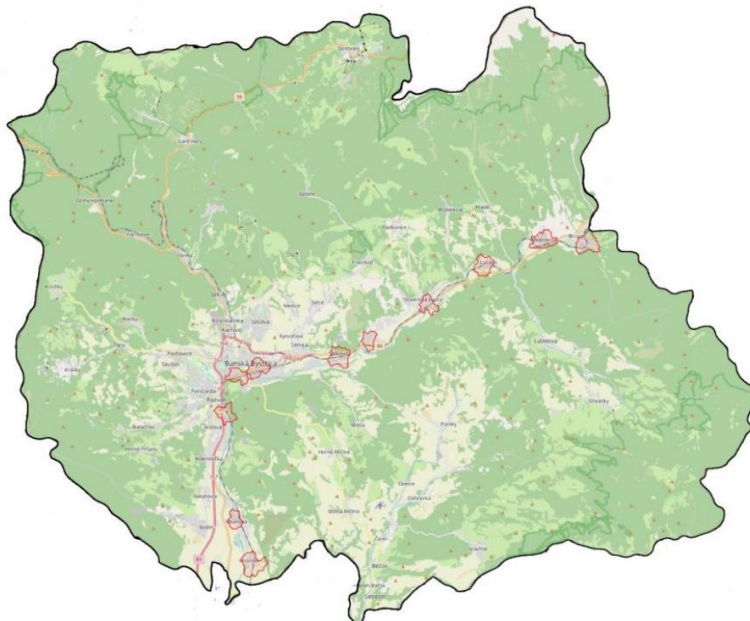


Fig. 3 Isochronic display of the commuting distance to railway stations by walk



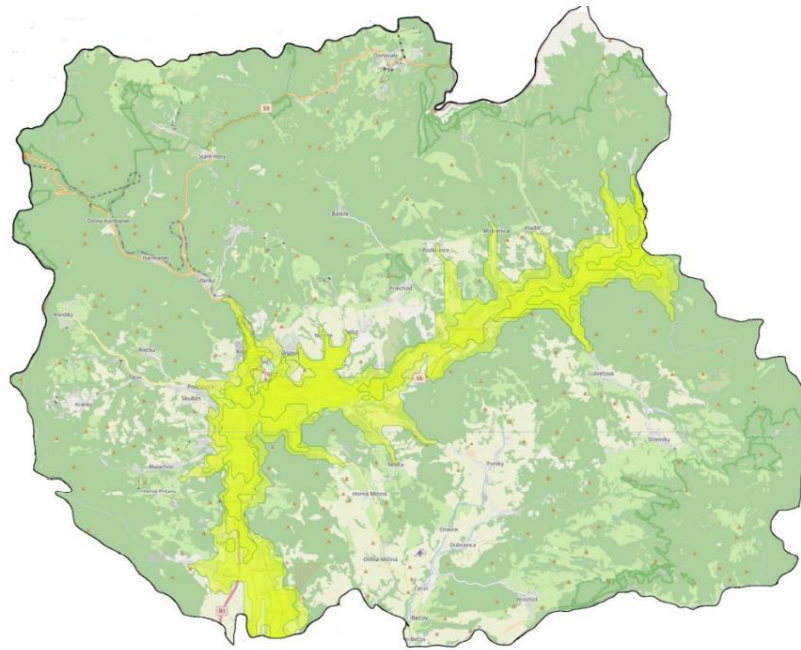


Fig. 4 Isochronic display of the commuting distance to railway stations by car

The Travel Companion app will help users to find a comprehensive door-to-door travel solution and will also allow them to use individual modes of transport (ride sharing), which will be linked to public transport (specially to cover the first and last mile) and this may increase the interest of the traveller to travel at least partly by public transport. From the isochrones shown in figures it was found that the use of the private car makes rail stations and stops much more accessible to the surrounding villages and their inhabitants compared to walking to the same public transport stops.

The general impacts of linking public transport with ride sharing and using of Travel Companion application are related to:

- Increased system efficiency - with sufficient information and route options, the overall efficiency of travel can be increased. This applies to route selection, but also to the choice of individual modes of transport [1];
- Congestion reduction - when reducing congestion, it is also important to bear in mind that there are financial savings, which consist mainly of time spent in congestion, increased transport costs and carbon charges [9];
- Improvement of air quality - reduction of CO<sub>2</sub> emissions, which occurs with the reduction single occupied car rides [15];
- Increasing social cohesion - by transport users swapping the single car rides to public transport on at least part of the journey and by ride sharing the space for people to meet is created from different social backgrounds, which can have a positive impact on social cohesion in society [8];
- improving access to services for people with low incomes – the ride sharing opens the door for cost sharing, which can potentially improve the accessibility of transport services for these residents as well;
- Ride sharing as a part of integrated transport system [8, 9].

## 5. Conclusions

The disadvantage of public transport compared to individual modes of transport is less flexibility and reduced accessibility for users, since it is operationally and technologically limited. Travelers have to commute to public transport stations and stops by various means, whereas this problem does not arise when using individual transport and, in practice, travelers have the possibility to travel from any location [1] [2].

The ever-increasing trend of individual motorisation is having a negative impact on the lives of residents and the environment. The proposed solution states that private car journeys will allow users to become part of public transport through ride-sharing services, which will increase the range of services provided to public transport users [11]. In addition, ridesharing will bring many benefits to the whole system, such as reduced road congestion, savings from externalities, increased private car occupancy, increased availability of public transport for users, etc. The Travel Companion application allows travelers to use a co-modal approach, besides this it also includes other innovative functionalities and a comprehensive range of travel arrangements for passengers, from planning their journeys based on their preferences, it allows travelers to booking and purchasing travel tickets for a complete travel solution. Also, through Travel Companion application, travellers can track their chosen complex travel solution on a map base and travelers receive real time information and many more [3].

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