periodica polytechnica

Transportation Engineering
38/2 (2010) 85–92
doi: 10.3311/pp.tr.2010-2.05
web: http://www.pp.bme.hu/tr

RESEARCH ARTICLE

The possibilities of the provision of urban railway function on the suburban railway lines of MAV

Viktor Borza / *Zoltán Imre* Horváth

Received 2009-09-03

Abstract

The railway line capacity measure is in inverse proportion to the homogeneity of effective traffic. The main railway lines lead into Budapest manage both freight and long-distance/commuter passenger traffic in the same time-span. Besides the claim comes up to give a significant role to the commuter railway lines in the public transport of Budapest by the mentioned provision of urban railway function it is not practical to damage the efficiency of the existing public transport system, so the implementation is only worth if the applied method not increases the journey time of the long-distance and commuter trains and not dangerous for the track capacity of the freight trains.

Keywords

economical commuter transport · regular interval timetable

Viktor Borza

Passenger Transport Business Unit Marketing and Sales Department, Rail Capacity Allocation Office Ltd., H-1054 Budapest, Bajcsy-Zsilinszky út 48, Hungary
e-mail: borzav@vpe.hu

Zoltán Imre Horváth

Infrastructure Business Unit, MÁV Hungarian State Railways Co, H-1087 Budapest, Könyves K. Krt. 54-60, Hungary
e-mail: horvathzo@mav.hu

1 Introduction

Today three of the fourteen existing commuter railway lines of Budapest provide planned urban railway function too (the HEV lines of the BKV). BKV has chosen the most simple mode to combine two claims; the serial method. This is not exactly an innovative solution, it manifests itself in such a way that the trains stop in every some hundred meter inside the city. As a result of the serial multifunctional method the commuter segment suffers from a significant disadvantage, so only those passengers use these trains that have not got any other choice.

Inside of the city the trains are quite overloaded, against this in the suburb area they are unexploited. That is why on the one hand the BKV has a significant unproductive mileage from the point of view of cost, and concerning the benefit conditions caused by the reduced fares for short distance passengers the BKV has been crowded out of the field of the more valuable long distance passenger transport (due to the more expensive fares).

From among the 11 commuter railway lines of the MAV (Fig. 1) three have exclusive commuter function the rest have simultaneously the following extended functions:

- freight traffic;
- long distance passenger service;
- commuter service.

Because of the mixed traffic the negative effects on the line and room capacity are increasing, if the national rail try to supply the special demand of the urban traffic beside the long distance and commuter traffic as a third passenger transport section.

This article shows the problems induced by the urban traffic realised together with the long distance and commuter lines and deals with the solution alternatives for this topic.

2 Line capacity problems on the mixed traffic railway lines [3]

The problem is presented in the Fig. 2 which is a simplified distance vs. time diagram. The diagram shows a part of a timetable cycle which is made for the commuter and long distance market sections in the time span considered. The train path

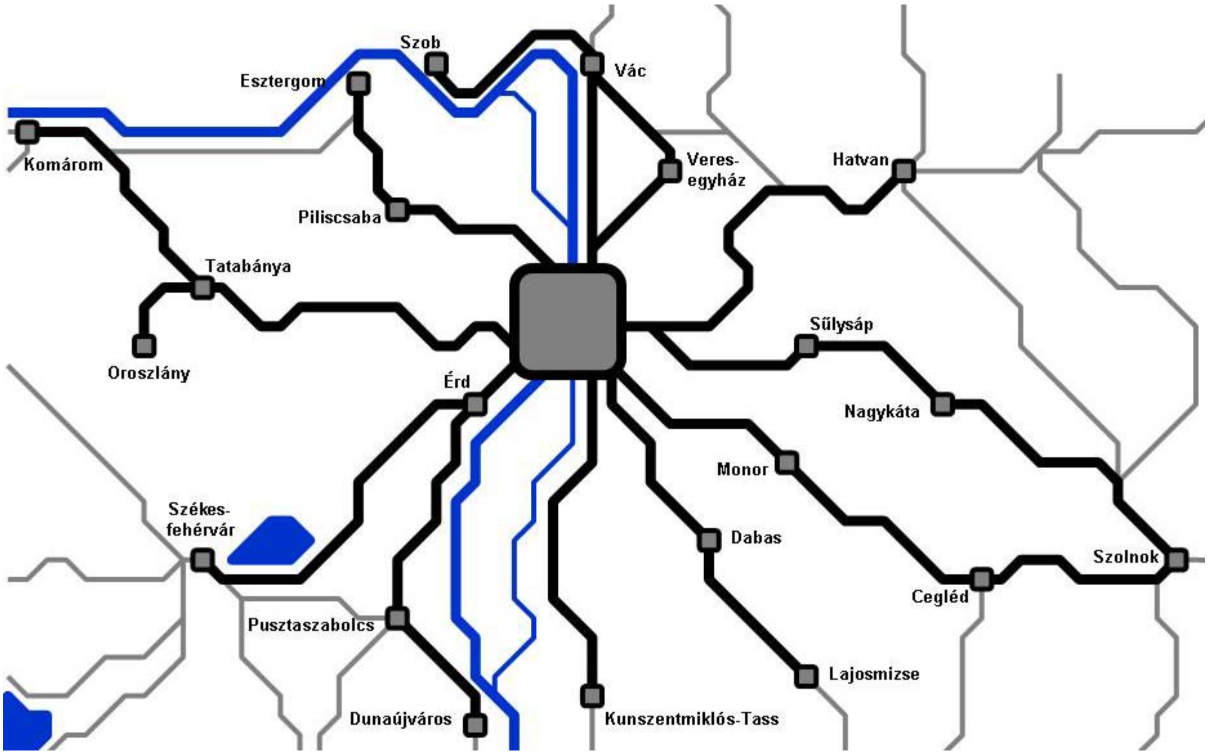

Fig. 1. The commuter railway lines of MÁV

of the long distance trains are signed by dashed lines which are steeper because these trains are faster than the commuter trains which have to stop more frequently on the figure. The commuter train is designated by full line.

For the long-distance trains it is forbidden to catch up the commuter trains between two timetable-junctions. On the one hand, the market value of outran commuter train would be quite low, while on the other hand without a commuter train it would be impossible to design the adequate passenger connection system at the junction because of the former catching up. It follows that the track capacity will be the smaller if the difference in speed between the two train paths is greater. The more flat commuter train paths push the train paths of long-distance more intensively if the difference between the two train path types is greater. As the commuter trains can run only in the slot between the “stressed” long-distance train paths, so the effect of decreasing in line capacity is manifesting for both train types in the same time-span.

3 Solution by segmentation of the traffic (parallel method) [1]

If the addition of urban functions to the present long distance – commuter structure, basically two possibilities can be taken into consideration:

- the parallel method (Figs. 3 and 7),
- and the line method (Figs. 5 and 6).

Beyond the commuter and long distance trains the parallel method means especially also the fast train traffic service. For the urban trains (S-bahn in German) it can ensure the train path between the paths of commuter trains and the following long distance trains, because of their shorter routs (as shown in Fig. 3).

The special case of this method with the mixed traffic structure of two different levels (commuter and long-distance) gives an attractive solution for the doubled frequency of the long-distance trains. By the parallel method combined with the zonal-traffic the possibility is given for splitting the commuter train path into two parts without overtaking. The characteristic of the zonal-traffic offers a structure with two different train types below:

- zonal-trains which do not stop between the cities situated at the zonal boundary and stop at every station outwards the zonal boundary,
- and trains which stop at every station between the zonal boundaries and at the towns connected to the zonal trains.

The train path of the excess long-distance trains can be set between those train paths of the two types of the zonal traffic system at cost of increasing the train changing time (Fig. 4).

4 The additional problems of serial solution without any development of installation [1]

The serial method is classical realizable by stopping the commuter trains inside of the city boundary. This method results slower traffic of the commuter trains (the steep of the train path decreases) by leaving all of other parameters on the same level. If the train path of the commuter trains will be more flat then it makes the train path of the long-distance trains more tight as well.

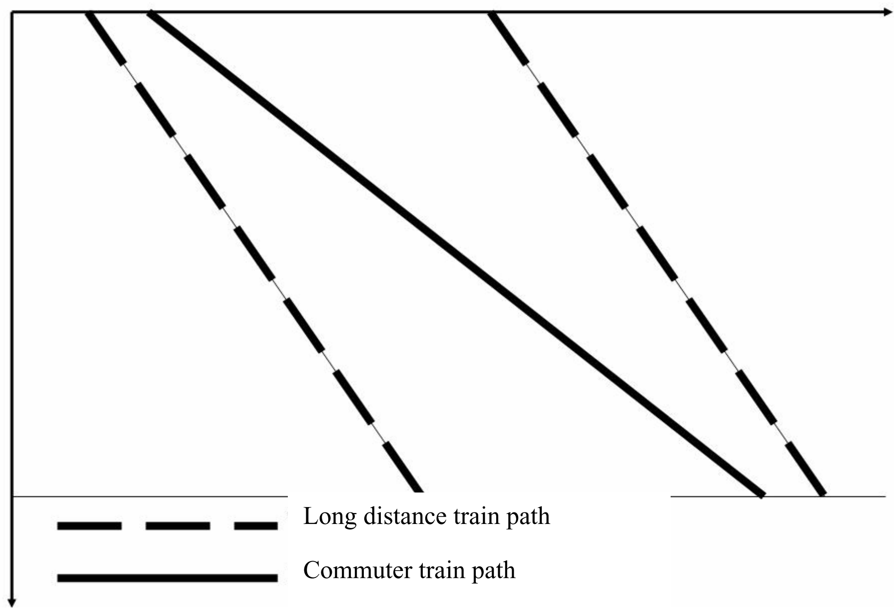

Fig. 2. Line capacity problems on the mixed traffic railway lines

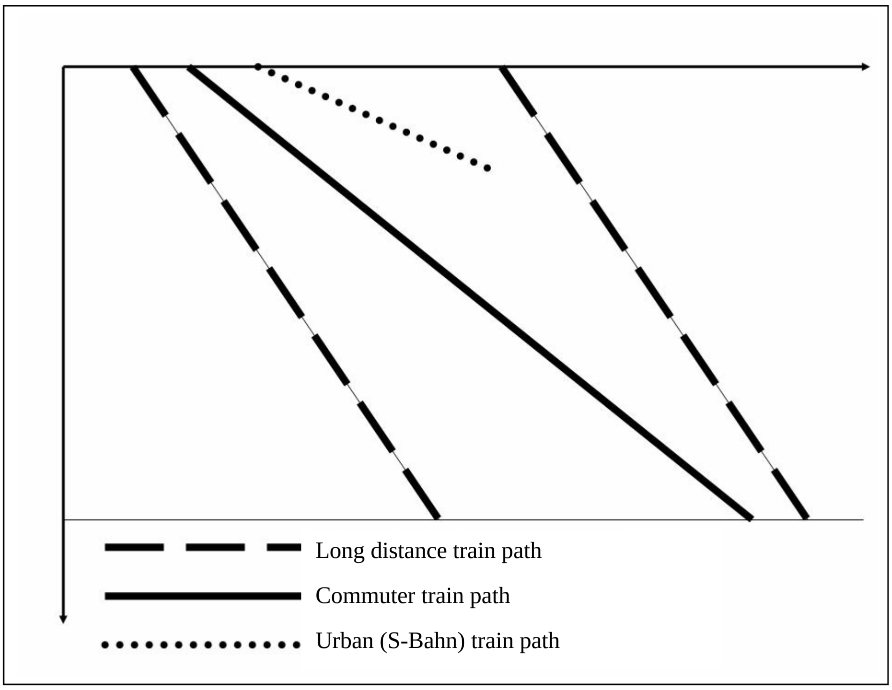

Fig. 3. Parallel supply of long distance and commuter traffic in one direction and one track

So the 30-minutes-rate is only possible in that case if the gradient of train paths of the long-distance trains decreases too, so these trains will not apply the maximum speed level permitted for the railway line. For example they run at a reduced speed of 80 km/h instead of 120 km/h. Therefore the journey time increases for both the commuter and the long-distance trains and in both conventional attended segments decreases the competitiveness of the rail traffic (Fig. 5).

5 Serial solution by moderating the effect of collateral problems [1]

The original structure is sustainable nevertheless the increase of journey time of commuter trains because of the more stops in that case when we decrease the journey time of the train until the next junction in the same measure is increased, i.e. an increased average speed is applied on the suburban section of the line (Fig. 6).

Two methods of increasing the average speed on the suburban line section:

- discontinue of stops on the outer line sections and/or
- using traction units with the ability of ensuring higher train acceleration and speed.

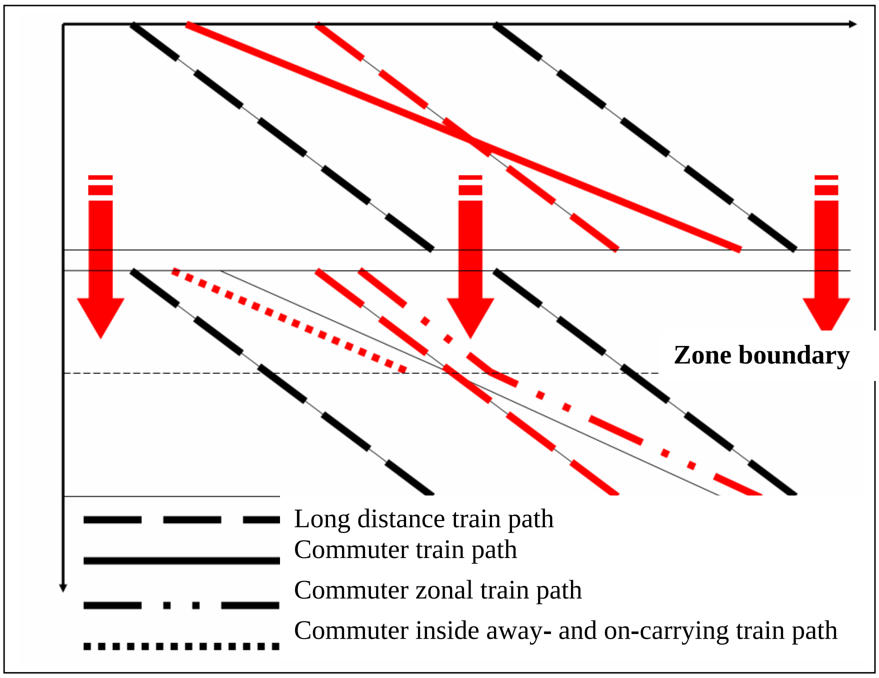

Fig. 4. Parallel method combined with zonal traffic on such railway line which supplies significant commuter and long-distance traffic in the same time. in different directions and on one line.

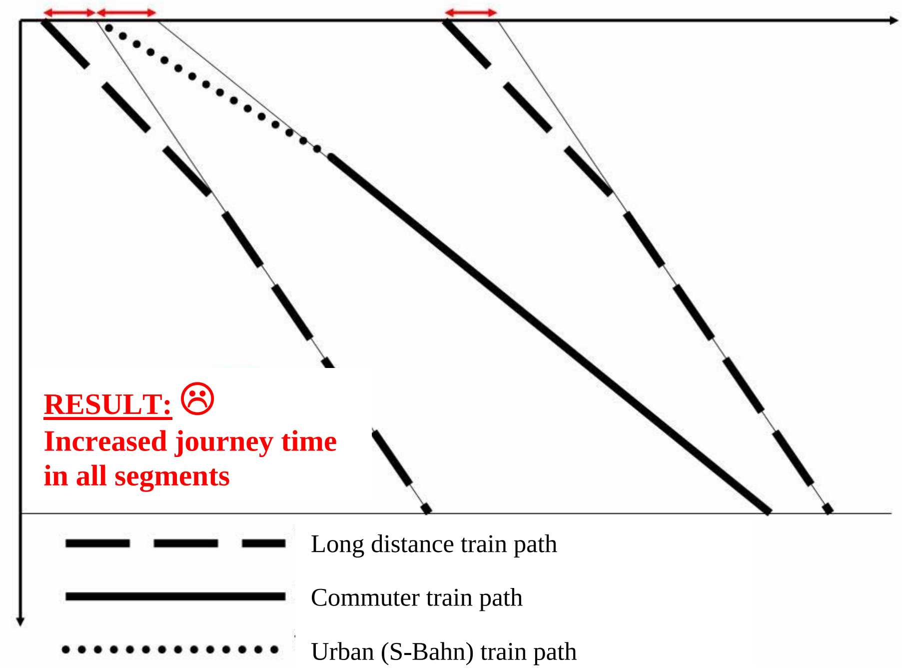

Fig. 5. Fitting into the system the urban-commuter trains by slack off the long-distance train paths (the fine lines show the original system

6 Solution alternatives for solving the track capacity problems [2]

By the parallel method of fitting the urban trains into the system it is possible to decrease the number of stops of commuter trains inside of the city what results a faster pass for the suburban passengers. At the same time it ensures the possibility for development in the segment of long-distance service.

If the line speed is higher; the number of train stops must be less because of the time-loss due to acceleration in the timetable of those urban trains which are running between the commuter trains (Fig. 2) and without arresting the long-distance trains in Fig. 5.

Until we do not decrease the number of stops of commuter trains, the track reconstruction works aimed speed increase are almost needless. The only result we get is that the timetable reserve will increase but the journey time according to the timetable will be the same.

The parallel method of the function-separation results an increased track capacity load, what is anyway not manageable especially at the "narrow throats" without infrastructure extension. In the urban line sections (at least a partial) construction of two additional tracks (altogether four tracks) makes it possible to in-

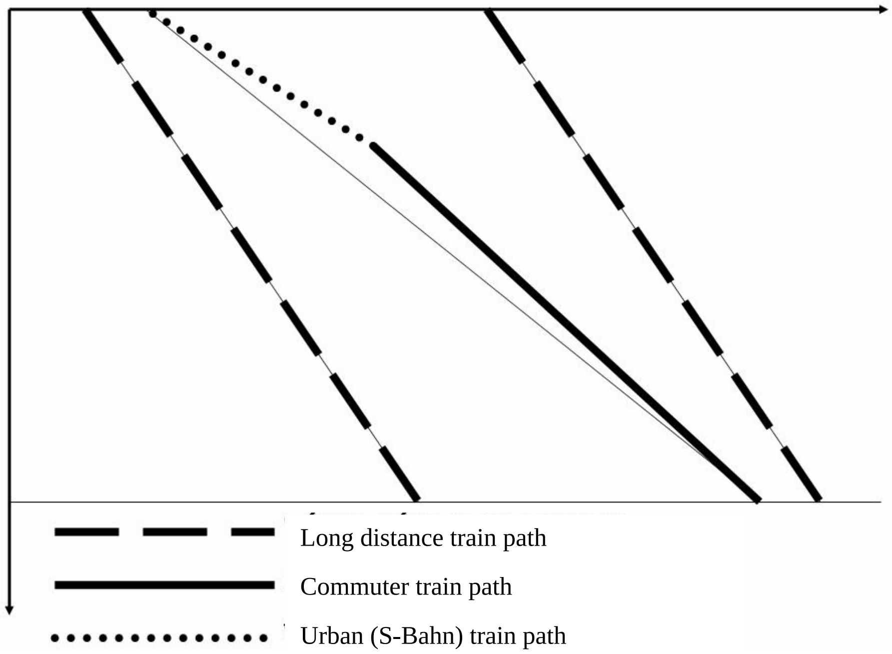

Fig. 6. Undisturbed fitting into the system of the multifunctional urban-commuter trains by increase of the average speed.

crease the service frequency (following time) of urban trains as well (Fig. 7).

7 The space capacity problems and its solution [2]

The system of trains provides urban and commuter functions at the same time (in line) negatively influenced the operation effectiveness considering the passenger seat capacity. Between the number of passengers on the urban fast trains and on the commuter trains there is orderly a difference for the benefit of the first one. If we look simply at Fig. 7 it is visible the 55,45 % difference so the decrease in the efficiency is immediately striking for us.

The rush hours are exactly the same in the urban and commuter traffic. When it is needed to load additional urban traffic to the commuter trains which are designed for the rush hours, it is possible only by double space capacity (in case of the ratio in Fig. 7). When it is important to keep the suburban passengers with more important market value opposed to urban passengers, who bring lower specific income. The more space capacity of the larger dimension train would be utilized only inside of the city, and in a short section of the whole line. On the longest section of the route there would be an unnecessary movement of the unproductive capacity. For the traffic of the trains supplying also urban functions (strengthening of trains), it is needed to obtain additional rolling stocks, which undergo unnecessary running in the majority of its lifetime (it is predictable).

However the urban and suburban passengers are served by different trains (parallel), then because of the faster train turns caused by the shorter routs, only the minimal standing space + seat capacity enlargement is needed for serving the new segment (Fig. 8).

8 Application of the parallel method in practice [3]

To present the above described methods it is an obvious place the Budapest suburb area of Rákosmente. There are two important main lines branching at Rákos station and they supply both of urban and commuter functions (lines No. 80 and 120) which share the 18^{th} district of Budapest to some parts. The reasonable claim of the quarter is to have benefit from the rail by advantages of the faster traffic and feel not only the disadvantages of it. A quarter hands in its claims to a good urban rail service from the MÁV Hungarian State Railways (Fig. 9).

The suburban section of the railway line No. 80 (Budapest – Hatvan – Miskolc) which cuts the north part of the quarter and it has two junctions, railway stations Budapest-Keleti and Hatvan. From the railway station Keleti in the timetable 2009 the fast trains to Eger and Sátoraljaújhely start at hour:03 minutes in every hour and it is followed immediately at hour:08 by the slow train to Gödöllő and at hour:33 starts the InterCity to Miskolc and last but not least the commuter slow train to Hatvan. This train arrives at hour:52 minutes to Hatvan just before the fast train to Sátorljaújhely and Eger at hour:56 minutes.

There is only one track in both directions on the line No. 80 between Keleti and Kőbánya-felső railway stations for the traffic of two additional railway lines. That is why it seems to be impossible to start more trains at the present infrastructure conditions because of the line capacity limits of the line section in junction.

Without any infrastructure development aimed capacity increase the parallel method is not applicable to maintain the present supply (30-minute cadence).

On the urban section of the line No. 80 every additional stop increases the jurney time of the commuter trains by 3 minutes. The consequence of only one additional stop all of the trains

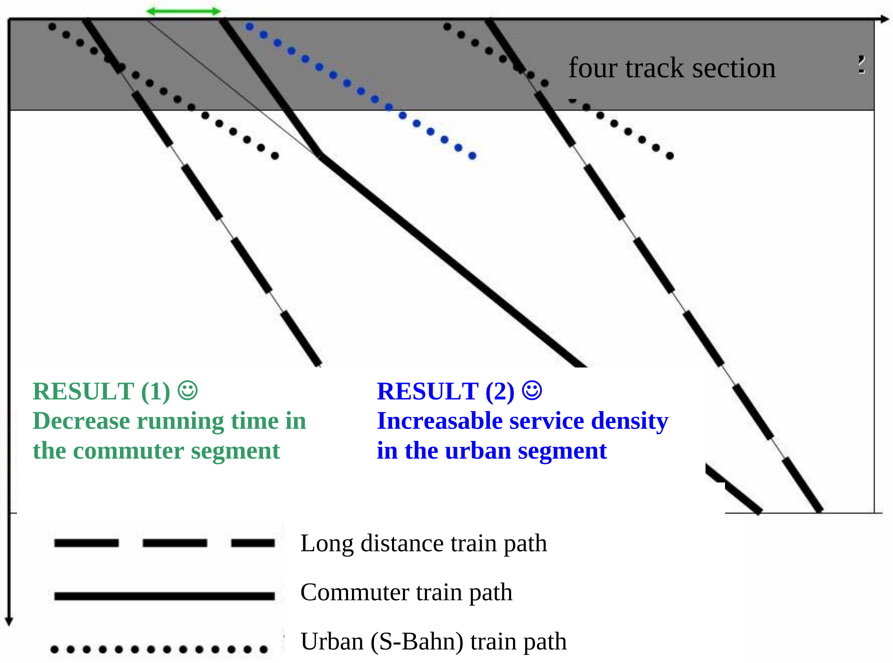

Fig. 7. Parallel supply of long-distance, commuter and urban traffic with suitable service density for the segments, and partly four tracks.

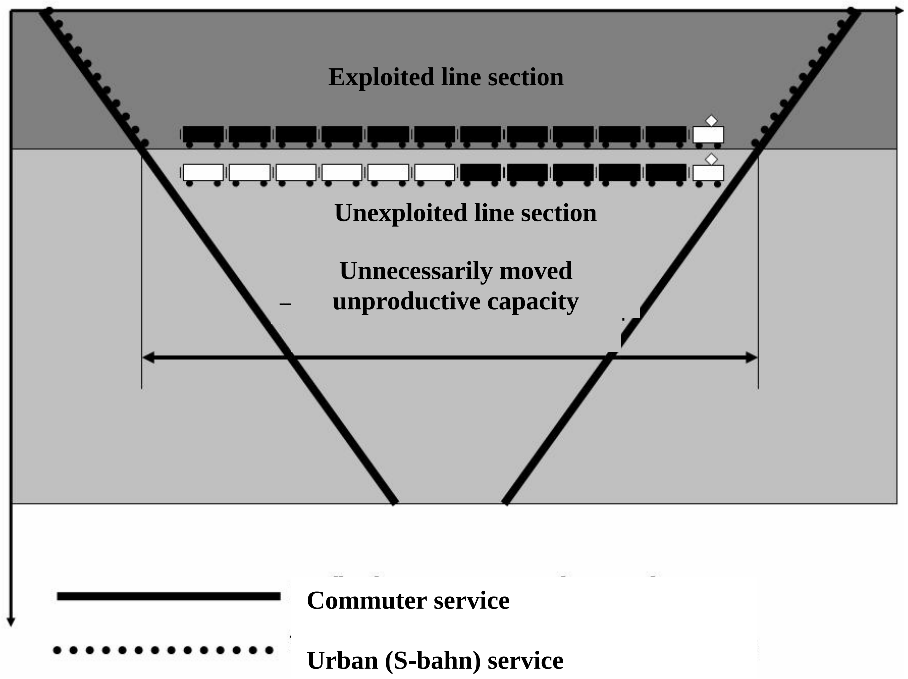

Fig. 8. Seat capacity problems in case of in line service of commuter and urban traffic

Tab. 1. Start time of trains in the daytime start from railway station Budapest-Keleti to Kőbánya felső in the traffic system of timetable 2008/2009

03	Fast train (Eger/Sátoraljaújhely) hourly	33	InterCity (Miskolc) hourly
08	Slow train (Gödöllő) hourly	38	Slow train (Hatvan) hourly
13	IC and international trains (to Szolnok)	43	IC and fast trains (to Szolnok)
18	Zonal train (Szolnok) hourly	48	Accelerated (Nagykáta) hourly in the rush hour
23	Slow train (Mende) hourly	53	Slow train (Sülysáp) hourly
28	EC (Prága) and other trains out of cadence	58	Other trains out of cadence

starting from the railway station Keleti and running between stations Keleti and Kőbánya-felső have to start 3 minutes earlier. The service of the urban passengers is possible (in case of leaving all other parameters) only by increasing the journey time of all trains in Table 1.

On the Budapest – Hatvan line section there is not any stop with extremely low number of passenger but collaborate with the coach service Volanbusz it would be imaginable that for

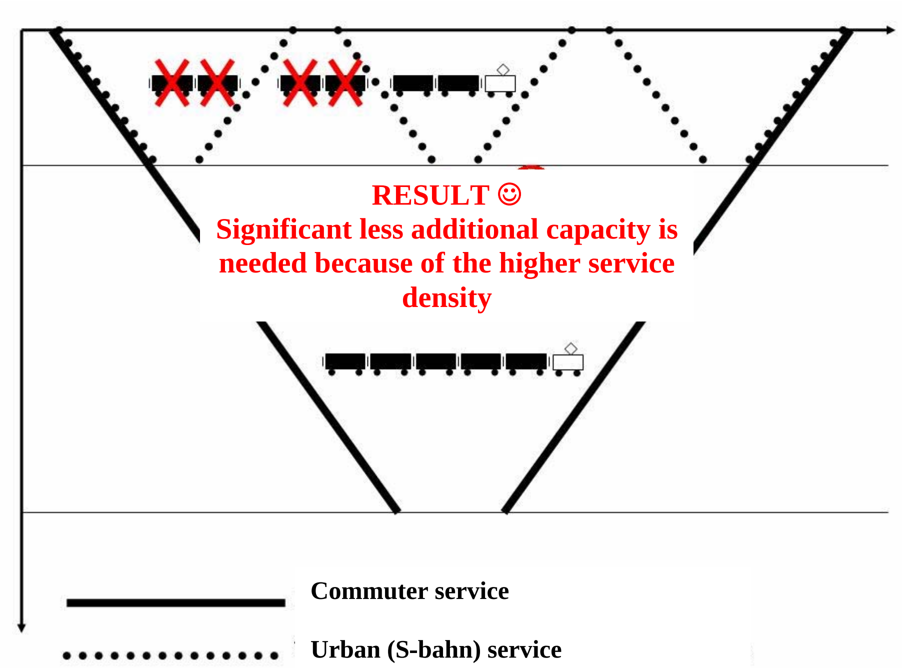

Fig. 9. Parallel serve of the commuter and urban traffic with service density suitable for the different segments and minimal demand for the seat capacity enlargement.

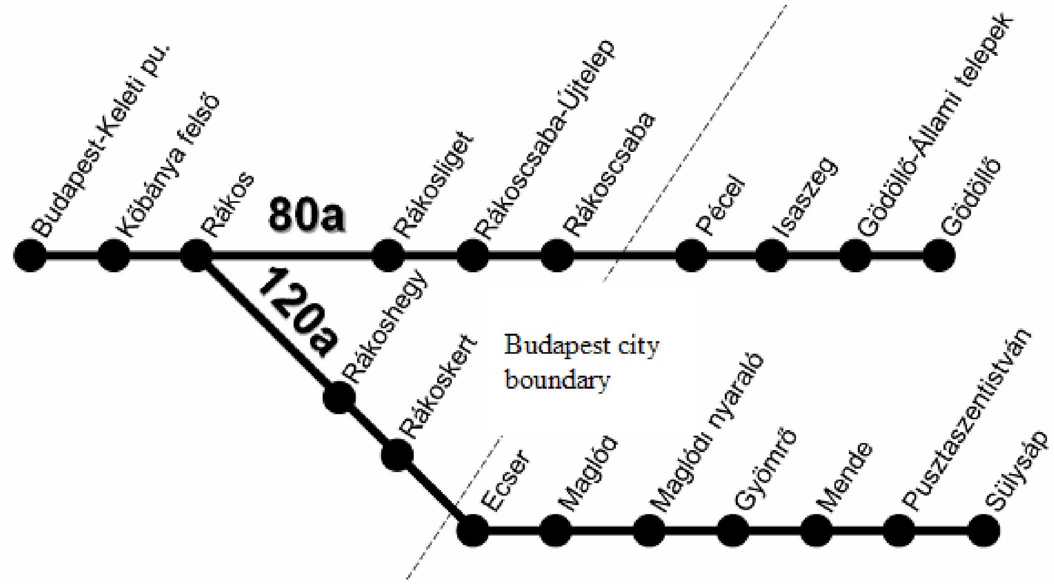

Fig. 10. Suburban railway connections of Rákosmente

some village or city it would be more attractive to be served regularly by bus between the centre and the nearest railway station.

By doing so it is possible to give up some stops on the outside line section. The most obvious stop quite is possible even on the inside line section of the city where the stop sharing is quiet thick which is unexampled in the mixed railway traffic. It is necessary in the same time to ensure the carry on service of the BKV – Budapest Public Transport Co.

In the present rolling stock of the MÁV only the Flirt commuter electric multiple units can be regarded as suitable vehicles for dynamic pickup. However these units have confined volumetric capacity and because of this reason these can not ensure long-time solution for the above mentioned problem (by the present track parameters guaranteed service density). The necessary average speed rise can be realised by operating either new electric multiple units with a high enough volumetric capacity and ability for dynamic pickup, or trains consisting of extant commuter carriages combined with locomotives with ability for dynamic pickup and thereto fit driver cars.

There are four existing parallel tracks between stations Kőbánya felső and Rákos. Between Budapest-Keleti and Kőbánya felső by plan four tracks (there is the only one section where it is already planned) and by introducing additional tracks on the stations (track splice and built double lira primarily in station Rákos) the additional urban and commuter trains can be fitted into the system. It is important to four independent tracks instead of two on the whole line section between Keleti and Rákos because only in this case can be ensured the separation of train types to fit into the symmetric network timetable system.

By the commuter trains run to Pécel and supply special urban function in the commuter segment of urban-zonal traffic system can be implemented 10 minutes journey time saving (in comparison with the present solution) in both directions in the case when the commuter trains do not have to stop between Keleti pu. and Pécel.

The introduction of urban-zonal traffic to Pécel gives a solution for the seat capacity problems as well.

The railway line No. 120 (Budapest – Rákoshegy – Szolnok – Békéscsaba) is similar to all of the discussed problems, with similar solution alternatives, that is why they will not be introduced here in details.

9 Conclusion

Provision of urban railway function it is not practical to destroy the efficiency of the existing public transport system so the implementation is only worth if the applied method not increases the journey time of the long-distance and commuter trains and not dangerous for the track capacity of the freight trains.

Considering that the absorption of the urban railway function of the national railway is an additional expectation not to decrease the efficiency of the dynamic seat capacity utilizing of the passenger vehicles on the whole system. It is suitable to allocate the additional vehicles of satisfying the transport claims using a new system in such a way that on the suburban line sections the mentioned vehicles are not put into service unexploitedly.

The satisfaction of all of these aims made it possible by using the above presented parallel traffic-share method the same time. By the profile-cleaning of the commuter trains additional trains with urban rail function should be taken into service simultaneously . For this aim and for the 15-minutes succession service frequency it is inevitable to increase the capacity of the railway lines leading to Budapest by installing new tracks and unterlocking-control system.

References

1 **Leu H P**, *Bahn2000 Project*, Bratislava, 18 October 2005. conference presentation – Strategy of ŽSS,A.S. int he context of European Transport Policy.

2 **Borza V, Kormányos L, Vincze B**, *Periodic timetable-map for Hungarian railway system by an adaptation of the European structure*, (ŽEL 2004, Žilina, 2004, pp. 182-189.

3 ———, *New regular interval timetables in operation on the suburban line of the Hungarian State Railways*, (ŽEL 2005, Žilina, 2005, pp. 57-64.