



## ENHANCEMENT OF RAILWAYS IN DALMATIA

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### Abstract

When first railway lines were built in Dalmatia before the outbreak of World War I tourism was less important for the region than today. Nowadays, every Saturday during summer time tourists are blocking all major cities in Dalmatia with their cars although a lot of investment has been carried out to upgrade streets to deal with this demand. On the other hand, the railway lines are in a poor condition and still not electrified which requires a change of engine at Ogulin. During summer time state owned passenger companies like HZPP, MAV and ZSSR offer night trains to cover long travel times. Private railway company RegioJet also offer touristic trains in combination with local bus connections to connect touristic places along the coast which do not have a direct railway link. In this paper we present short term, mid term and long term solutions to improve railways in Dalmatia.

*Keywords: railway planning, demand analysis, network design, timetable*

### 1 Introduction

A well known challenge for public services is the mismatch of requested services in peak times as well as almost no demand in peak off periods. While traffic on working days in the relation from home to work is the typical task for modes of public transport, private car traffic is preferred for spare time and holidays. Wherever demand cannot be satisfied with a bus solution only, railways offer the potential to carry a lot of people in an efficient manner. A railway network in such an environment has to fulfil different types of services. For local people services should allow them to travel to city centres where typically the majority of working places can be found. Tourists require long distance services with connections to the local villages where they want to spend their holidays. As indicators for the demand of a railway service the daily numbers of cars entering or leaving a city centre can be taken into account as well as the number of tourists. While working traffic is mainly focused on the days from Monday to Friday, majority of tourists still come and leave on Saturdays. Moreover, the luggage of tourists is an important factor for the choice of transport mode. Therefore, trains operating on working days require a different layout than touristic ones. Last but not least, the price policy should be also mentioned for the choice of people for a mode of transport. Considering all these influences and well known relations we investigate in this paper the situation of the railways in Dalmatia. First, we remember the history of railways in Dalmatia. Afterwards, we present the current situation in the year 2024. Finally, we propose solutions to improve the situation. Obviously, some solutions can be realised in the near future while other solutions require investments in rolling stock and infrastructure.

## 2 Brief history of railways in Dalmatia

Until the outbreak of World War I many railway lines were built in Dalmatia [1]. Unfortunately, many planned extensions were not realised after the war. The only exception is the so called Lika line which was opened in 1925. From 1877 the line from Knin to Split was operated independent from the rest of the railway network. Another branch line to Zadar was already planned even before WWI. While the connection from Knin to Zadar was later on built, the other branch from Drniš was only partly realised [2] but never fully connected.

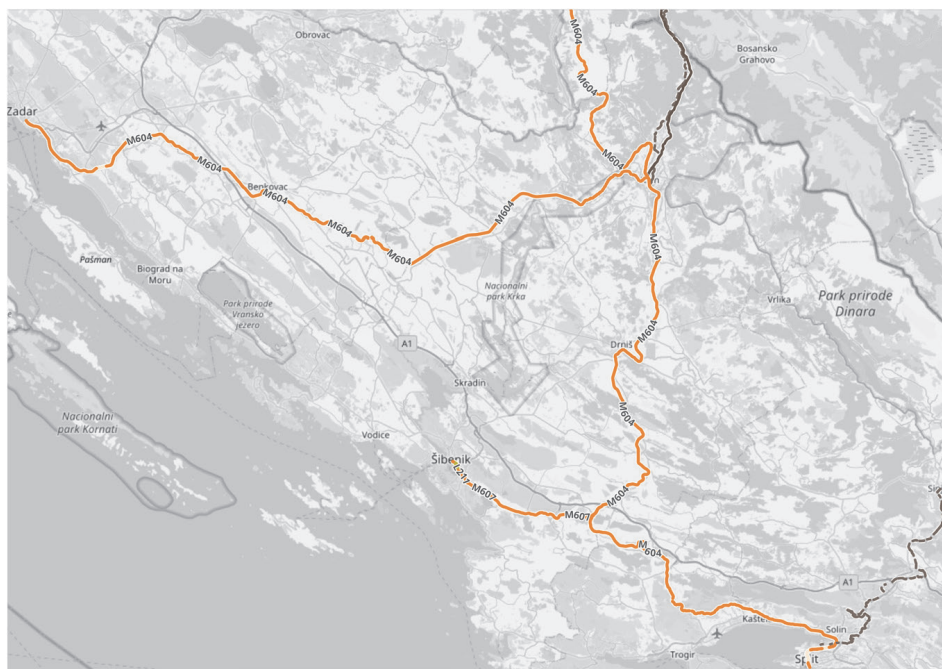


Figure 1 Core part of railway network in Dalmatia [2]

Another narrow gauge line started in Split to connect the city of Sinj in the Dalmatian hinterland. At Dugopolje a connection was planned to the Bosnian narrow gauge network ending at that time in Bugojno. In the South of Hercegovina the line from Mostar had a junction at Gabela with a short section to Metković in Dalmatia and a longer branch to Hum where there was another junction to Trebinje and Zelinka in Dalmatia. At Uskoplje there was a branch line to Ragusa (today's name Dubrovnik) in Dalmatia. Therefore, there were several connections to the Dalmatian south coast. After World War II the line from Bihać to Knin was opened in 1948 and Knin – Zadar in 1967 [3]. Unfortunately, the shorter connection to Zagreb via Bihać is not operated since the end of the Croatian independence war in 1995 although this line was electrified. One high light of the performance of the railways in this region where seasonal direct trains from Zagreb to Zadar and Split while splitting them in Knin.



Figure 2 Railway network in the South of Dalmatia [2]

### 3 Actual situation

Since 2004 so called RegioSwinger from company Bombardier are in use as InterCityNagibni (ICN) between Zagreb and Dalmatia [4]. Stops in Dalmatia are Gračac, Knin, Drniš, Perković (connection to Šibenik), Kaštela and Split. Frequency of service is rather poor: normally one ICN per direction and day, two ICN when more passengers are expected. Running times of scheduled six hours are in comparison to bus services with almost five hours not so bad at all but delays typically occur on the section of the Zagreb-Rijeka-Line where there are a lot of freight trains running as well.



Figure 3 ICN in station Split

The domestic night train of HŽPP currently runs only on Fridays to Split and on Sundays back to Zagreb [5]. Additionally, there are several touristic night trains during summer time from Praha, Bratislava, Budapest and Vienna. Besides the ICN, local regional trains between Split and Kaštela Stari try to cover the local traffic demand in the suburban region of Split where there is a populated area along the Adriatic coast. In the south of Dalmatia, Bosnian Talgo trains run cross border during summer time only on Fridays, Saturdays and Sundays while they end on other days in Čaplina which is the border station on the Bosnian side [6].



Figure 4 Bosnian Talgo train at border station Čaplina

Missing electrification of the Lika line and all Dalmatian railway lines is a limiting factor for successfully running more services. Additionally, there are several slow speed zones on the existing lines in Dalmatia due to a lack of maintenance because other lines of the Croatian network gain more notice.

## 4 Proposal of enhancement

Our proposal of enhancement is related to the time to realisation for every single measure. For short term measures we only take into account what can be done within the next year. For mid term measures we assume a horizon of five years. Long term measures are in this paper all measures which take at least five years or more to become realised.

### 4.1 Short term measures

As a first short term measure bus services can be added to close gaps of the existing network as well as shortcomings of the infrastructure. A good example of this measure was realised by the private Czech company RegioJet already during summer 2021. In detail they offered from railway station Rijeka a bus to Cirkvenica and Karlobag. Another bus from railway station Gračač to Zadar, Sukošan and Biograd. A third bus from railway station in Split to Makarska, Dubrovnik and even Budva (Montenegro) [7]. Performance on the Lika line was rather poor and therefore causing frequently delays to the trains which had only three hours in Split to turn direction. Therefore, the train service to Split was replaced by a bus service from Ogulin to cover all destinations in the South.

Another issue is the so called track access charge which describes the price of a time slot. Many network statements do not care for the length of a passenger train. Obviously, it is therefore more efficient for a railway undertaking to run a longer train than a shorter one.

Therefore, the demand and the transport capability are becoming the limiting parameters. Generally speaking, most state owned railway undertakings have a lack of wagons for night services because it is not their core business. Opening the railway market for private operators allowed running again more night trains to Split at least during summer time.

Another short term measure is the application of an integrated timetable with the existing rolling stock. Hereby, as a benchmark the existing bus services can be used as an estimation of the demand. For sure, bus operators will not provide any services where they have no benefit. Of course, there are different requirements in larger cities and along the coast between villages and cities. Price, travel time and frequency of services are for sure the most important parameters for the choice of transport mode. This measure could be applied to the existing railway line from Split to Šibenik via Perković. Unfortunately, for the connection from Split to Zadar via Knin the travel time would be double than the bus travel time.

## 4.2 Mid term measures

In this section so called mid term measures are collected and presented. Due to the high public interest here the opening of additional stops of the existing railway line crossing the city of Split has for sure the highest priority. Several authors have presented their proposals of a railway connection to the Airport of Split which is pretty close to the city of Trogir [8-10]. When looking on the daily press affected people of proposed railway lines are less happy although they will for sure benefit once the railway line is operated. Typically, the construction of a railway line in a tunnel is ten times more expensive than on ground. High costs of construction can cause the end of a project. A way out scenario might be to rethink the Airport connection as a light rail service following the magistrala (street number 8).



Figure 5 Train set used as so called “Splitski Metro”

The situation of a populated area like here between Split and Trogir shows the challenge for a new railway line. The relatively high density of inhabitants in this corridor would justify an investment in a track bound solution in addition to frequent bus services. On the other hand, space for a new railway line is rather limited because on one side there is the sea and on the other side mountains. To prevent troubles with affected people a conventional railway line would end up in a tunnel solution. When looking on the demand of such a railway line, a light rail service (in former days called tram) might fit better since it can be integrated on the existing roads. Moreover, such light rail services can also use existing railway infrastructure. In this example, the section from Solin to Split. Mixed operation with conventional trains is also possible when considered during design. Even different power supply systems are not a limit to this approach.

Other populated corridors could follow this approach of a light rail service. Looking from Split to the South the coast line to Omiš would be a strong candidate. Even today's local bus services are travelling to Omiš. Another area for a mainly touristic used light rail service might be the Makarska riviera. Furthermore to the south, the region around Dubrovnik could also realise a light rail service. Looking to the North of Dalmatia cities like Zadar, Biograd na moru and Šibenik might be also interested in a light rail solution which could grow together in time. For the existing railways lines an electrification is required to allow an efficient operation when the frequency of services will be increased. This requires the purchase of new rolling stock for passenger trains. Last but not least, also the political topic of the reactivation of the direct connection between Zagreb and Knin via Bihać should be addressed and solved. The old idea of corridor trains should be remembered as a concept for riding trains without border control.

### 4.3 Long term measures

Once, the mid term solution of light rail services has been realised and the growth of population continues along the coast new lines might be demanded. One gap in the existing network is here the connection from (Zadar -) Benkovac to Gračac or Lovinac which would allow to shorten the travel time by skipping Knin.



**Figure 6** Proposal for new railway lines in North Dalmatia

Of course, the difference in height should be mentioned here as a critical design parameter. Depending on the project budget, possible solutions are a long base tunnel or a traditional single track line following the old state street to Gračac (length at least 40 km). Bypassing Knin with the historical proposal of a line between Kistanje and Drniš might become interesting again (estimated length 25 km).

Finally, a new line along the coast from Split via Ploče to Sutomore (CG) would allow to connect all the dead ends of the existing railways. As previously mentioned, the new line could also grow step by step with the creation of light rail services in the populated areas. Outside these populated areas the design could follow the schema of a conventional railway line.

## 5 Outlook

In this paper ideas for enhancing railways in Dalmatia have been presented. The categorisation of short, mid and long term solutions allowed us to deal with the related investments to implement these solutions. The main focus is always on passenger transport for this region. Therefore, a light rail system is proposed to connect all the terminal stations of conventional and historical railway network along the Adriatic coast. The decision for such a kind of railway system is simply done by looking on the investment costs and the time span of realisation. Now it is up to political decision makers to create the legal and financial framework to enable the realisation of all these ideas.

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