A topographic map of the Rhine-Alpine region, showing the Rhine river in blue and a complex rail network in black with white circular nodes at various points. The map is framed by blue L-shaped corner brackets in the top-left and bottom-right corners.

# CODE RHINE-ALPINE

New Insights and Challenges  
for Action on the Rhine-Alpine  
Corridor Rail Network

November 2019

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Corridor**  
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## Summary

The purpose of this study is to identify the spaces of importance for the future spatial development along the Rhine–Alpine Corridor. The focus is set hereby on spaces with unsolved conflicts between spatial and railway infrastructure developments.

The first chapter gives a brief analysis of the current status of the Rhine–Alpine Corridor rail network and its ongoing development. This shows that the railway infrastructure experiences increasing specialization along the Corridor: In the seaport hinterland transport and onwards along the Rhine, separate lines for efficient rail freight transport are established. Also, separate high-speed lines for passenger transport form a network, which will be further extended by the proposed Frankfurt–Mannheim line. Serious congestion concentrates on lines with mixed traffic and the nodes, where the various transport flows intersect. Bottlenecks are and will be particularly pronounced in the German section of the Corridor.

In the second chapter, recommendations on further proceedings are outlined: Strategic capacity planning for railway and terminals is recommended, since this helps to prioritize investments and helps to avoid bottlenecks in future. It is further recommended to promote vehicle-mounted noise reduction technologies in preference to noise barriers. Also support to rail projects in implementation is recommended to avoid further construction delays and restrictions on the function of the Corridor.

Nine spaces of importance are identified, whereof two demand immediate action: 1) the rail node Viersen and 2) the rail node of Mannheim. In the case of Viersen, the authors recommend to prepare and run a “test planning”. This procedure has been specially developed for situations in which an open question must be clarified and negotiated with the diverging interests of several actors involved. In the case of Mannheim, we suggest to await the results of an ongoing optimization study and to prepare a test planning procedure in parallel. In the other seven spaces of importance, no immediate action is required. However, the identified conflicts are important and a careful monitoring by the EGTC Rhine–Alpine is necessary for now. This concerns for example the two identified spaces in Northern Italy, the border region of Sottoceneri/Lombardia and the Ligurian Coast between Savona and Genoa. For each case, completion of a test planning procedure is recommended, before national investment plans are prepared.

## Imprint

On behalf of the EGTC Rhine-Alpine

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# Introduction and Objective

The Rhine–Alpine Corridor connects key North Sea ports of Belgium and the Netherlands with the economic regions along the Rhine river and further onto Switzerland and Northern Italy. Here, the Rhine–Alpine Corridor terminates at the Mediterranean port of Genoa. Thus, the Corridor not only offers vital connections to various ports, but also offers a strong North–South link between important economic regions: It connects the living and economic spheres of around 70 million inhabitants.

This interconnecting function is not only reflected in the high demand for transport, but also in everyday delays in air, water, road and rail transport; the transport infrastructure is partially overloaded. In order to dissolve the existing bottlenecks, multi-billion capacity enlargements are being implemented or are under discussion.

It is obvious that the Corridor's transport infrastructure is important to Europe. The huge investments into it ease international transport and also influence the regions' long-term development. To identify potential conflicts between the transport and spatial development along the Corridor and to develop a joint strategy for its further development, an INTERREG project named CODE24 was carried out between 2010 and 2015.

The CODE24 project was completed with a joint assessment of the corridor. In 2015, the participants identified three main challenges in developing the Corridor: First, stimulating international competitiveness. Second, setting clear priorities in financing of desired projects. Third, using the available development potentials for future housing and business developments.

In order to tackle these challenges, development priorities and a common strategy (figure 1) were elaborated in CODE24 regional workshops. The most important insights are: First, rail and waterways should be given preference over road and air transport. Second, funding should prioritise network optimisation and capacity building. Third, fostering the integration of land-use and transport. Fourth, accelerate speeds. Fifth and finally, acceptance must be ensured.

The results of the CODE24 regional workshops also showed that many regions share similar problems and that

actions in one region have an effect on other regions along the Corridor. Participants acknowledged that in the future an even stronger cooperation across the administrative borders will be necessary to solve the extensive challenges in spatial and transport development.

To continue the cooperation built up within the INTERREG project, the European Grouping for Territorial Cooperation (EGTC) Rhine-Alpine was founded in 2015. Since then, the EGTC expanded to 24 members and successfully started first research projects. As yet, the EGTC has initiated no cooperative procedures to address the identified lack of integration between land-use and transport development.

Since the completion of the INTERREG project, the railway infrastructure along the corridor as well as the public discussion have evolved. The demands on the integration of new railway infrastructures into the densely populated Rhine-Alpine Corridor have continued to increase, as demonstrated by the discussions about noise protection in Germany.

Thus, the objective of the commissioned study is to give: First an up-to-date cross border overview of the Corridor's railway development status. Second, identify the regions where unresolved problems persist between land-use and rail infrastructure development. These urgent problems must be resolved for the further functioning of the transport corridor and also to maintain a high quality of living along its regions.

However, no ready-made solutions can be developed within the framework of this study. Instead, for each problem solutions need to be found on the regional level. The strength of the EGTC Rhine-Alpine is its voluntary association of territorial entities and infrastructure operators. This strength enables the EGTC to make an active contribution to the design of regionally supported concepts and solutions.

Our recommendations are directed towards collaborative procedures that the EGTC Rhine–Alpine can support. Accordingly, this study is not the opinion of the EGTC, but is a recommendation for actions to be further discussed by its members.

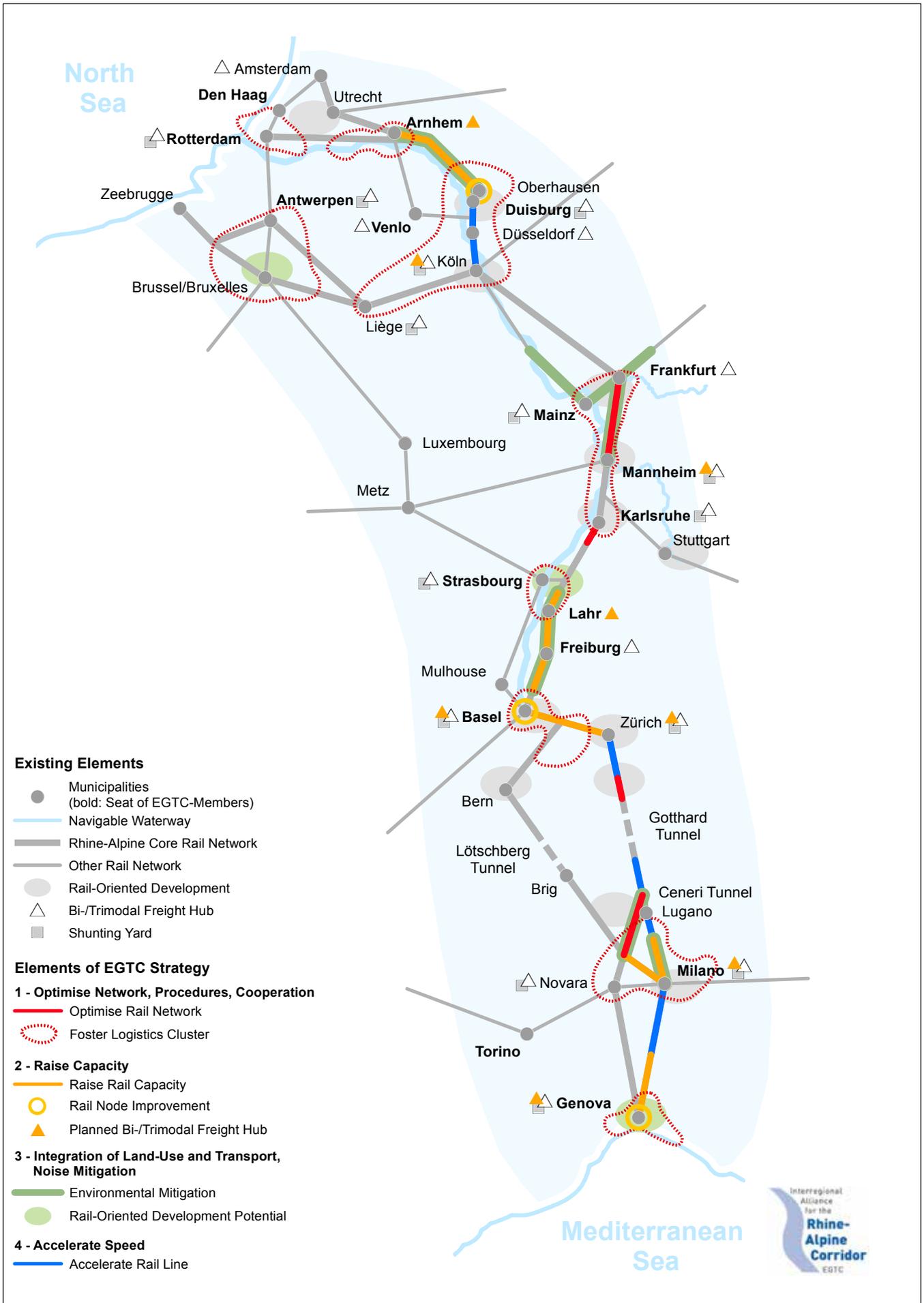


Figure 1: EGTC Rhine-Alpine joint strategy 2017

# 1 Current status of the development along the Rhine-Alpine Corridor rail network

## 1.1 Infrastructure

The Rhine–Alpine Corridor is served by various rail services today: regional trains and S-Bahn, long-distance trains and dense freight traffic.

The historically grown infrastructure is technically designed to accommodate all types of traffic in mixed operation. The railway system could only be operated economically by bundling the different demands on a few busy routes. However, this mixed operation is associated with a significant disadvantage: The more the operating speeds differ on a route, the lower the performance of such a mixed traffic route will be (in trains per hour). While this was not a relevant issue in the first years of railway operation, this became more important as speeds increased. In order to remedy this disadvantage on busy routes, different train types were separated onto specific tracks. Examples of this include separate tracks for urban bypass-rails, freight trains and suburban rail traffic, which were opened in many cities in the 19th century. Separate tracks for the suburban rail traffic made it possible, for example, to add additional stations at a close distance without obstructing the parallel long-distance traffic. Outside the cities, the traffic continued mostly on common tracks.

At the time of the mass motorization, travel speeds on the road increased. Due to shrinking demand in rural areas and to offer competitive travel times in rail transport, numerous rural railway stations were closed in the 1960s and 1970s. In this way, speeds were harmonized and the railway network accelerated at a low cost. With the introduction of first high-speed services in the 1980s though, the issue of divergent speeds on the rail network became prominent again. A process of specialization began anew with the construction of the first high-speed lines. The investment made it possible to better meet the requirements of individual types of traffic and to offer high performance on new lines. Because of the high construction costs however, this approach can only be pursued regionally. Many main railways on the Rhine-Alpine corridor continue to be operated with mixed traffic. So, to what extent has the differentiation process progressed?

An overview of today's infrastructure is shown in figure 2. In this illustration, routes operated in mixed traffic are represented by grey lines. Routes reserved for specific modes of transport are marked in colour: Suburban train systems on separate tracks are marked as areas in green. In red, are routes used almost exclusively by long-distance passenger traffic. Shown in dark grey are routes that are almost exclusively used by freight trains. This analysis is supplemented by new lines which will be put into operation in the coming years (with year of opening indicated), alongside projects in their early planning stages and considerations for long-term expansion.

This analysis shows that the differentiation of railway infrastructure in central parts of the corridor is already well advanced. For seaport hinterland traffic between Antwerp / Rotterdam and the German border, two high-capacity freight lines are available, the Montzen and Betuweroute. For long-distance passenger transport between Brussels and Aachen and Brussels–Antwerp–Amsterdam, separate high-speed lines are in operation. Further to the south, between the Ruhr area and the Rhine / Main area, an efficient high-speed line is in service, while the rail line on the right bank of the Rhine serves as separated line for freight trains. The region southward of the Rhine / Main area is still largely served by mixed traffic routes, but in 2041 new lines for passenger and freight traffic will begin operating. The situation is similar in northern Italy, where existing lines to the west of Milan will be strengthened as freight lines within the next years, while the rail lines running towards Milan will be expanded for fast and slow passenger services.

No clear differentiation is realised between the German border and the Ruhr area. At this section, measures to raise the existing network's capacities are in planning, but basic reorganization is not projected in the near future. Likewise, rail traffic is handled on two mixed routes in the transit of the Jura Mountains and the base tunnels through the Swiss Alps.

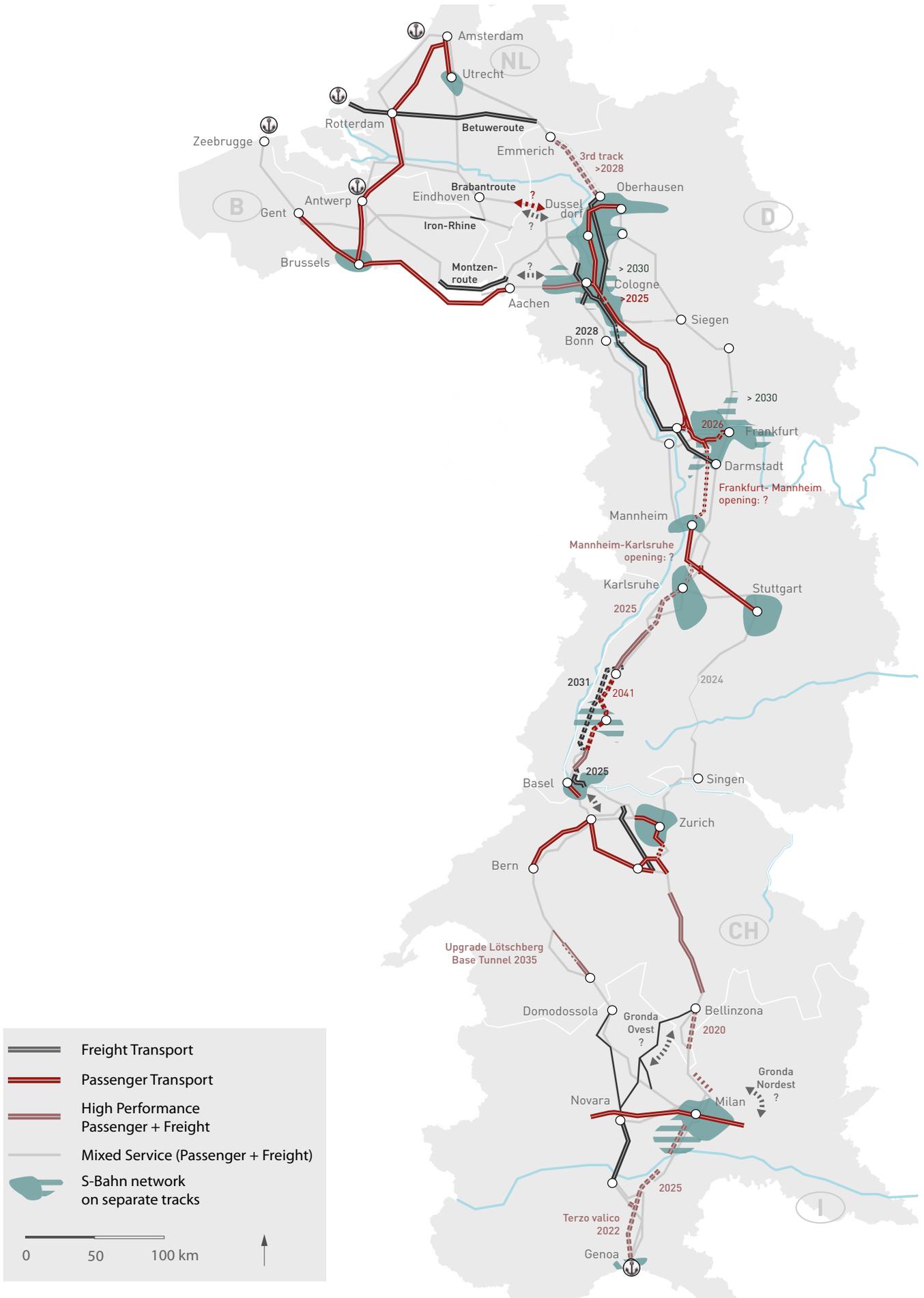


Figure 2: Overview of today's railway infrastructure along the Rhine-Alpine Corridor: the differentiation of railway infrastructure in central parts of the Corridor is already well advanced

## 1.2 Traffic demand, traffic relations and capacity planning

As discussed in the previous chapter, the Rhine-Alpine Corridor serves various rail services today. Yet, the performance of rail freight is of critical importance for the future of the corridor. Discussions within the CODE24 workshops and also public debate show that freight trains can cause conflicts with urban developments on the regional level. A hypothesis is that the growing number of freight services on mixed lines hinders the intended modal shift to rail in densely settled areas. In addition, there is the risk that a space-saving, transport-oriented development of settlements is being hampered. To identify the current and upcoming conflicts between spatial and railway development, an in-depth view of its future transport demands needs to be taken. Due to these conflicts and its strategic importance, the focus is hereby set on the freight transport.

Generally, the routing of freight trains can be handled more flexibly than the routing of passenger trains, since the former serve only a few operating stops. On the other hand, freight trains make other specific demands on infrastructure. Preferred characteristics of competitive freight train paths are:

- No changes of direction along the route
- Direct routes, with only limited detours
- Possibility to operate long trains
- Low line gradients
- Limited waiting times and delays caused by infrastructure

These characteristics show that the specific train paths do not always have to follow the optimal routes, for example, in respect of the shortest distance.

Nevertheless, for reasons of competition detours need to be strictly limited. Based on these considerations, an overview on the average volumes and numbers of freight trains travelling along the corridor is necessary.

These transport flows in detail, split over parallel rail lines are shown in figure 3<sup>1</sup>. As the illustration clarifies, the highest freight volumes are transported along the route Rotterdam-Emmerich-Oberhausen and onwards along the Rhine to Basel. Considerably more than 200 freight trains per day run along these sections. Prognosis show that future transport volumes call for up to 300 freight trains per day in the future, for example, on some sections between Karlsruhe and Basel (BMVI, 2015). South of Basel, the transport streams split up along the trans-alpine base tunnels of Gotthard and Lötschberg. A significant share of the rail transport flows terminates at freight terminals in northern

Italy, while the remaining traffic splits up into the direction of the Padan Plain and the Ligurian Coast.

At the main nodes, red arrows indicate which turns are regularly used by branching traffic. There is no transport demand, for both freight and passenger, between the end-points at Rotterdam and Genoa. Clearly, the Rhine-Alpine Corridor is part of a dense transport network with its traffic volume comprising various sources and destinations. The Corridor must be seen as a tool of the European Union's transport policy.

This raises the issue of which demand and which traffic relations need to be served by the rail network in future. For the horizon 2040<sup>+</sup>, this becomes not only a question of demand, but also a political issue about the targets being aimed for. Here, the concerned states have different approaches. In the Netherlands, a clear decision for a modal shift to rail was met; materialized by constructing the Betuweroute as a strong connection between the port of Rotterdam and its eastern hinterland. Similar motivations in Belgium saw past investments focused on the Montzenroute. A strong emphasis is now on modernizing and reactivating the Iron Rhine route as a second and more direct access route to Antwerp's hinterland. In Germany, no sufficient strategy exists on a federal level about how a modal shift to rail would be achieved, nor about which performance would be offered by the rail network. The planning of the infrastructure was based on comparatively short-term demand with a lack of consideration about long-term capacity targets. Projects unanimously seen as necessary are implemented with long delays today. With the second expert draft of a Germany-wide integrated timetable, "DeutschlandTakt", a discussion about a higher modal share of rail freight is now underway. Due to the long delay times of the project's implementation, the demand in traffic with and within Germany will continue to exceed the given capacities. In order to shorten these restraints along the Rhine-Alpine Corridor, a memorandum on preliminary measures was recently signed between the German and Swiss Ministers of Transportation. The memorandum provides for infrastructure measures that can be implemented quickly in order to increase the capacity of the Karlsruhe-Basel rail line to 225 freight train paths per day (both directions) (BAV, 2019a). Future capacities to be delivered have been already defined in Switzerland. In 1980, the conception phase of the two alpine crossings, an offer of 90 train paths via Lötschberg and 180 via Gotthard was defined. This combined capacity of 270 international daily train paths (equal to about 40 mil. tons per year) will be fully available with the final opening of the New Railway Link through the Alps (NEAT) projects in 2020 (BAV, 2019b). To ensure these train paths can also be offered southwards, infrastructure

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1 For detailed analyses of the Corridor Rhine-Alpine see also Rail Freight Corridor Rhine-Alpine (RFC, 2015)

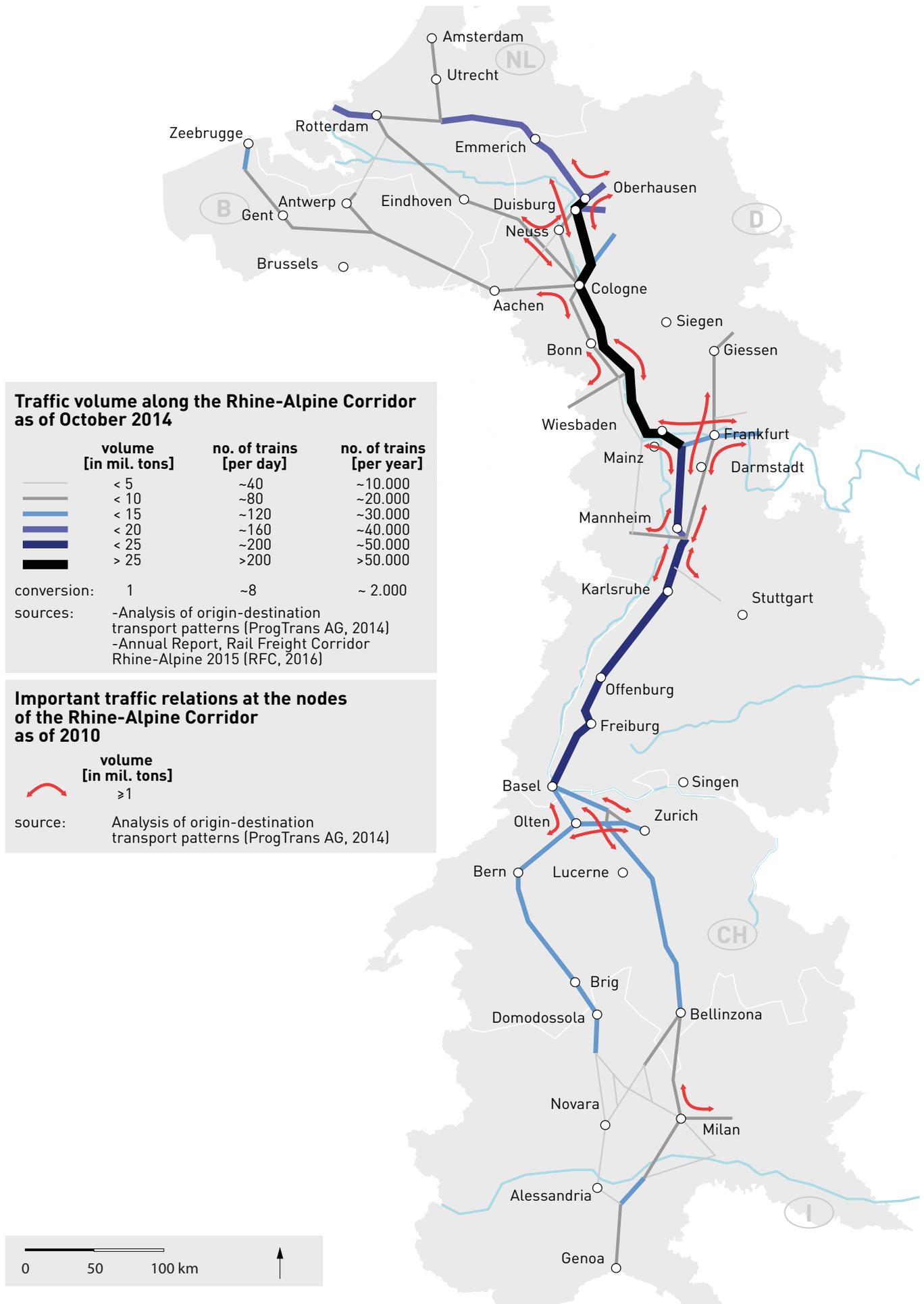


Figure 3: Freight traffic volumes along the Rhine-Alpine Corridor and important traffic relations at the nodes

investments will be realized in collaboration with Italy and Switzerland along the southern NEAT access lines. In Italy, generally strong investments into the modernization of the main rail network can be found alongside financial support for the construction of freight villages and rail terminals.

Besides these long-term political strategies, on the demand side a further containerization and growth of intermodal transport is predicted. Growth is expected for the ports in Belgium/Netherlands and Genoa. This may bring growing seaport hinterland transport along the north-western section of the Corridor and shift demand to/from the southern seaport of Genoa along the Corridor's southern section.

In summary, the following conclusions can be drawn about demand and traffic relations for future freight services:

- The high demand and transport volumes along the core section of the Rhine-Alpine Corridor permit the operation of separated freight lines. Such lines can be designed specifically for the requirements of freight services (e.g. limited speed)
- Separated freight lines require good interconnection to branching lines and to important terminals.
- Sufficient terminal capacities are essential for a modal shift to rail. An exemplary analysis has been carried out for Italy (Sottogruppo terminali del gruppo di lavoro 1, n.d.). An overview of the capacities of terminals along the Corridor is required to identify bottlenecks

## 1.3 Congested lines

On specific lines, the Corridor rail network experiences considerable congestions today. To assess where congested lines can be expected in the future, this study extended existing analyses by considering future developments.

The term 'congested line' was introduced by the EU directive 2012/34/EU on establishing a single European railway area. It is defined as an "element of infrastructure for which the demand for capacity cannot be fully satisfied during certain periods, even after coordination of all the requests for capacity." This means the demand for train paths exceeds the capacity of the rail infrastructure at hand. Despite the given demand, the timetables cannot be densified. The intended modal shift to rail is hindered, as is a space-saving, transport-oriented development of settlements.

According to directive 2012/34/EU the railway network operators are obliged to publish about capacity restrictions on their lines. It needs to be considered however, that the exact definition of 'congested lines' may differ in detail between the states and thus they may not be fully comparability. Nevertheless, important estimates can be gained by the

overview on congested lines and nodes as of 2019, shown in figure 4. This illustration clarifies that the most and longest bottlenecks by far can be found in the German section of the Rhine-Alpine Corridor. To be mentioned are the lines Essen-Düsseldorf-Cologne, the rail line Cologne-Bonn-Remagen on the left bank of the Rhine and Frankfurt-Mannheim, and wide sections of the Offenburg-Freiburg-Basel line. Besides these, further bottlenecks are located on nodes of Amsterdam Centraal and Den Haag as well as on a brief section of the Luino line in Italy.

A summary outlook on future bottlenecks is regularly given by the Rail Freight Corridor (RFC) Rhine-Alpine. Currently the outlook 2030 is in procedure and expected to be published by end of 2019. For the purpose of this study, however, a more far-sighted outlook is needed. Thus, our estimate on future bottlenecks as of 2040 was made with the following considerations:

- projects under construction that will begin operating at the foreseen date
- due to common planning and implementation periods of minimum 20 years, commissioning of additional major railway infrastructure projects is not expected
- short time capacity restriction caused by construction activities are excluded
- the frequency of passenger train services increases to at least half-hourly between the main cities and in suburban areas, in some cases even to frequencies of 15 minutes
- for agglomerated areas, S-Bahn frequencies of 10 to 15 minutes are expected at minimum, requiring separate tracks
- the seaport hinterland traffic is strongest between the Netherlands/Belgium and Germany. Also for the central section of the Corridor, the northern seaports remain the most important, while for the southern section the port of Genoa gains importance
- trans-alpine intermodal transport stays an important quantity

This estimated outlook is illustrated in figure 5. The illustration should be interpreted cautiously, since great uncertainty remains about the development of demands. However, it can be noted, that even in 20 years into the future the situation on the German section of the Corridor remains the most critical: Although some bottlenecks are cleared by opening the high-speed line Frankfurt-Mannheim and the bulk of the Rheintal rail line, congestions endure and additional bottlenecks are to be expected. This especially affects the Ruhr area, where the bottlenecks Essen-Düsseldorf-Cologne and onwards in direction of Bonn-Remagen may persist. Additional bottlenecks are to be expected in

the area between the border to Netherlands/Belgium and the Rheinland. Southwards, bottlenecks are mainly expected at the nodes of Frankfurt, Mannheim and Karlsruhe. In Switzerland and Italy bottlenecks are not expected along the two Alpine crossings, but rather along the connecting lines where transit traffic overlaps with local traffic on limited infrastructure.

By comparing figure 5 to findings in chapter 1.1. it becomes obvious that capacity conflicts mainly occur along mixed lines, which are reaching their capacity limits.

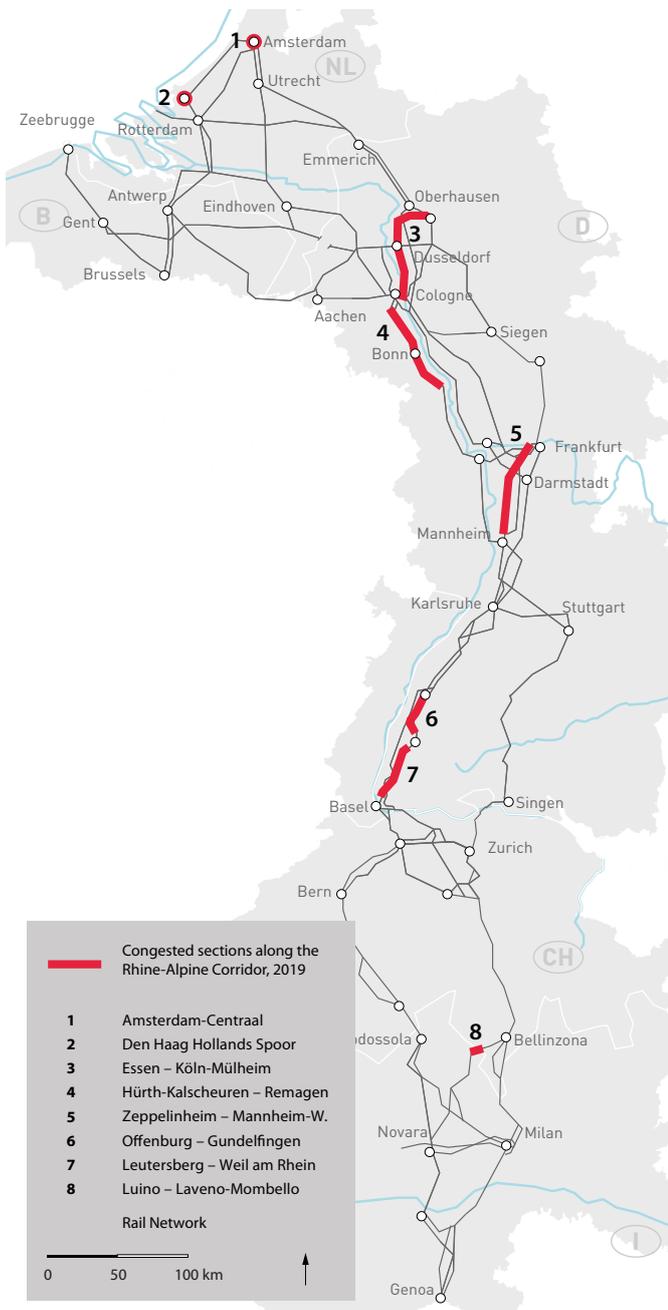


Figure 4: Congested lines along the Rhine-Alpine Corridor in 2019. Data source: railway network operators

Figure 5: Congested lines along the Rhine-Alpine Corridor in 2040. Estimation by the authors based on various sources.

## 1.4 General lines of conflict between railway and regions

Two topological elements can be distinguished in the rail network: The nodes, connecting different lines and the lines itself, as connections of the nodes. The following is a brief discussion of capacity constraints within the rail network.

### Nodes:

Small and main nodes are crucial elements in the rail network, often limiting its capacity. Through the concentration of numerous train services, these nodes determine the capacity of wide sections of the rail network. In Germany, for example, the nodes Köln, Frankfurt and Mannheim are operating at their capacity limit. The demand for the expansion of the stations and their access lines has been widely approved. However due to limited financial resources and planning capacity, the implementation of projects is delayed. Projects in implementation take long time, since train services need to be sustained during construction periods. An example is the provision of two additional tracks between Frankfurt Stadion and Hauptbahnhof. After several years of planning and approval, the implementation of this project will last until 2028. The following observations can be summarized:

- Today, the main stations of the major cities are still the preferred stations for almost all passenger trains. However, the more connections are offered, the more importance secondary stations can gain, relieving the overloaded main stations. The station Frankfurt Airport is an example of a second station which allows trains to bypass Frankfurt Hauptbahnhof. In Cologne, the secondary station Messe/Deutz may serve more bypassing trains in the future, relieving the overloaded main station.
- Capacity reserves can often be found in the approaches of the stations. Disentangling transport relations here by grade-separations can reduce the conflicts between crossing trains and release capacity. However, the implementation of such projects is highly complex, since rail services must continue during the construction period. Capacity building within important nodes takes a long time and thus should be urgently prioritized. This must be coordinated with urban development. The synergies between well served stations and densified urban development are not nearly exploited.

The same mechanisms apply also to minor nodes and turnouts. The less non-grade-separated crossings exist, the more capacity is available in the rail system. Thus, it is of utmost importance to design turnouts and approaches to stations that are grade-separated. Within the scope of the Swiss ZEB program (future development of the railway system) for example, the major part of the budgeted 4 billion CHF was spent on grade-separations along the existing rail network, instead of investments into new lines.

### Edges:

A traffic dilemma generally persists if trains with differing speeds run on the same line. The more the speeds differ, the lower the capacity of a line. If a new rail line is used by long-distance passenger transport with speeds over 160 km/h, only a few or no freight trains can use the same line. Also, safety regulations prevent oncoming traffic between freight and passenger trains at high-speed. Thus, the freight trains are routed to the existing rail lines and mixed with regional passenger trains, which run on average at the same speed. This approach, however, leads to noise exposure at the settlements commonly situated along the existing rail network. If a new rail line is optimized for freight trains, the settlements along the established line can be discharged of noise exposure efficiently. Long-distance passenger train services, however, need to adapt to the speed of the regional trains, leading to less competitive travel times (see figure 6).

To achieve both objectives, two new rail lines must be built simultaneously, which is viable only in the rarest cases. Thus, this dilemma regularly leads on to discussions between the railway infrastructure operators and the concerned regions. A common compromise is traffic management which differs between day and night: if a new high speed passenger rail line is dimensioned for freight trains, then these can be easily routed to this line at night.

However, nights are short. It needs to be considered that for efficient freight transport, exclusively night-time train paths are not sufficient for competitive rail services on long-distance freight transport. For high competitiveness, freight trains need to also travel during the day. Today, however, the common postponement of freight trains behind passenger trains prompts numerous delays along the path of a train, resulting in serious prolongation and capacity constraints for freight transport.

Separated rail lines for freight can shorten the transport times and capacities significantly and thus increase the competitiveness of rail freight transport. For a freight only rail line, the capacity is estimated as follows (own estimation):

Trains per hour and direction:	8–10
Number of tracks/directions	2
Operating hours :	18–20
Daily performance (in No. of trains)	288–400

To reduce vibrations and noise emissions, alignments far from settled areas or along highways are desirable. Aside from the construction of new high speed lines, separated freight lines should be considered if necessary.

Another approach to the mentioned dilemma was developed for the alpine base tunnels in Switzerland and in Austria: high-performance lines serve for both, long distance trains with slightly limited speeds up to 200km/h and long-haul freight trains. This approach is only viable, where only few train stations are served.

## Conflicts

The results of CODE24 regional workshops show that many regions along the axis have similar problems. Along the Corridor, two lines of conflict repeatedly show up:

- 1) protection against railway noise caused primarily by goods transport, and
- 2) fear of displacement, i.e., limited development options for regional transport.

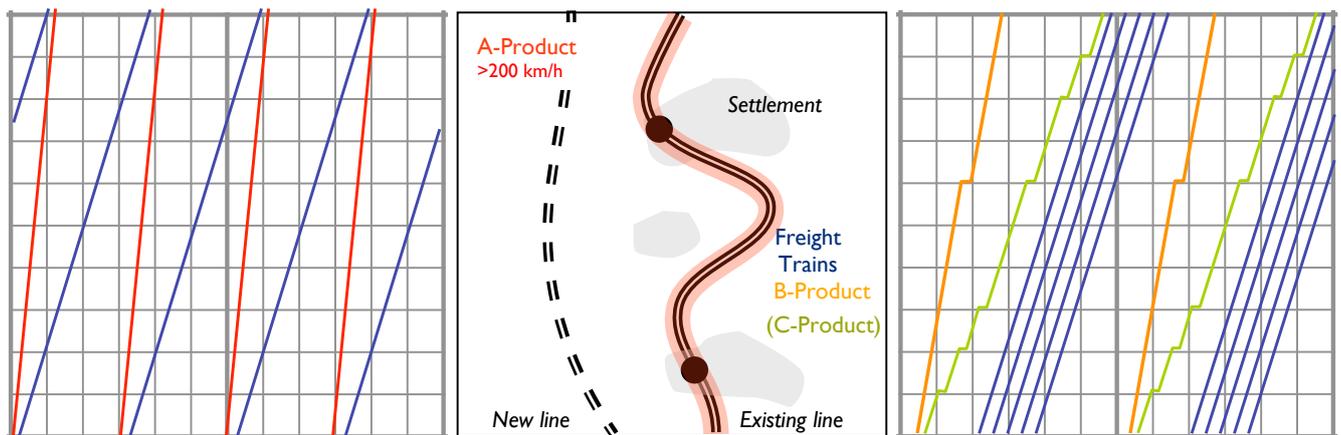
These conflicts are focused on the existing rail network along the Corridor. Since the completion of the CODE24 project, the situation as well as the public discussion have evolved. In order to identify the current conflicts and problems between railway and spatial development, a reanalysis became necessary. Several interviews and two workshops were conducted within this study to discuss the preliminary findings with the members of the EGTC.

The discussions revealed, that these basic conflicts are still relevant. They are mainly present in the agglomerated regions, where the rail network is highly frequented. In these areas, the question arises, whether the existing network can

be sufficiently expanded, or whether new bypass concepts are conceivable. This is important, since the relocation of freight train paths to bypass routes can reveal capacities for passenger services. This may also reveal possibilities for intensified urban development to the areas around stations of public rail transport. What precautions can be taken to ensure that a bypass concept will be taken into account in the future if it is not feasible today? This question needs to be discussed on a regional level with appropriate procedures so that a solution can be found

Other conflicts were identified outside the agglomerated regions. Here the question arises, how linear bottlenecks can be solved and transit traffic can be organized in the future. A very specific situation is in place along the Middle Rhine valley, where capacities on the right bank rail line are sufficient over a long time, however due to the valley situation, a serious concentration of noise emissions occurs at existing settlements. The detailed results are presented in chapter 2.2.

### scenario «high-speed passenger service»



### scenario «noise reduction and freight capacity»

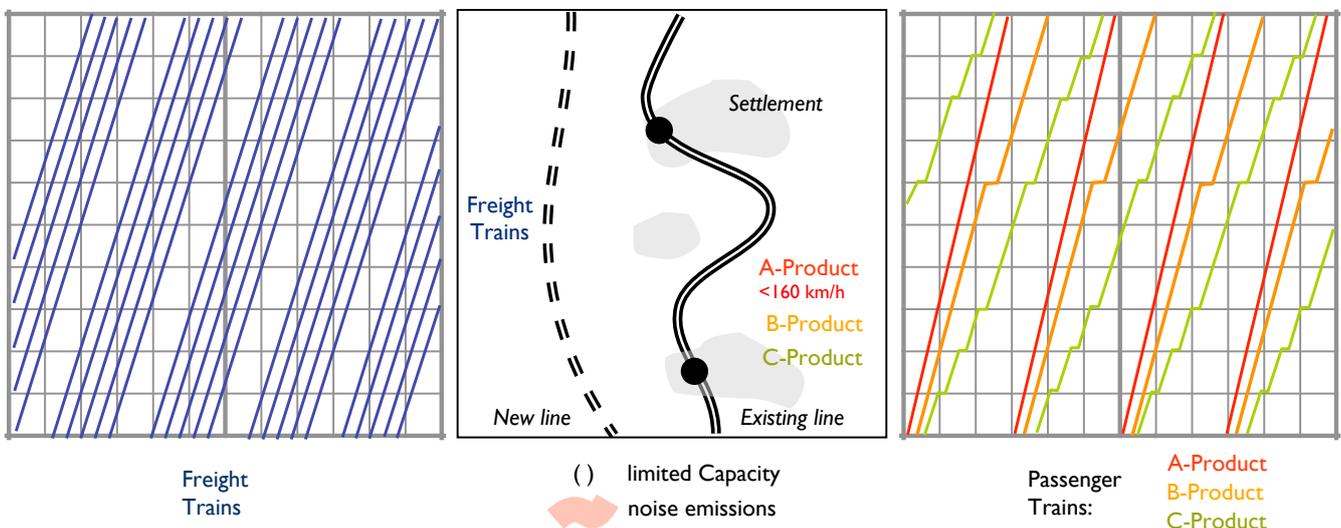


Figure 6: Exemplaric train paths and potential conflicts for the profoundly different scenarios of «high-speed passenger service» and «noise reduction and freight capacity»

# 2 Recommendations on further proceeding

## 2.1 Recommendations on the corridor

In this chapter, three general recommendations by the authors are outlined: Strategic capacity planning for railway and terminals is recommended, since this helps to prioritize investments and helps to avoid bottlenecks in future. It is further recommended to promote vehicle-mounted noise reduction technologies in preference to noise barriers. Also support to rail projects in implementation is recommended to the EGTC and its members. This will avoid further construction delays and restrictions of the Corridor's functionality.

In chapter 2.2, the spaces of importance for the spatial development along the Rhine-Alpine Corridor are introduced.

### 2.1.1 Strategic capacity planning for Corridor rail and terminals

The analysis in chapter 1 reveals: sufficient capacities are available today, where strategic capacity planning for freight traffic was carried out at an early stage. In contrast, bottlenecks in the rail network are particularly pronounced in the German sections of the Rhine-Alpine Corridor.

The example of the Karlsruhe-Basel line illustrates how delays occur on the basis of an inconspicuous detail: An important key figure in the planning of new rail infrastructure is the expected number of trains. It is one of the factors on which the necessary rail infrastructure as well as protection against noise and vibration are dimensioned. In the subproject bypass Freiburg in 2013, disputes about the alignment and the extent of protection could be settled. Design planning and project implementation were continued. In 2018, however, the planning process was hampered by public dissatisfaction; the federal demand forecasts for rail transport were updated shortly before, with the result of longer, but fewer freight trains. Citizens and politicians feared a reduction in noise protection along the bypass as a consequence. Time and resources were spent on discussing these prognoses and their underlying assumptions, the planning process was put back by one year.

This delay's cause is systematic: The demand forecast period for major infrastructure projects is limited to 10-20

years in Germany. Demand analysis is however repeated anew every 5-10 years, while the projects on average take 20 years at minimum. The changes, for example in the number of expected trains coming along with the reassessment, brings delays and disturbance into the planning process and in numerous other cases in Germany as well.

This case shows, how missing long-time capacity planning delays the implementation of an important project.

#### Recommendation:

The problems can be solved by establishing long-time capacity planning. Decisions on projects should be based on these findings. This requires a change of perspective from the demand side to the supply side. Competitive freight transport on rail can only work efficiently if along important sections of the network sufficient capacities are provided over a long time. These capacities need to be established as targets into the planning (see figure 7 and annex for examples).

When building the NEAT in Switzerland, this strategic approach helped to develop and implement a functioning system stepwise over decades. Based on a long-time strategy,

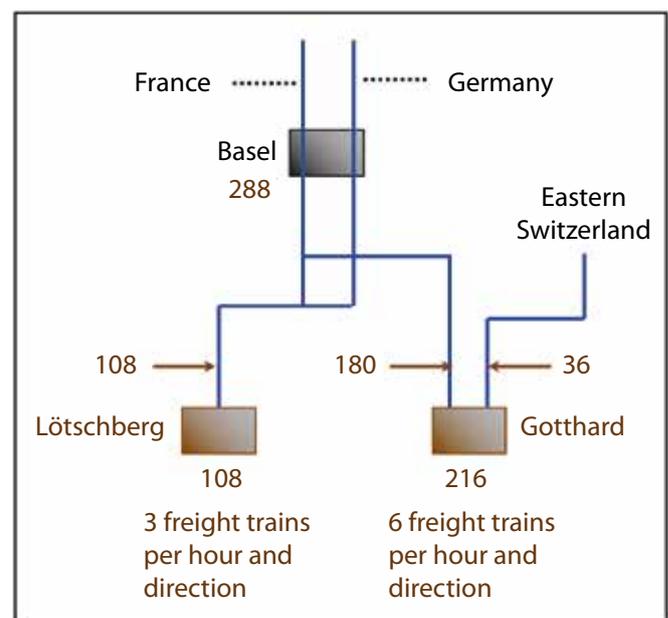


Figure 7: Basic example of a strategic capacity planning scheme for trans-alpine rail traffic

specific target values were developed for the freight, long distance and regional passenger transport of the future. On this agreement, the infrastructural measures were defined afterwards.

An extension of strategic capacity planning to the entire Rhine-Alpine Corridor needs to be done. The strategically important transport modes waterway and railway need to be considered, including both, the transport of goods and passengers. For rail, such long-time perspective can widen the view on to new solutions and projects, which cannot be found with limited focus. This comprises, for example, the rearrangement of transport routes in the wider area of the Rheinland. Strategic capacity planning offers the chance to take precautions for the enlargements of the transport infrastructure. Without strategic capacity planning it is often impossible to determine which precautions need to be taken for later network enlargements.

Strategic capacity planning also needs to be done with a special focus on the terminals along the entire Rhine-Alpine Corridor. An analysis of existing capacities and projects in preparation can reveal where sufficient capacities exist for the future and where capacity needs to be built up to allow a modal shift to rail and to the desired extent. The exemplary analysis carried out for Italy (Günther, Vetsch, Facchin & Nollert, 2016) needs to be extended to the whole Corridor.

## 2.1.2 Vehicle-mounted noise reduction

As illustrated in chapter 1, the main transport flows of rail freight focus along a few lines. Some sections are today exclusively used for freight trains. Even if these lines are equipped with adequate noise protection, conflicts caused by railway noise remain on parallel lines, since trains continue to run on the tributary lines. To protect settlements and inhabitants along all lines, vehicle-mounted solutions need to be promoted. Reducing noise at its source can save considerable investments into passive protection along the railway



Figure 8: Test run of an innovative freight wagon developed in a research project on behalf of the Federal Ministry of Transport and Digital Infrastructure (BMVI)

lines. If sufficient noise reduction cannot be reached across wide areas, the rail freight transport increasingly endangers its acceptance as low-emission means of transport.

A comprehensive comparison taking into account the long-ranging benefits and cost of both approaches is not known. Thus, we recommend to contract out an analysis of the cost-benefit for each, passive and active noise protection.

## 2.1.3 Support of rail projects in implementation

The focus of this study is mainly set on the spaces of importance for future planning actions. However, integrated spatial and infrastructure development can also take place during the implementation phase of a rail project. Especially during formal planning phases (like the construction approval procedure “Planfeststellungsverfahren” in Germany) spatial actors can and shall support the progress of these extensive procedures in two ways:

- By concentrating their own objections as much as possible on crucial issues and seeking informal ways of problem solving with the project leaders (e.g. the railway companies)
- By informing other stakeholders about the project, advising them and possibly working together to find a solution before officially raising objections.

The aim of these actions is to limit the objections of a planning approval procedure to the actual number required and to prevent blockades. This recommendation is of particular importance for the section between Karlsruhe and Basel. Almost all discussions have shown that this section will be the most important bottleneck of the entire corridor in the future. Its delayed realization was also caused by numerous objections and the initiation of alternative alignments, which have massively reduced the negative spatial effects of the railway line. However, the completion of this section was consequently postponed until 2041. Finally, this date must be supported from all sides, otherwise the massive capacity bottleneck would continue to affect the entire corridor. In particular, the regional associations concerned can help to keep the time required for the construction approval procedure as short as possible so that this central section can be completed on time.

Such support is, of course, only possible if regional actors agree with the railway project in principle and can also promote it as being in their own interests. To ensure this is the main reason, the authors suggest joint planning actions between spatial and railway actors occur from the beginning, to find integrated solutions for key sections of the corridor.

## 2.2 Spaces of importance for the future spatial and corridor development

A key objective of this study is to identify the regions, in which unresolved problems persist between land-use and rail infrastructure development — problems which urgently need to be solved for the further functioning of the transport corridor and to maintain a high quality of living along its regions. This chapter briefly introduces the chosen method and the nine identified spaces of importance for future spatial and infrastructure development.

Based on the analysis presented in chapter 1, eight spaces with conflicts and problems of spatial importance were pre-identified. These findings were discussed with the EGTC members in five preparatory talks and during two workshops in July 2019. Based on the comments from the workshops and talks, the pre-identified spaces and conflict definitions were revised by the authors. The number of spaces of importance increased to nine, all of which are presented in Figure 9. The problems connected to two of the nine spaces are considered as most urgent, to be solved soon by appropriate planning procedures: The rail node of Viersen in the border region Limburg/North Rhine-Westphalia, presented in chapter 2.2.1 and the rail node Mannheim with its complex correlation to the new Frankfurt–Mannheim and Mannheim–Karlsruhe rail lines in chapter 2.2.2.

For these spaces, action by collaborative planning procedures is recommended. An early, well organized analysis of the mutual interdependencies proved to be valuable for upcoming planning phases. Before escalating, existing and upcoming conflicts can be detected and settled this way.

For the other spaces, no urgent action is required now. This does not mean, these conflicts should be neglected. While immediate action is not necessary now, it should be taken as soon as the opportune moment comes. Thus, the following spaces need to be monitored carefully:

- The border region of Flandern/Limburg/Aachen
- The Rhineland including the node Cologne
- The Middle Rhine Valley
- The node of Karlsruhe together with proposed Mannheim–Karlsruhe line
- The Jura in Northern Switzerland
- The Border Region of Sottoceneri/Lombardia
- The Ligurian coast with the ports and rail network between Genoa and Savona

These spaces are shortly presented in chapter 2.2.3

### 2.2.1 The rail node Viersen

Although not all rail lines between Limburg and North-Rhine Westphalia are part of the Rhine-Alpine Corridor officially, the Brabantroute is of importance for the functioning of the Rhine-Alpine Corridor. This line not only serves as diversion route in the case of construction works along the Emmerich—Oberhausen rail link, but also in its continuous operation is interconnected to the Rhine-Alpine Corridor. Today, the demand for transit trains is closely interdependent between the three main cross-border rail links Montzenroute, Brabantroute and Emmerich-Oberhausen line.

In Viersen, today the two railway lines from Düsseldorf/Cologne to Venlo/Eindhoven and from Duisburg/Krefeld to Aachen meet. A direct connection from Duisburg/Krefeld to Venlo/Eindhoven is not given today. The missing connection between Duisburg/Krefeld and Venlo/Eindhoven would allow a direct routing of freight trains between the Ruhr Area and the province of Limburg (see figure 10). With an additional connecting curve at Venlo and Roermond freight trains could run unobstructed from Antwerp to the Ruhr area. This new connection between the ZARA ports and Germany would relieve the existing lines—especially on the German side. New regional train connections between the Rhineland, Limburg and North Brabant would also be possible. This project is known under the name 3RX, the feasibility of which has already been examined in a 2017 study (Spit et al, 2017). The Federal Ministry of Transport and Digital Infrastructure of Germany (BMVI) announced that the planning process for the connecting curve Viersen will be started, as soon as a treaty “3RX Project Antwerp Roermond–Venlo–Viersen–Duisburg” has been negotiated and concluded between Belgium, the Netherlands and Germany. The BMVI and the German Bundestag warranted, that a routing “compatible with urban conditions” will be considered then<sup>1</sup>. However, there is no agreement for such a compatible routing of the connecting curve Viersen yet. The BMVI plans to start the search for a “Viersen curve compatible with urban conditions” at a later date. In order to develop a preferential alignment, the complete range of variants must be examined. According to the current state of knowledge, three basic variants have been proposed so far:

- Connecting curve through the Viersen-Rahser district (north of the railway station)
- A northern bypass of Rahser, outside the built-up area
- A new line, which branches off to the east south of Viersen railway station and leads east along the A52 or A44 motorway, where it is connected to the existing Neuss-Viersen line.

<sup>1</sup> see «ABS Grenze NL/D – Kaldenkirchen – Mönchengladbach – Rheydt-Odenkirchen» at: project information system of the Federal Transport Infrastructure Plan 2030: [www.bvwp-projekte.de](http://www.bvwp-projekte.de)

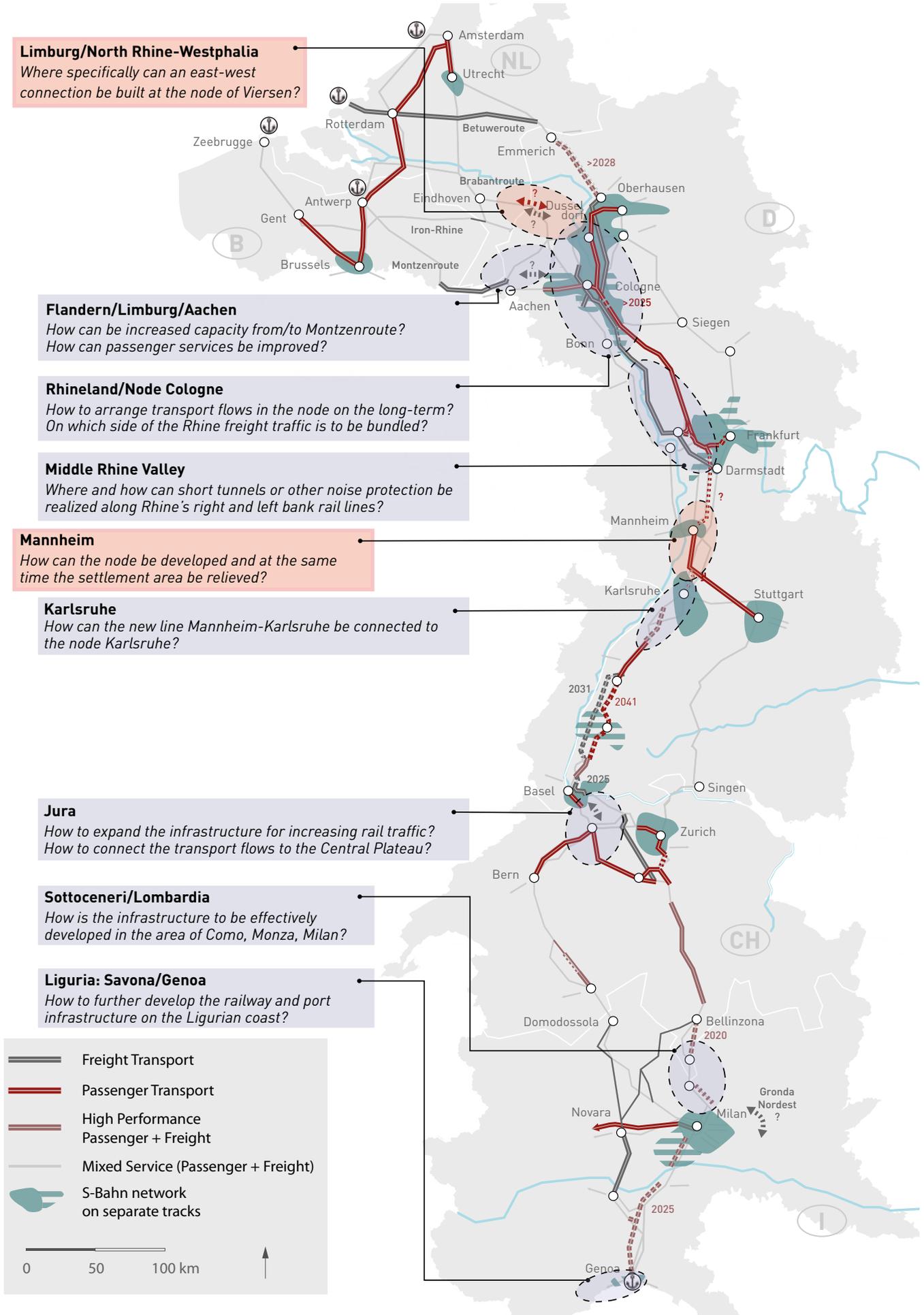


Figure 9: Nine spaces of importance were identified for the future spatial development along the Rhine-Alpine Corridor. Two spaces demand immediate action: 1) the rail node Viersen and 2) the rail node of Mannheim

There are good arguments for and against each of these variants. For example, an advantage of the shortest possible connecting curve in Viersen-Rahser is, that the necessary plots for still kept free of buildings. A disadvantage however is, that this curve lies directly in the settlement area of the city Viersen. An above-ground construction of this curve, combined with an increase in the number of trains, would result in an increase in noise emissions, which is why the city and the district of Viersen oppose this variant.

This typical conflict between local and supra-regional objectives may—if the typical infrastructure planning paths are followed—lead to a blockade of the situation in a later phase. The planning of a simple connecting curve would most probably be fought by the city of Viersen with all means at its disposal, with an open exit. Given the importance of this connection for increasing capacity between the ZARA ports and North Rhine-Westphalia, such a blockade should be prevented by all means. It is therefore important to find out, which possibilities exist in principle for the realisation of the “Viersen curve” and which of these possibilities would be feasible for all parties involved. If today we take the time to discuss this question in detail, a more rapid implementation may be enabled in a later phase.

This is where the informal cooperative planning procedure of “test planning” sets in. This procedure has been specially developed for situations in which an open question must be clarified and negotiated with the diverging interests of several actors involved (Scholl, Vinzens & Staub, 2013). The test planning is run as a tightly organized, informal planning procedure, which serves to uncover the complete solution spectrum in a short time. Thereto, several teams develop in competition with each other solutions for the task at hand. The solutions are discussed in three rounds with the affected actors and external experts. However, there is no winner at the end: The aim is to test the basic possibilities of action, find arguments for and against the individual options and to identify viable solutions.

An advantage of this procedure is that the involved teams usually consist of experts from various disciplines. This opens up the view from the outset beyond the «specialist solutions» to be expected. The involvement of stakeholders in the preparation of the task and the assessment committee ensures that test planning also enjoys local support.

In Viersen such a test planning should explore the possibilities of an integrated solution of the Viersen curve. In addition to the technically simple solution described above, these include tunnel solutions and extensive bypasses of the city. In particular, however, the strength of the procedure is to explore also mixed combinations of these solutions as well as possible synergies between railway and urban development. These could lead to an increase in the acceptance

of such a connection curve in Viersen — especially if the city of Viersen would benefit from such a connection.

The best proposals from a test planning on the Viersen curve can be handed over to the federal government at the end of the procedure and serve as a valuable basis for formal planning (construction approval procedure). In the Viersen case, this is particularly valuable, as the risk of complaints and objections is significantly reduced after a variant examination by means of test planning.

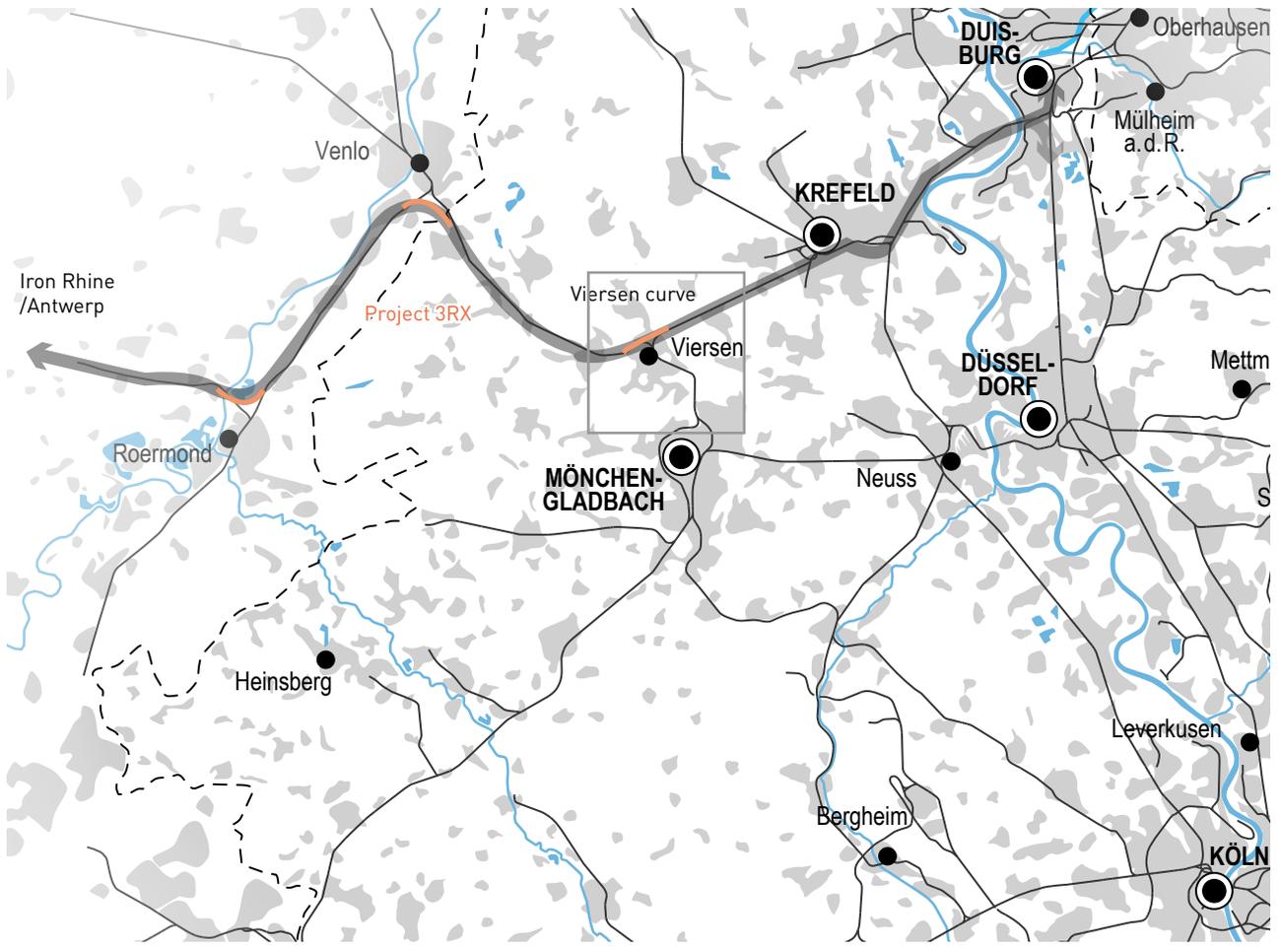
In the city of Viersen, the state of North Rhine-Westphalia and Deutsche Bahn respectively, the BMVI as the responsible Federal Ministry (BMVI) should be involved in such a procedure. The Rhineland Metropolitan Region would be predestined to initiate and support such a procedure.

Now is an opportune moment to initiate such a structured discussion. Otherwise, the federal ministry may award a contract for a detailed planning of the ministry’s most favourable solution—usually the cheapest solution—for the Viersen curve. Experience shows that after the formal planning process has begun, it is difficult to stop. However, it may be delayed for years and be built with long delays—the least satisfying outcome.

An alternative is to extend this procedure to the three connections to be built in the 3RX project. This would have the advantage that similar problems could be discussed in an integrated way in the three cities involved in the 3RX project and, in particular, possible synergies for cross-border regional traffic could be explored

## 2.2.2 The rail node Mannheim

The section Rhine/Main–Rhine/Neckar is one of the most heavily loaded sections of the German railway network. On the one hand, this is where North-South and East-West oriented transport flows are bundled, on the other hand around this section important transport sources and destinations are located. The demand is today served by the Riedbahn and the Main-Neckar-Bahn, both of which have a high traffic load. The Riedbahn is already recognized as a congested rail line. The discussion to increase the capacities for passenger and freight transport on the new high-speed line (NBS) Rhine/Main–Rhine/Neckar has progressed. At the moment, a motorway parallel alignment is preferred (see figure 11). A final decision is scheduled for the end of 2019, although realistically it is expected to be later. To allow a project-independent, rapid realization, the high-speed line will be led to Mannheim Waldhof, from where passenger trains can reach Mannheim main station by existing tracks. From Mannheim Waldhof, freight trains can be routed on a bypass line, which is also located in the city area. However, this line shows limited capacity, since it is partly single-tracked and



— curves for freight trains proposed by 3RX project

➔ direction of view aerial photo (Source: Google Maps)

— possible perimeter for Viersen curve (with its three basic variants proposed so far)

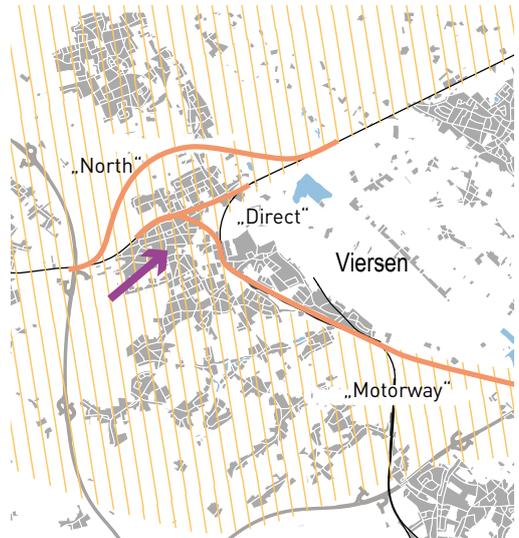


Figure 10: 1) Aerial view on the node Viersen

2) Proposed search perimeter for a new connection in Viersen

local passenger transport on it was recently densified. Thus, it remains unsolved how a growing rail traffic can be routed within and around the node of Mannheim over a long-term. The current development is in conflict with the objective of relieving the settlement areas in and around Mannheim of emissions caused by rail freight.

As a whole, the node Mannheim is today one of the most important nodes in Germany—both for long-distance passenger transport and in freight transport:

- Mannheim Hbf is the only railway station in southwest Germany in which a direct connection is possible ICE lines to Cologne/Hamburg/Berlin, Stuttgart/Munich/Basel/Milan and Paris/Marseille.
- The Mannheim marshalling yard is after Maschen Germany's second most important marshaling yard. It is connected to the trimodal Rhine port of Mannheim. The marshalling yard also serves the various industrial companies in the Rhine/Neckar area, which are significant sources and destinations for rail freight.

To offer regional connections, the S-Bahn Rhine/Neckar operates as an additional regional transport system. Altogether, the node of Mannheim is expected to operate at its capacity limit soon. A technical study on the node of Mannheim was commissioned on behalf of the federal transport ministry and presented in 2019. However, it largely overlooked the upcoming conflict between a growth in rail freight and the desires of the settlement area for relief.

As result, minor adjustments of the existing infrastructure were presented and potential bypass solutions were scrapped. In September 2019, the federal ministry reassessed its perspective. The discussion of how the routing of transport flows within and around the node of Mannheim can be managed on a long-term is now combined with the preliminary planning of another federal rail project: The upcoming expansion/new construction of rail capacity between Mannheim and Karlsruhe. This analysis will be done in a recently announced "optimization study". Within this study, the Federal Ministry BMVI lets investigate large-scale variants for the node of Mannheim and its connection to Frankfurt and Karlsruhe. The BMVI announced it would involve the concerned federal states, the region and the network operator DB Netz AG in the preparation of the study. The objective of the optimization study is to determine which requirements need to be addressed by investments into the

node of Mannheim. After the completion of the study, the preliminary planning can be started by DB Netz AG. The implementation of a regional dialogue forum, a participation process for the later planning phases was announced as well.

This means that currently important determinations of the planning base for the node of Mannheim is in progress. The following steps of the planning process are defined. The authors, however, see the risk that the focus is already too narrow on technical and economic aspects. In combination with a too limited forecast period, this entails the risk of disregarding the identified conflict between spatial and railway development for Mannheim. Although a participation process has been announced for the future, disregard of a conflict in early planning will be much more difficult to correct later.

Thus, the authors recommend to await the results of the ongoing optimization study. In parallel it is recommended to the EGTC and the city of Mannheim, to observe the situation and prepare for a collaborative planning process in Mannheim as well. Should this procedure prove necessary, it needs to be organized before binding arrangements are met in the formal planning process.

The city of Mannheim, its neighboring villages and the state of Baden-Württemberg, Deutsche Bahn and the BMVI as the responsible Federal Ministry should be involved in such a procedure.

### 2.2.3. Other spaces of importance

As mentioned above, for the below mentioned spaces, no urgent action is required now. However, this does not mean that these conflicts should be neglected. Even if in these cases immediate action is not yet necessary, it will be required when the opportune moment comes. This mainly depends on when the national investment programs of the respective states are elaborated. A discussion shall be initiated about three years before project designs are collected for the revision of the respective national investments program. For the case of Germany, this moment is expected around 2023, about seven years before the adoption of the next Federal Transportation Plan is expected<sup>2</sup>. To be prepared for a collaborative planning procedure later, these spaces need to be monitored carefully by the EGTC. The identified conflicts and are presented hereafter.

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<sup>2</sup> The current Federal Transport Infrastructure Plan 2030 was adopted in 2016 (some parts regarding the railway infrastructure in 2018). It is expected to be valid until 2030. The preparation phase of this Plan began in 2011. In 2013, railway projects could be announced to the Federal Ministry between three and five years before its full adoption

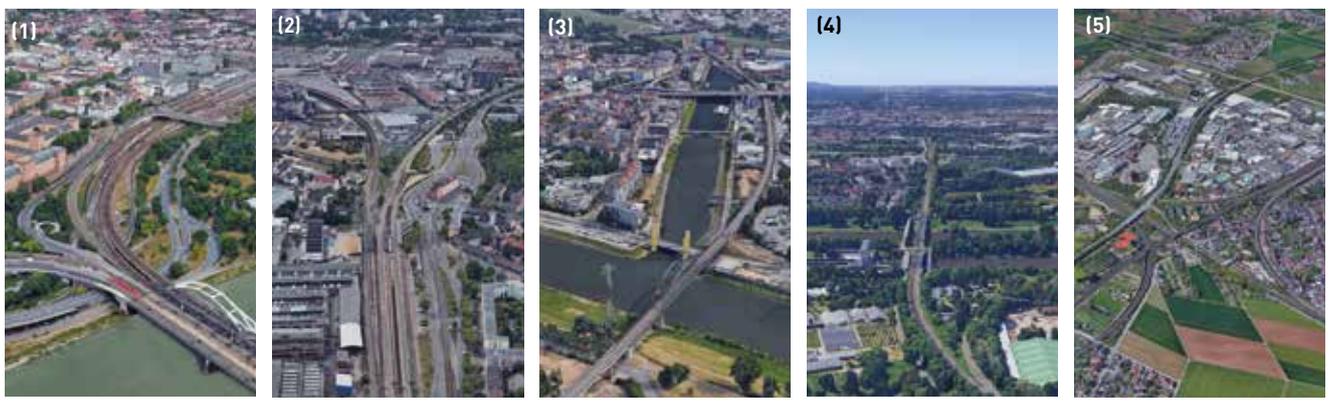
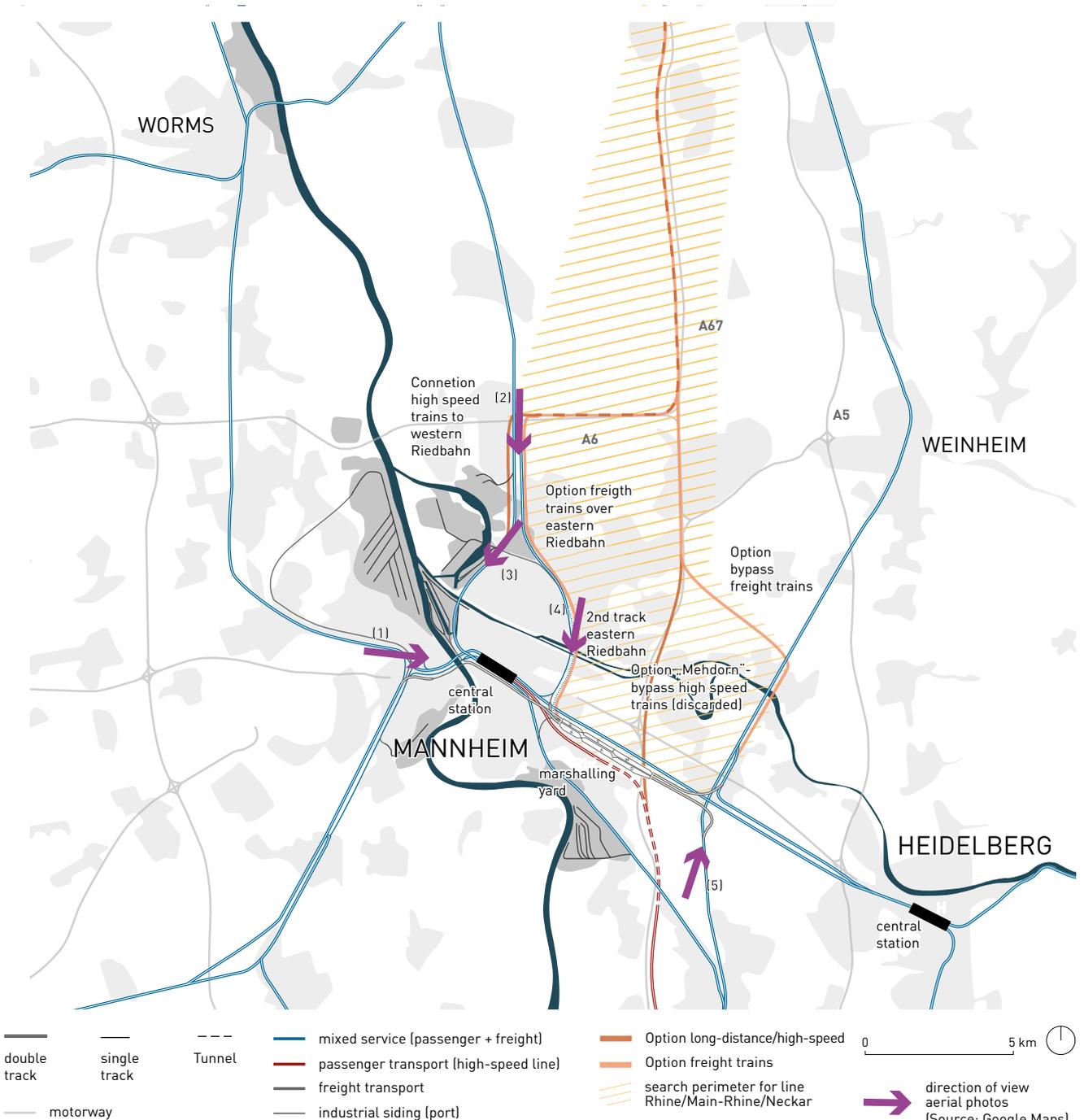


Figure 11: Situation at the node Mannheim

## **Flanders/Limburg/Aachen**

The cross-border rail link between Flanders, Aachen and Rhineland is important for international freight and passenger transport, and demand is expected to grow. In addition, there is a need to expand the cross-border local passenger transport. Around the station of Aachen, today the transport flows from the Montzenroute, the Belgian High Speed Line 3, from Mönchengladbach and Cologne converge. Combined with the local trains, various capacity bottlenecks are expected in the densely-settled area around Aachen within the next years. Thereby, demand for transit trains in the node is closely interdependent with the cross-border rail links Brabantroute and Emmerich-Oberhausen line. Increasing capacity or bottlenecks on these lines have an effect on each other. Under consideration of this connectedness, long time solutions need to be identified for railway and spatial development between Flanders, Aachen and Rhineland.

The situation needs to be monitored and action is required early enough before the new German Federal Transport Investment Plan is prepared. For now, the main questions are:

- How can capacity be increased from/to the Montzenroute?
- How can passenger services be improved?

## **Rhineland/Rail Node of Cologne**

At the node of Cologne, rail traffic from the west and north flows together in a funnel shape. The node is heavily frequented by local, long-distance passenger and freight transport. In order to reduce congestion in the central sections, more separated tracks for the S-Bahn are in planning. However, on the Ring Railway in Cologne or onwards to Bonn, separated S-Bahn tracks can only be realised at enormous expense. Along the Troisdorf-Mülheim-Speldorf rail line, local passenger transport cannot be implemented alongside the dense freight traffic.

Besides the urgently needed investments in planning, a long-term concept for the rail node of Cologne does not exist. An ample reorganisation of freight transport (on the right or left bank of the Rhine) could create valuable capacities for local passenger transport in the existing network. These considerations are closely linked to the long-term management of freight traffic south of Cologne (right bank of the Rhine, left bank of the Rhine, freight train tunnel long) and to a possible new Rhine bridge south of Cologne. Also, the current RWE Coal Railway must be included in the consideration. Now, this line is not available for other uses, but by 2040 at the latest, this rail line may be exempted from its exclusive use for coal mining<sup>3</sup>.

The authors consider it urgent, to monitor here the ongoing developments. Action is required before the new German Federal Transport Investment Plan will be prepared. Thus, in four years around 2023 a discussion on the node of Cologne needs to be opened. For now, the main questions are:

- How is the traffic in the node to be arranged on the long-term?
- On which side of the Rhine freight transport is to be bundled?

## **Middle Rhine Valley**

Persistent rail noise pollution is so serious for the communities in the Middle Rhine Valley, that the spatial development of the communities is limited and further migration must be expected. With the two double-track lines to the right and left of the Rhine, however, there is sufficient capacity for rail traffic so that the problem there cannot be solved by increasing capacity. The idea of a 118km long freight tunnel between Bonn and Wiesbaden brought up by the region faces this challenge. This is also confirmed by the non-inclusion of this idea into the prior demand of the German Federal Transport Infrastructure Plan 2030. The Federal Ministry has stated it would potentially commission a feasibility study. This offers little hope for the region. The authors assume that realization of the tunnel remains highly unlikely in the long-term. Instead, it is necessary to find a way of dealing with the ongoing railway network in the Middle Rhine Valley.

Thus, the region needs to prepare for the elaboration of the next Federal Transport Infrastructure Plan. Strong alternatives need to be developed and prepared. These alternatives can be brought into the formal planning processes if the long tunnel is declared unfeasible. To be discussed are:

- Where and how can short tunnels or other noise protection be realized along Rhine`s right and left bank rail lines?
- How can these tunnels be co-financed by means available for maintenance?
- How could a possible new freight line be built in stages in the long-term and connected to the existing network?
- How will conditions for freight transport change as a result of new developments in the Cologne/Bonn area?

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3 The transport of coal will be stopped already before 2040, however this private rail line will still be needed to backfill the surface mine.

## Karlsruhe

North of Karlsruhe, a capacity enlargement is under discussion with the project Mannheim–Karlsruhe. The node Karlsruhe is the hinge onwards to the Karlsruhe–Basel rail project in the south. A conflict for Karlsruhe today is, that restrictions exist for regional rail transport northwards.

A joint planning process together with the node of Mannheim and the capacity enlargement Mannheim–Karlsruhe was announced by the Federal Ministry, as briefly described in chapter 2.2.2.

As preparation for these upcoming processes, a regional discussion is recommended on the question about where and how regional rail transport can be densified. The potentials for urban development along the rail network around Karlsruhe needs to be surveyed to facilitate synergy between a joint railway and regional development in the node of Karlsruhe.

## Jura

Until 2040 at least, the crossing of the Jura is not a critical bottleneck on the Rhine-Alpine Corridor. Rail traffic is handled with mixed operation via the Bözberg and Hauenstein lines. The ongoing expansion of the Liestal railway station to be completed in 2025, will enable local traffic in the Basel area to be increased while retaining current capacity for the transit of the Jura. In the long-term, however, the question arises where and for which objective a 3rd Jura crossing should be realized. Two major alternatives need to be discussed:

- A base tunnel specifically designed for freight traffic
- A base tunnel designed for mixed traffic

However, this question is not pressing as there is still a bottleneck in the railway network north of Basel and the full commissioning of the Karlsruhe–Basel line is far away. In due course, however, these questions will have to be answered within a suitable perimeter, since the discussion must also include where such a base tunnel should be connected to the railway network of the Swiss Central Plateau.

## Sottoceneri/Lombardia

Various capacity enlargements and modernizations of the rail network are going on along the Corridor rail network in Sottoceneri/Lombardia. Accordingly, the railway network is expected to absorb the predicted and agreed number of freight trains between Switzerland and Italy in 2030. A Swiss–Italian working group “Ceneri opening”, monitors and assesses the capacity development along the three border-crossing railway lines for the upcoming years.

However, beyond 2030 the following conflict may stay prevalent along the line Lugano–Chiasso–Como–Monza: The capacity of the nodes is restricted and operation along the double tracked line is complex, for example, regular overtakings of RE/S and EC/R occur along this line. Its capacity and flexibility are insufficient over a long time, thus a 3rd/4th track is proposed between Chiasso–Monza. Thereby from Monza onwards a conflict arises as to whether cargo trains shall be routed via a proposed, but controversial “Gronda Nordest” bypass or through the Milano urban area. As alternatives, in recent years an extension of the Luino line “Gronda Ovest” or a new line between Cadenazzo and the terminals in Gallarate and Novara are discussed. Thus, the following question needs to be solved:

- How is the infrastructure to be effectively developed on the stretch Lugano–Chiasso–Como–Monza–Milano and in Milano area?

For this a collaborative planning procedure on the dependencies between the Rhine-Alpine Corridor and the Milano urban node can offer new insights, how the infrastructure shall be developed in future.

## Liguria: Savona/Genoa

With the implementation of the Terzo Valico, rail capacity between Genoa and Milano will be sufficient on a long time. However, along the Genoa–Savona–Ventimiglia line, conflicts may emerge soon between spatial development and development of the railway infrastructure:

- The coastline is densely settled and an increase in passenger transport in this area is expected.
- Track doubling of the line from Savona onwards to France is proposed and may lead to additional rail traffic.
- The interconnectedness of the ports and terminals of Genoa, Savona and Vado increases, since these are administrated by the single Port Authority of Genoa.

In this situation, it is still undecided if the infrastructure between Genoa and Savona is capable to service future needs and how it can adapt to these. Thus, this space needs to be monitored carefully by the EGTC. Further steps can then be taken as required in due time.

## 2.3 Conclusion

The purpose of this study was to identify the spaces of importance for the future spatial development along the rail network of the Rhine–Alpine Corridor. Explorations and interviews along the corridor have revealed a number of bottlenecks as well as nine spaces of importance for the future. North and South of the Alps, there is great agreement that the Karlsruhe–Basel section will be the most important of these bottlenecks until its planned completion in 2041. This bottleneck prevents the trans-alpine railway lines in Switzerland from exploiting its full capacity. Even if this is not in the EGTC's responsibility, the regional players between Karlsruhe and Basel can provide support for rapid implementation of this important line.

Other bottlenecks on long-term accumulate in the border region between Belgium, the Netherlands and Germany. Here, the two high-performance freight lines, the Betuweroute and Montzenroute, meet an already highly loaded German railway network, where expansions are planned but not yet realised. A third cross-border link offers the Brabantroute, which is predicted to also take over transport flows of the former Iron Rhine. Not only do several railway systems meet here, but also planning philosophies and interests. The expected bottlenecks may prevent timetables on regional level from being densified to the necessary extent, but also limit capacities in the seaport hinterland traffic. An intended modal shift to rail is hindered, as is a space-saving, transport-oriented development of settlements. The unsolved conflicts here, make the affected regions spaces of importance for the future development of the Corridor. To solve these conflicts, the services to be provided by the three cross-border rail lines need to be explored and agreed upon. Since the lines display strong interdependencies, it should be avoided that the affected regions shift the burden onto each other. Thus, one recommendation from the authors is to develop a long-term development strategy for the three routes requiring a tri-national agreement on their further development. The treaty "3RX Project Antwerp–Roermond–Venlo–Viersen–Duisburg" in negotiation is an important basis for this. The rail node Viersen was identified as a specific space of importance. Here, the question where specifically an east–west connection can be built needs to be answered.

In general, the importance of the nodes as a limiting element of corridor capacities is evident. Not only do the demands from long-distance passenger, local and freight traffic culminate here, but also the spatial constrictions and the intersecting transport flows make the nodes the most critical sections of the railway network. Capacity

enlargements are difficult here as well. Major Investments have already been made in the node of Milan. The node studies for Cologne, Frankfurt and Mannheim show that Germany has recognised the challenges too, but there is still a far way to go. It is therefore not surprising that the Mannheim junction is one of the areas identified as space of importance.

Regarding the future development of the corridor, three central recommendations can be formulated:

First, a cross-border capacity planning for Corridor rail and terminals remains of uttermost importance. An essential base for this, however, is a common long-time objective for the development of the Corridor. The advantage of such clear objective is revealed in chapter one; on a national level, sufficient capacities are available today if strategic capacity planning for freight traffic was carried out at an early stage. In contrast, bottlenecks in the rail network are particularly pronounced in the German sections of the Rhine–Alpine Corridor. Here, no sufficient strategy existed on a federal level to achieve a modal shift to rail, nor which performance shall be offered by the rail network. For the Rhine–Alpine Corridor, such strategic capacity planning would bring several advantages: At one side, the coordination and prioritisation of infrastructural investments along the Corridor becomes possible. At the other side, the affected regions and politicians can adjust their decisions to this strategy, instead of having to deal with frequently changing, uncertain demand forecasts. Although this coordination primarily takes place between the railway infrastructure operators and the national states, the EGTC as an international organisation can and needs to initiate coordination processes where necessary. It is recommended by the authors that the EGTC initiate the process of designing a strategic capacity planning for the whole Corridor.

The second recommendation regards the negative impacts of rail freight traffic on the affected regions. It is undisputed that freight trains can be much quieter than they are today! Thus, the reduction of rail noise at its source should be demanded and implemented as the highest priority. It also needs to be discussed to which extent separated freight lines can reduce emissions and if along the Corridor's core section in Germany more lines can be operated in that way. As the examples from Italy, the Netherlands and Belgium show, lines on which freight traffic is prioritised can have positive effects on the capacity of the entire network. Similarly, noise emissions are decreasing for many regions and specific noise protection is possible along the freight lines. However, the conflicts on the highly congested mixed traffic lines along the Rhine–Alpine Corridor lead to the conclusion

having no strategy is not the best solution. Here too, the EGTC can provide valuable input by enabling the regions concerned to discuss and develop their own strategies for dealing with freight transport and its impacts jointly. The strength of the EGTC Rhine-Alpine is its voluntary association of territorial entities and infrastructure operators. Solutions need to be found on the regional level.

The third and the greatest contribution that the EGTC and its members can make to the Rhine-Alpine corridor lies in supporting the planning of railway infrastructure projects in the regions. In the present study, the authors were able to identify nine spaces of importance in which an integrated approach to railway and spatial development is necessary, two of which require immediate action: 1) the rail node Viersen and 2) the rail node of Mannheim. In the case of Viersen, the authors recommend to prepare and run a "test planning". This procedure has been specially developed for situations in which an open question must be clarified and negotiated with the diverging interests of several actors involved. In the case of Mannheim, we suggest to await the results of an ongoing optimization study and to prepare a test planning procedure in parallel.

In the other seven spaces of importance, action is required in due time. This does not mean that these conflicts should be neglected, thus a careful monitoring by the EGTC Rhine-Alpine is necessary for now. This concerns for example the two identified spaces in Northern Italy, the border region of Sottoceneri/Lombardia and the Ligurian Coast between Savona and Genoa, where the interests of spatial and railway development need to be coordinated. The great added value of integrated planning from within the region is that these interests can be handled equivalently.

Comparable situations show that the time required for the preparation and implementation of such planning procedures pays for itself several times over in the following formal planning phases (Scholl, Vinzens & Staub, 2013). At several locations in Germany and Switzerland a test planning ultimately led to an improved integration of new infrastructure into the space, the resolution of blockades between the actors concerned, and in some cases, even an improved traffic effect. Since this way of thinking is not yet shared by the railway infrastructure companies or the national authorities, the regions concerned are called upon to initiate such integrated test planning procedures proactively.

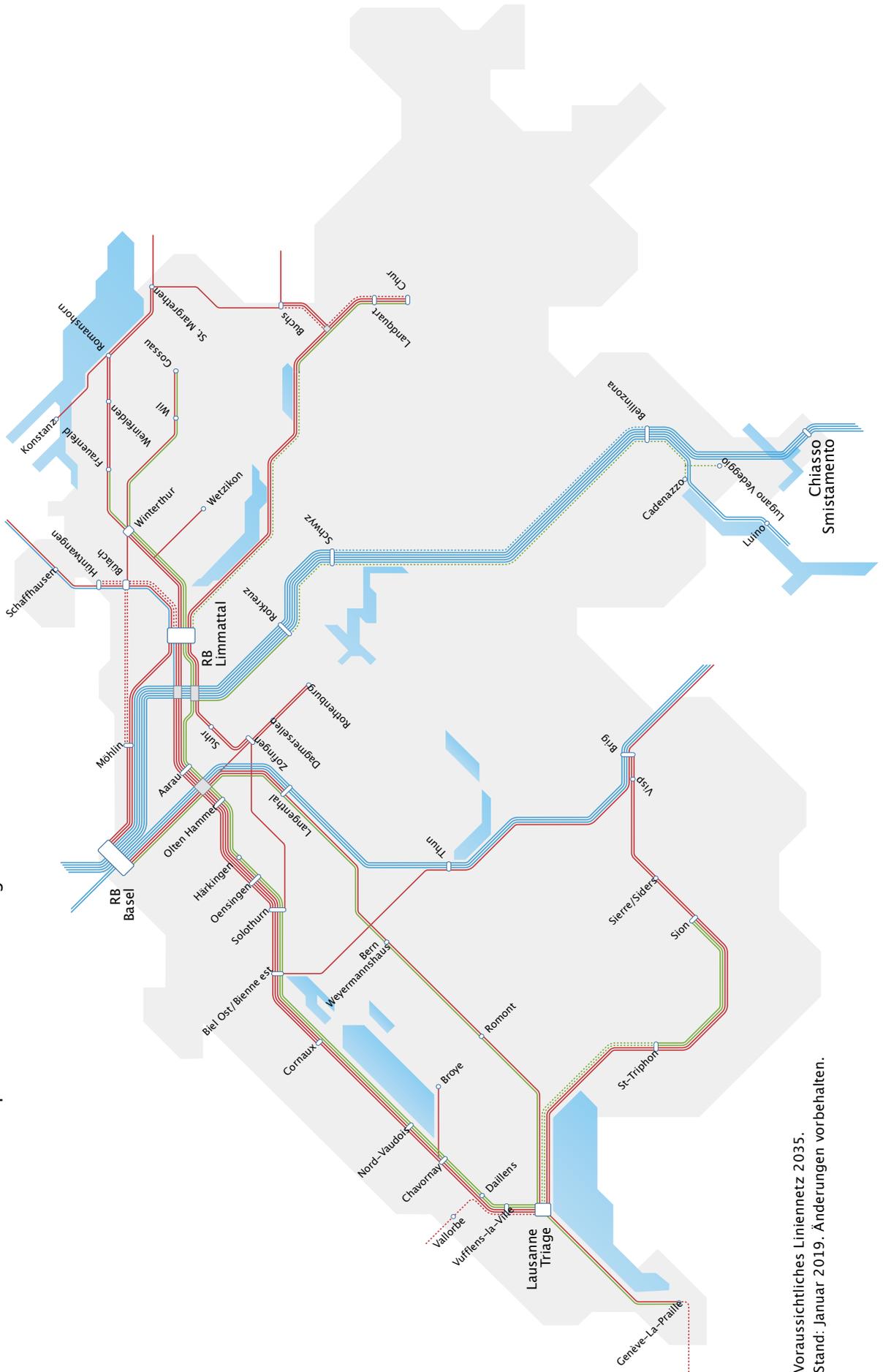
The costs of a test planning procedure are not insignificant at 400–600,000 €, but are negligible compared to the investment sums of the infrastructure and the possible economic effects of blocked planning procedures. Nevertheless, such an investment is not easily possible for individual regions. It is precisely here that the EGTC can become active by supporting the regions concerned in their search for funding, by providing methodological assistance or even by setting up their own long-term fund for the implementation of planning procedures at strategically important sections of the corridor. Either way, the existing conflicts will not solve themselves.

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# Annex

- 1 Standardtrasse pro Stunde und Richtung
- 1 Transitrtrasse pro Stunde und Richtung



Voraussichtliches Liniennetz 2035.  
Stand: Januar 2019. Änderungen vorbehalten.

