FINAL REPORT ON THE STUDY ON THE CORRIDOR'S INFRASTRUCTURE CHARACTERISTICS

BASED ON THE PRELIMINARY ROUTING AND INCLUDING CZECH CONNECTION

Co-financed by the European Union
Trans-European Transport Network (TEN-T)

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Introduction

The European Union, with the aim to enhance a European network for competitive rail freight, has published the Regulation (EU) No. 913/2010 that covers the implementation of nine initial rail freight corridors and a package of measures to improve the competitive situation of rail freight transport on these corridors. The corridor "Bremerhaven/ Rotterdam/Antwerp - Aachen/Berlin - Warsaw – Terespol (Poland-Belarus border)/Kaunas" with the extension to Prague (Rail Freight Corridor 8 hereinafter RFC 8 North Sea – Baltic or corridor) is analysed in this study. According to Article 11 of the Regulation (EU) No. 913/2010 the capacity management plan should be elaborated as part of the investment plan. To underlay this task a study about the infrastructure characteristics of the corridor describing the infrastructure parameters, such as train length, loading gauge, train weight and axle load and possible improvements is carried out. The study will also serve as an input for the implementation plan and the investment plan.

The completion of the study is one of the items of the Commission Decision (2012 11 06) concerning the granting of Union financial aid for projects of common interest "Preparatory studies and activities of the organizational structures of the Rail Freight Corridor 8 (Bremerhaven/Rotterdam/Antwerp - Aachen/Berlin – Warsaw - Terespol (Poland - Belarus border)/Kaunas)" – 2011 -EU-95090-S - in the field of the trans-European transport networks (TEN-T) where one of the activities named to fulfill the action is a study on the corridor's infrastructure characteristics. As described in the decision the activity covers the following tasks:

- assessment of relevant infrastructure characteristics related to capacity needs of freight trains on the corridor, e.g. use of 740m trains, maximum axle load, etc.;
- analysis of benefits in terms of capacity increase, train length, etc. resulting from the corridor's infrastructure modification;
- feasibility and cost estimation of the infrastructure modification and evaluation of alternatives.

The study on infrastructure characteristics is composed of seven parts.

1. The first part starts by describing the objectives and methodology of the study.
2. The second part overlooks the current situation of the existing infrastructure parameters. Each parameter is presented on a separate map showing differences between the values of the parameter along the corridor.
3. The third part covers the analysis of the results of the Transport market study regarding the demand for enhanced infrastructure parameters.
4. Part four provides the description of identified bottlenecks.
5. In part five the measures that result in infrastructure improvement are presented.
6. Part six gives an analysis of selected parameters.
7. Part seven provides qualitative information on costs and benefits of the improved infrastructure.

1 Objectives and methodological approach

The study on the infrastructure characteristics was carried out by the Working Group Infrastructure using the information from Infrastructure Managers and the results of the analysis of demand for enhanced infrastructure parameters (option 1 of the Transport Market Study). The aim of the study is to collect data on the corridor's infrastructure characteristics, which will allow assessing the current situation, future demand and enable the WG to undertake a qualitative cost/benefit analysis of possible improvements of the infrastructure. For the purpose of the study lines that belong to the preliminary routing and the Czech connection were taken into account. Once the final routing is determined the information about infrastructure parameters will be updated accordingly for the purpose of the Implementation plan.

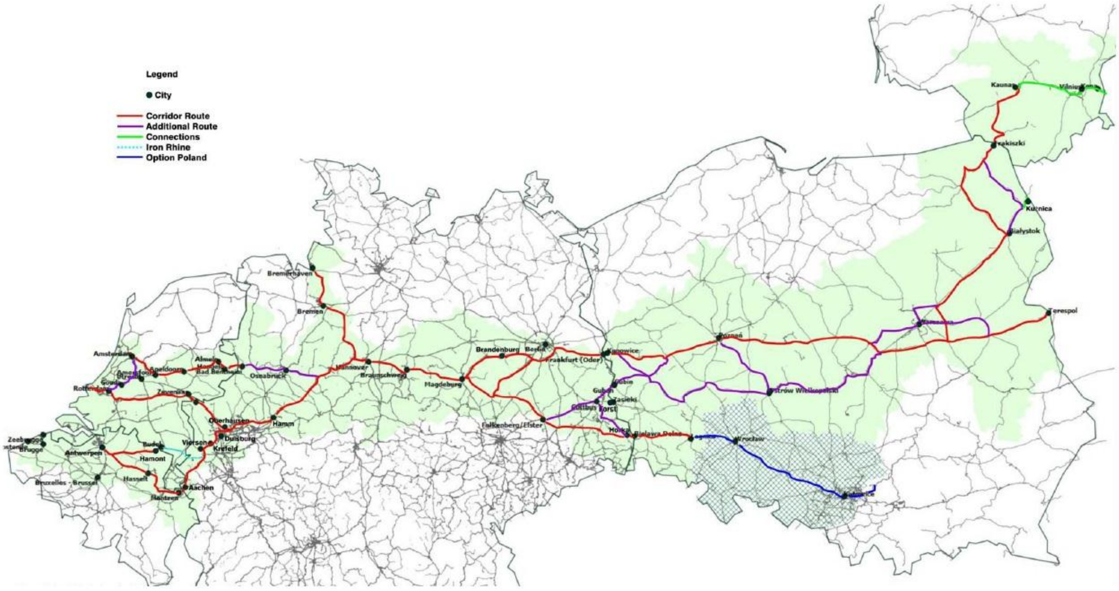

Figure 1 Preliminary Routing based on TMS excluding connection to the Czech Republic

2 Analysis of current situation of infrastructure parameters

In order to carry out the analysis of current infrastructure parameters, the WG Infrastructure has selected the main infrastructural parameters and defined them with the aim to have a common approach for collecting the information. The information is gathered by each member of the WG Infrastructure from their IM on the predefined parameters that are described in the table below.

Parameter	Values	Definition
Number of tracks	1, 2, 3, etc.	Number of tracks in the section
Type of power source	AC 25kV-50Hz/ AC 15kV-16,7 Hz/ DC 3kV/DC 1,5 kV /other (nominal voltage and frequency)/ Diesel.	The values of the catenary voltage and frequency in the section or Diesel
Max train length	…, 600, 650, 700, 740, …., 1050 m, etc.	The maximum length of a freight train with locomotive set by IM

<table>
<tr><td rowspan="18">Axle load

Meter load</td><td>Loading Class</td><td>Max Axle load</td><td>Max Meter load</td><td rowspan="18">Axle load: Sum of the static vertical wheel forces exerted on the track through a wheel set or a pair of independent wheels divided by acceleration of gravity

Meter load: A total rolling stock weight resting on a given meter</td></tr>
<tr><td>A</td><td>16,0 t</td><td>5,0</td></tr>
<tr><td>B1</td><td>18,0 t</td><td>5,0</td></tr>
<tr><td>B2</td><td>18,0 t</td><td>6,4</td></tr>
<tr><td>C2</td><td>20,0 t</td><td>6,4</td></tr>
<tr><td>C3</td><td>20,0 t</td><td>7,2</td></tr>
<tr><td>C4</td><td>20,0 t</td><td>8,0</td></tr>
<tr><td>CE</td><td>20,0 t</td><td>8,0</td></tr>
<tr><td>CM2</td><td>21,0 t</td><td>6,4</td></tr>
<tr><td>CM3</td><td>21,0 t</td><td>7,2</td></tr>
<tr><td>CM4</td><td>21,0 t</td><td>8,0</td></tr>
<tr><td>D2</td><td>22,5 t</td><td>6,4</td></tr>
<tr><td>D3</td><td>22,5 t</td><td>7,2</td></tr>
<tr><td>D4</td><td>22,5 t</td><td>8,0</td></tr>
<tr><td>E4</td><td>25,0 t</td><td>8,0</td></tr>
<tr><td>E5</td><td>25,0 t</td><td>8,8</td></tr>
<tr><td>F</td><td>27,5 t</td><td>-</td></tr>
<tr><td>G</td><td>30,0 t</td><td>-</td></tr>
<tr><td>Max line speed</td><td colspan="3">40, 50, 60,80, 100,...160 km/h, etc.</td><td>The maximum speed permitted for the best performing freight rolling stock</td></tr>
<tr><td rowspan="2">Profile</td><td colspan="3">C 22, C 32, C 45, C 70, C 80, other C 341, C 349, C 351, C 364, C 400, C 410, other</td><td>Standard combined transport profile number for swap bodies</td></tr>
<tr><td colspan="3">P 22, P 32, P 45, P 70, P 80, other P 339, P 341, P 349, P 351, P 359, P 364, P 400, P 410, other</td><td>Standard combined transport profile number for semi-trailers</td></tr>
<tr><td>Loading gauge</td><td colspan="3">GA, GB, GC, G2</td><td>A loading gauge defines the dimensions of the railway infrastructure e.g. bridges, tunnels and other structures allowing safe passage for railway vehicles and their loads</td></tr>
<tr><td>Gradient</td><td colspan="3">The gradient expressed as a permillage</td><td>$\text{Gradient} = \frac{\text{ED (Elevation difference)}}{\text{HD (Horizontal distance)}}$
Deepest gradient on the section (expressed in ‰ in both directions)</td></tr>
<tr><td>ETCS</td><td colspan="3">Is equipped in the section or not (yes or no).</td><td>European Train Control System</td></tr>
<tr><td>Control and command system</td><td colspan="3">Some examples: MPC (Lithuania); SHP (Poland); Indusi (IATC), LZB, PCB (Germany); ATB-EG, ATB-NG, TBL (Netherlands); TBL, Crocodile (Belgium), LS (Czech republic).</td><td>National train control and command system used in the section</td></tr>
<tr><td>Telecommunication system</td><td colspan="3">Analogue telecommunications network, RST (Radio Sol-Train, or Train to Surface Radio), GSM-R.</td><td>Telecommunication system used in the section</td></tr>
</table>

Table 1 Description of parameters

The currently existing infrastructure parameters are presented on the following maps (starting paragraph 2.2), where differences between the values of the parameter along the corridor are shown in different colours. Each map presents a different parameter.

2.1 Corridor length

The total length of the corridor based on the preliminary routing is 5,594 km. In the table below the length of lines of the corridor in each country is given:

Country	Corridor length, km	% of Total
Belgium	236	4,2
Netherlands	407	7,3
Germany	1,830	32,7
Poland	2,636	47,1
Lithuania	140	2,5
Czech republic	345	6,2
Total:	**5,594**	**100**

Table 2 Corridor length

2.2 Number of tracks

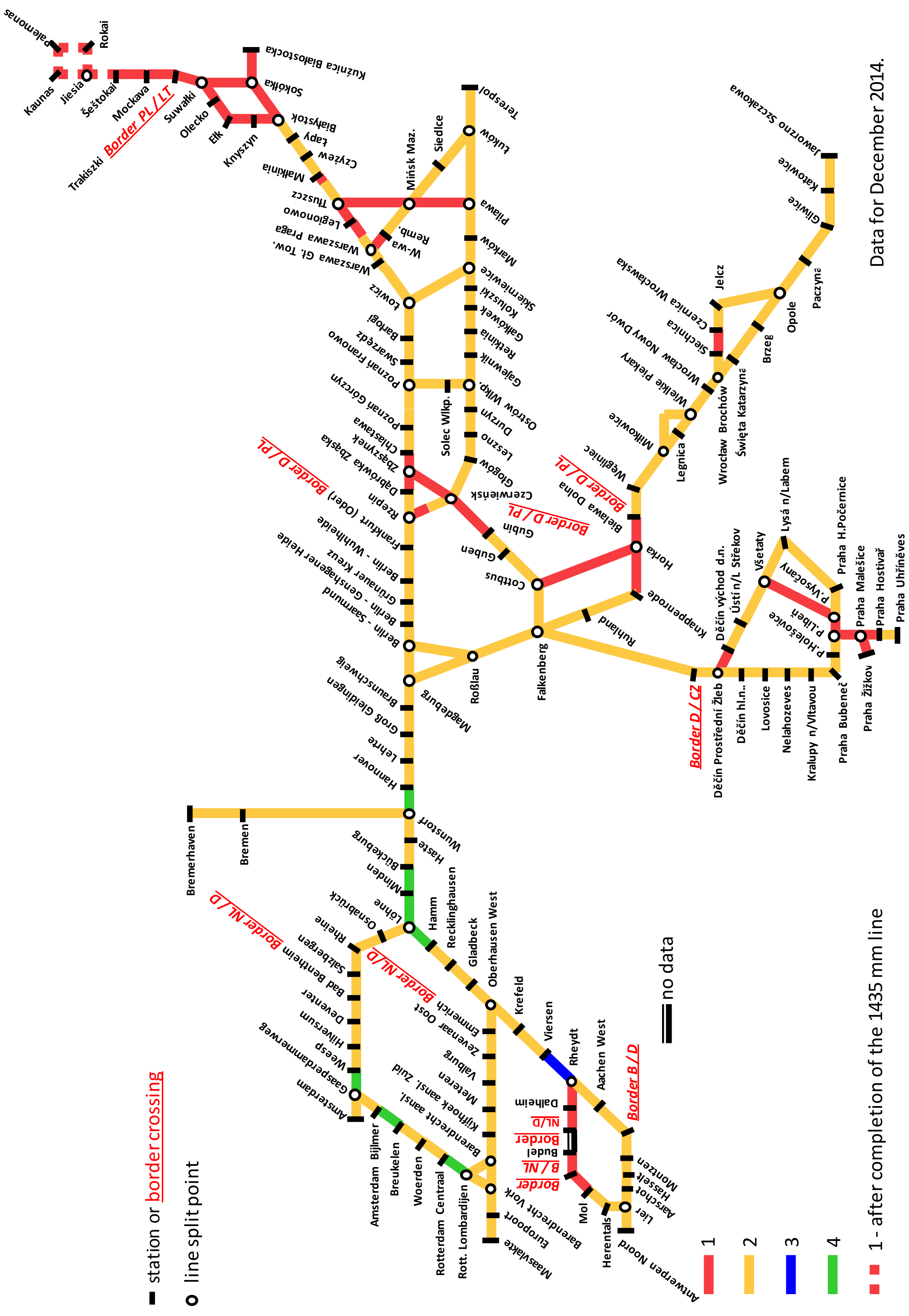

Figure 2 Number of tracks

The majority of the corridor lines are double-tracked lines.

2.3 Type of power source

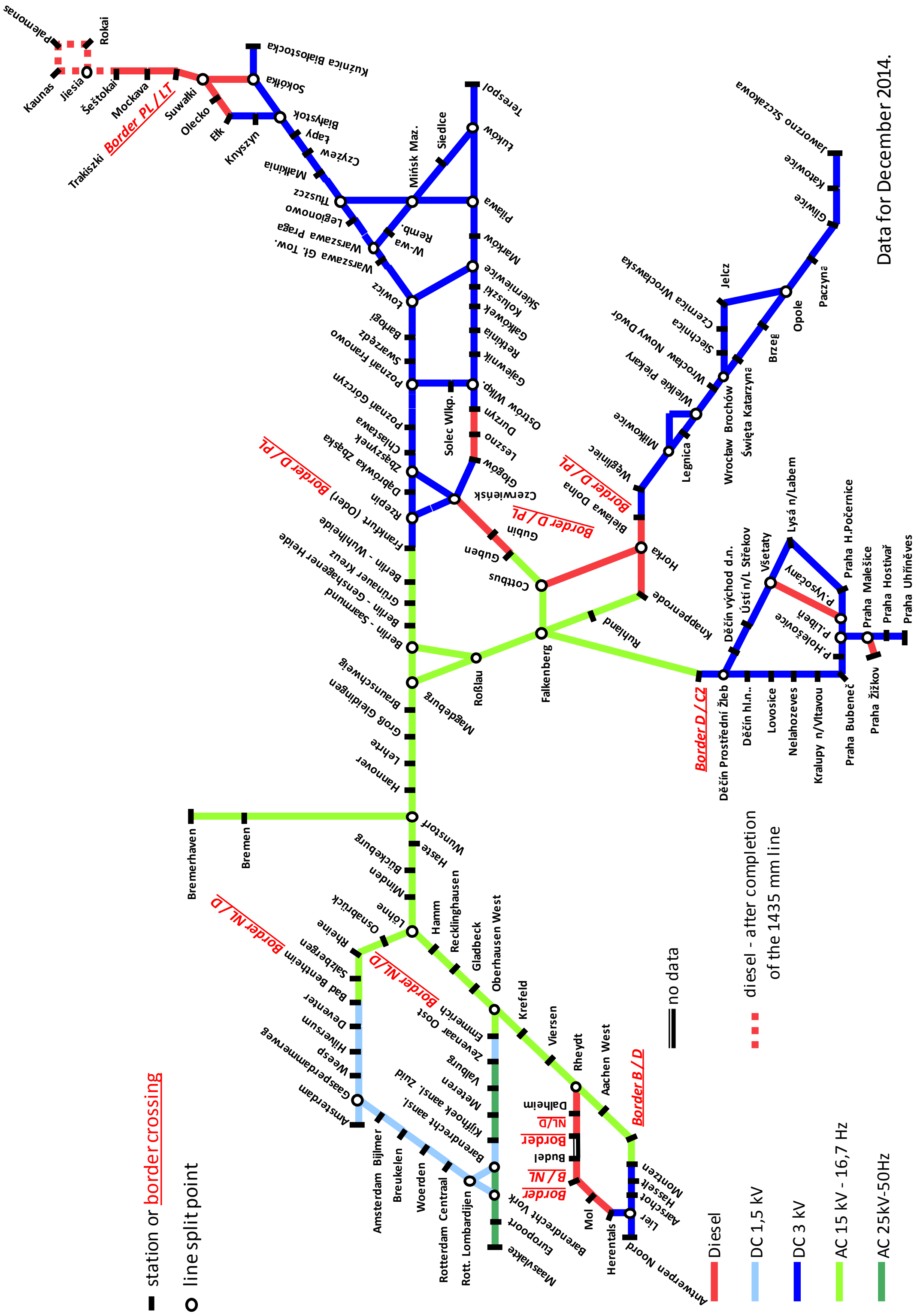

Figure 3 Type of power source

As can be clearly seen from the map, almost each country has a different voltage and frequency value, and not all the sections are electrified.

2.4 Maximum train length

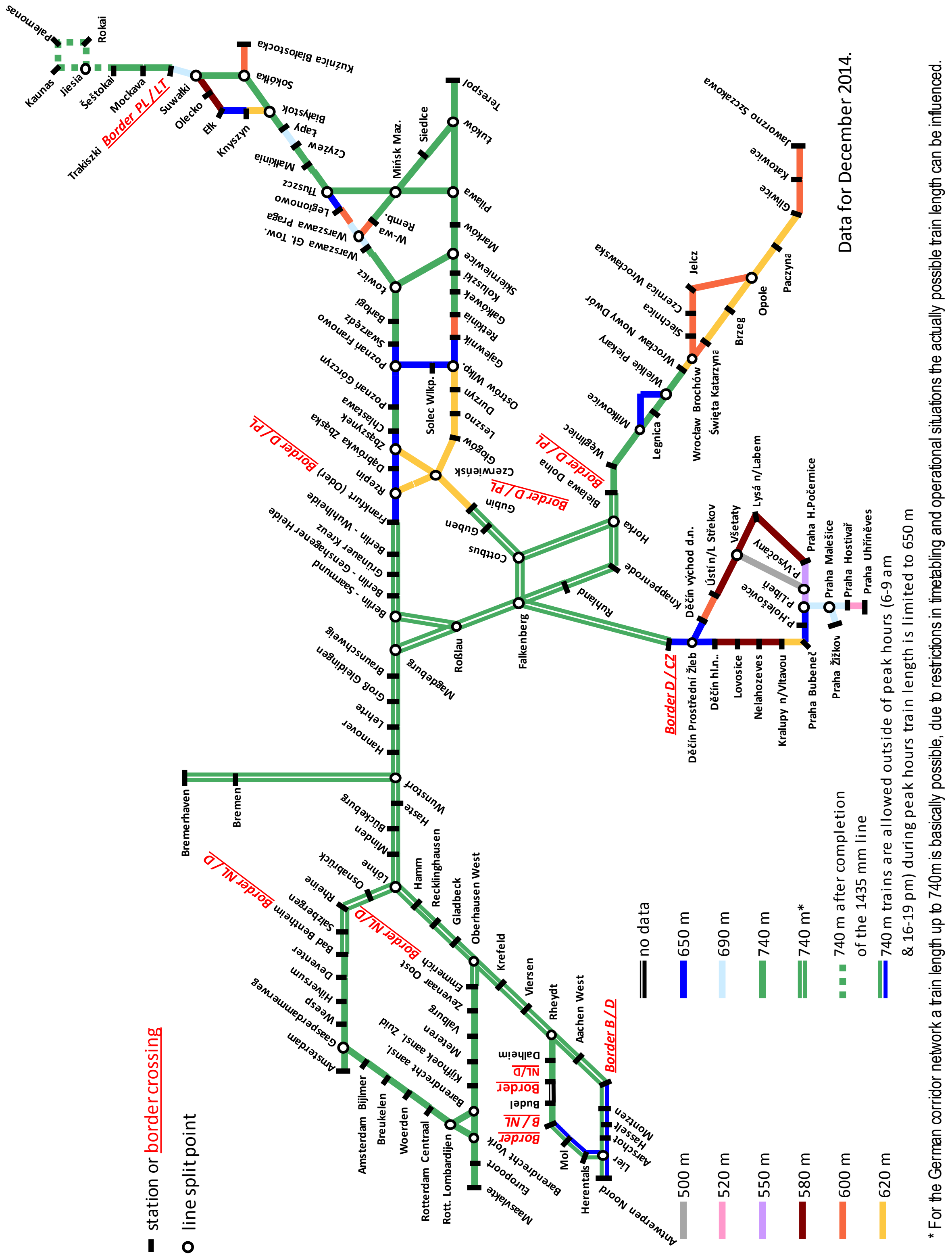

Figure 4 Maximum train length

The maximum train length on the corridor lines varies from 580 m to 740 m. Today journeys for 740 m trains on the entire corridor are not possible.

2.5 Axle/Meter load

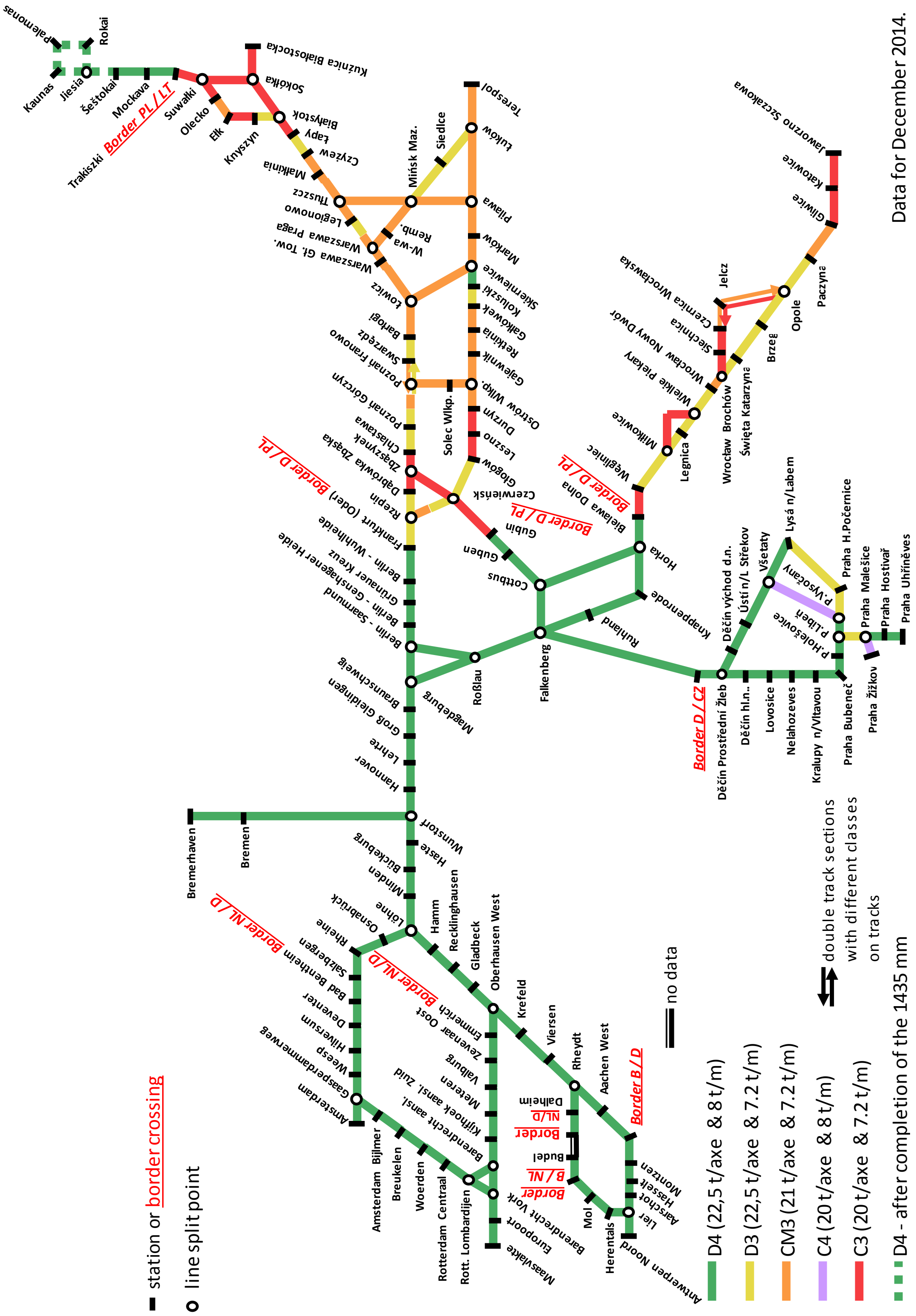

Figure 5 Axle/Meter load

As can be seen from the map in the major part of the corridor the allowed axle load is 22.5 t and meter load is 8 t, whereas the possibilities in Poland are more restricted.

2.6 Maximum speed

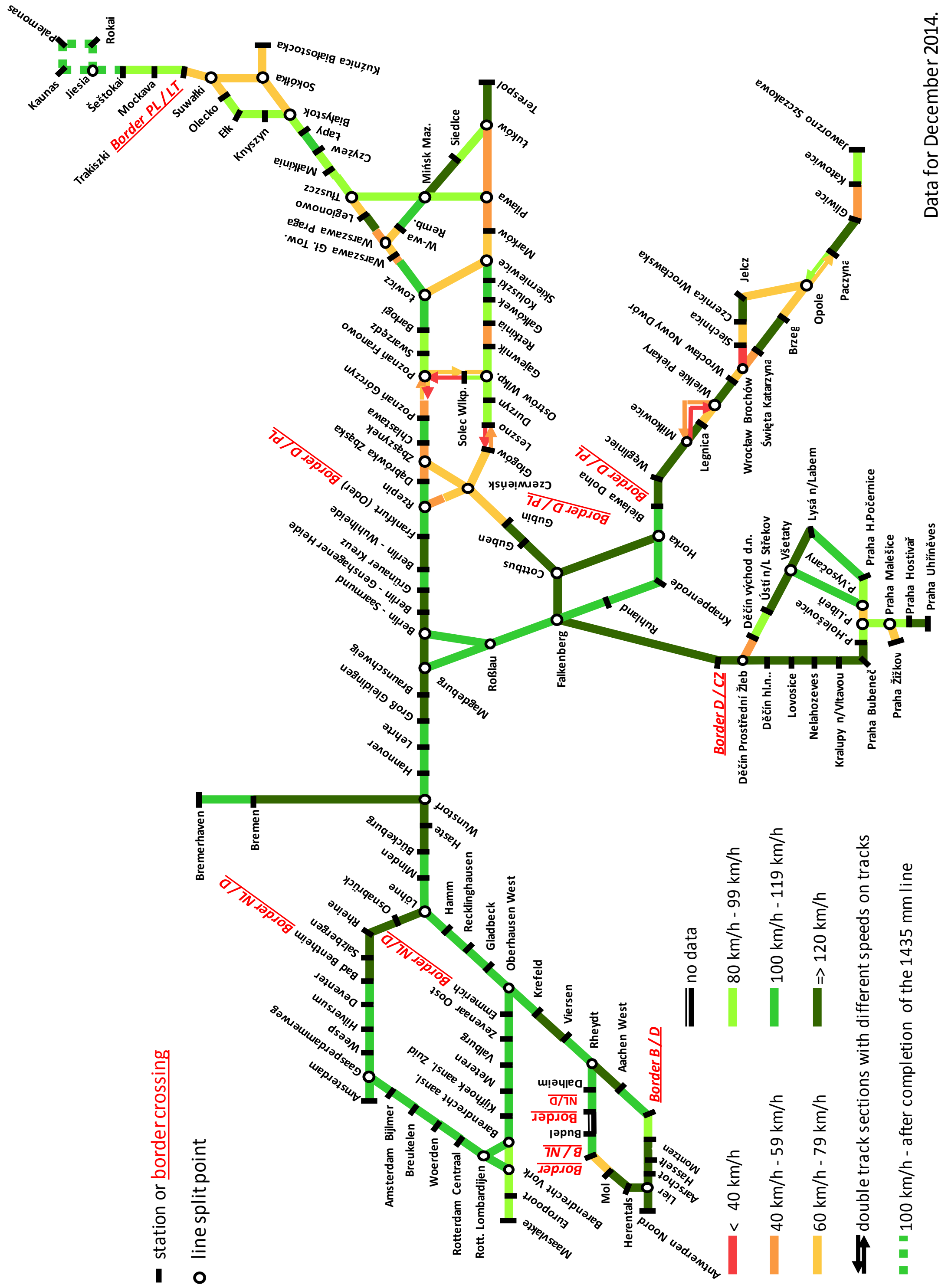

Figure 6 Maximum speed

In the majority of the corridor for even and odd direction the allowable maximum speed on lines for freight trains is 100 km/h or more except certain regions where the speed is limited down to 40 km/h. For most of the sections there is no difference between values for odd and even direction apart from certain sections where the difference is relatively small.

2.7 Profile/Loading gauge

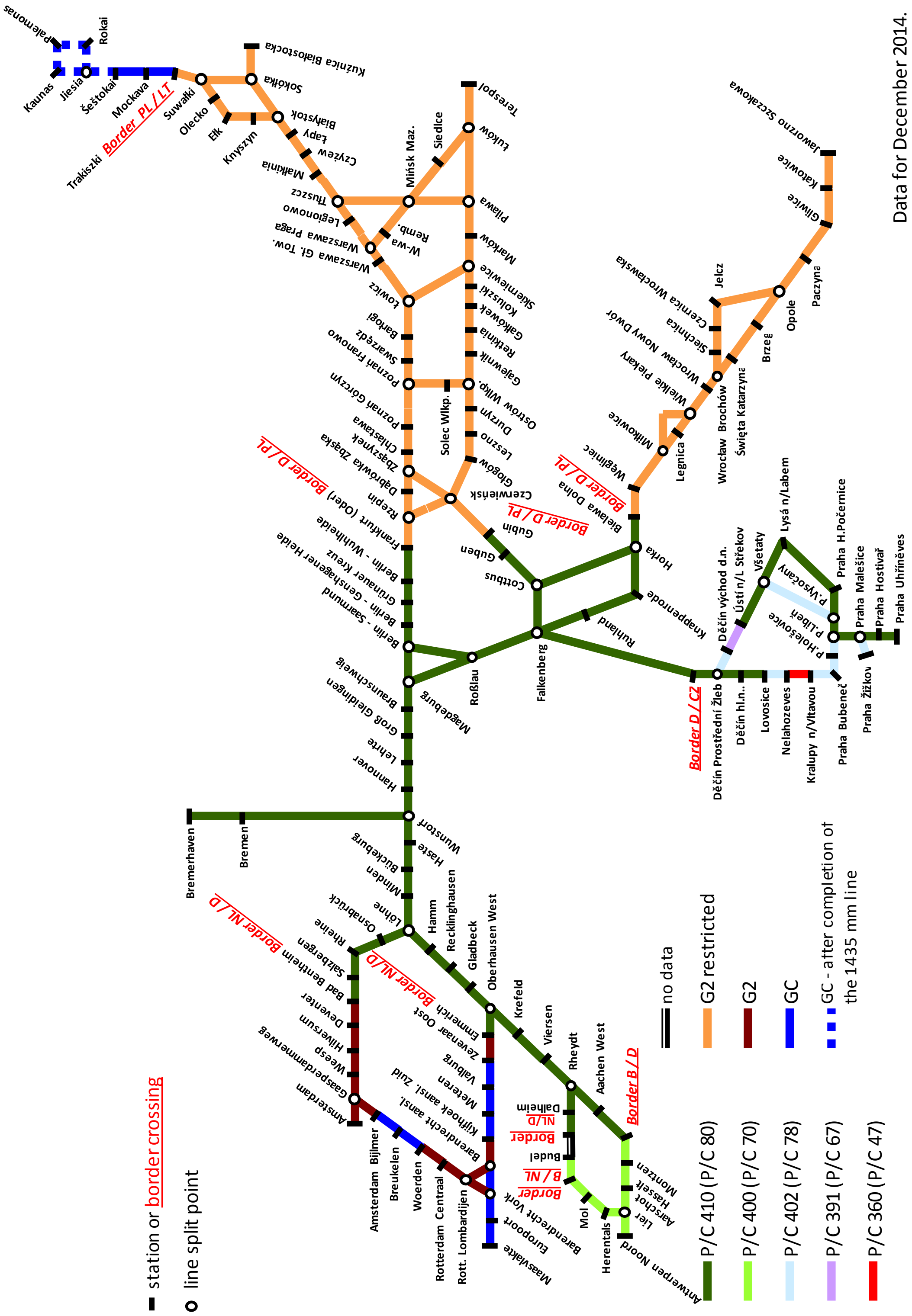

Figure 7 Profile/Loading gauge

For the purpose of describing the loading gauge, the parameters given in the IM network statement were used (except Poland), i.e. Belgium and Germany – the profile parameter, Netherlands and Lithuania – the loading gauge parameter.

2.8 Gradient

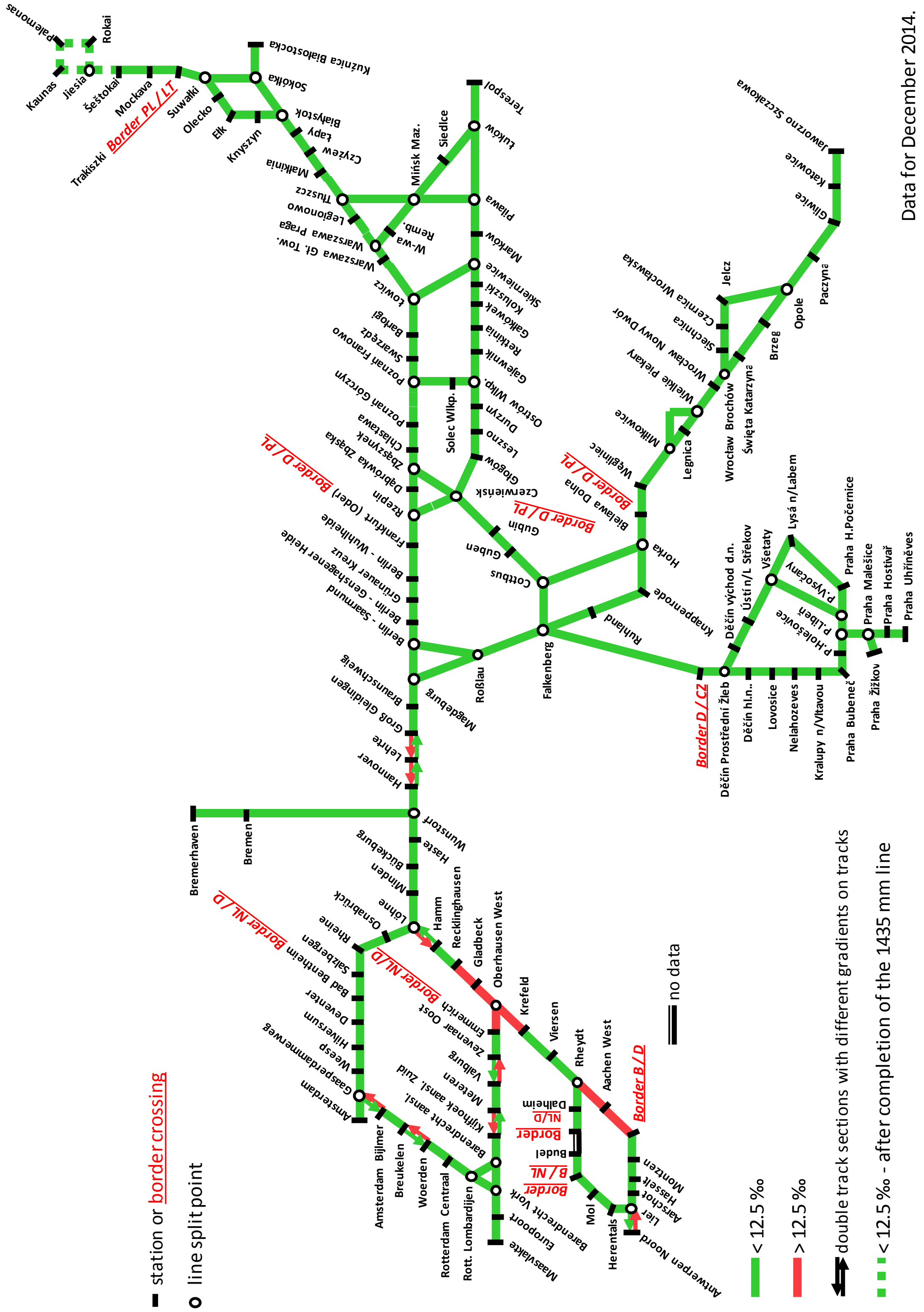

Figure 8 Gradient

As can be seen from the map on the majority of the corridor lines the gradient is less than 12.5 ‰ for even and odd direction.

2.9 Telecommunication system

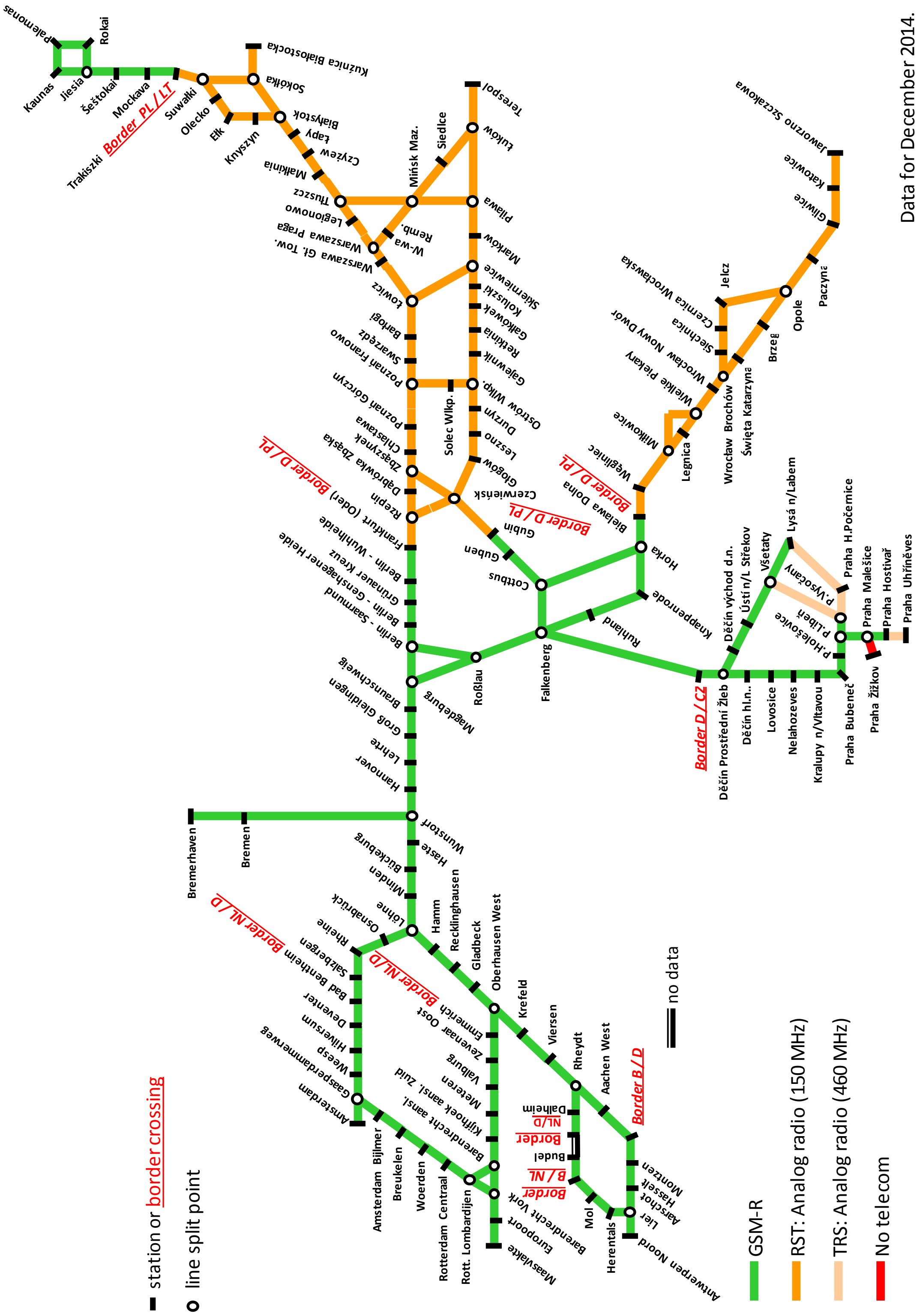

Figure 9 Telecommunication system

As can be seen from the map the western part of the corridor and Lithuania is covered with GSM-R whereas the radio communication is different in Poland and parts of Czech Republic.

2.10 Command and Control system

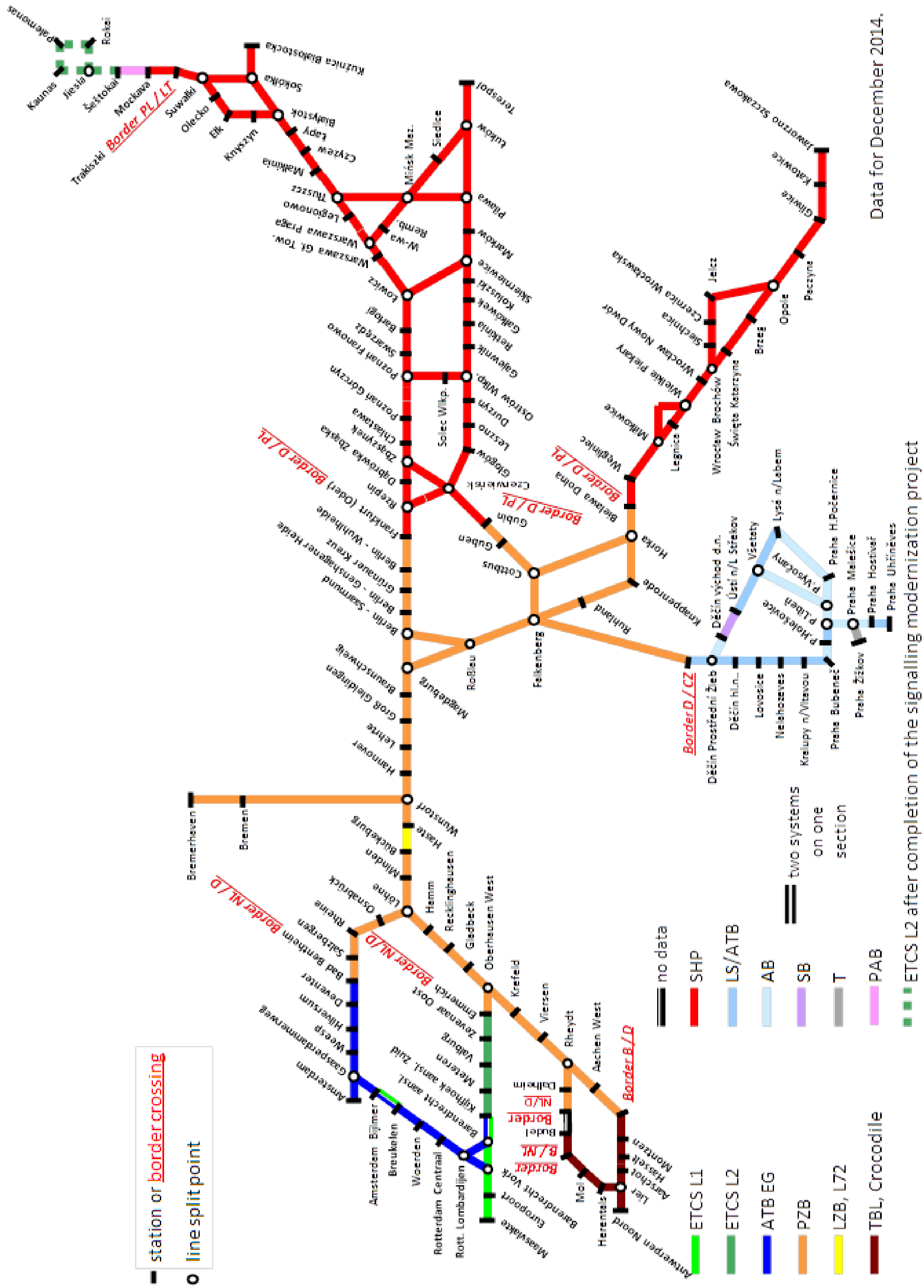

Figure 10 Command and control system

Each country has different national command and control system. In addition, the Netherlands have already equipped some (sections of) lines with ETCS.

3 Analysis of the results of the Transport market study (TMS) regarding the demand for enhanced infrastructure parameters

The results of the Transport market study regarding the demand for enhanced infrastructure parameters show that stakeholders require an upgrade of technical parameters to make their operations cheaper. This especially concerns the parameters that would make it possible to increase the loading capacity of trains.

The priority for the enhanced parameters is given to the train length, followed by train weight, maximum axle load and maximum speed. How much more demand there would be if enhanced parameters are put in place has not been calculated in the TMS, therefore the WG Infrastructure cannot make a quantitative judgement of the benefit the improvement would bring to the stakeholders since the TMS does not evaluate the consequences of enhanced parameters for the rail freight market share.

The most important topics given in the TMS are described in figure 11.

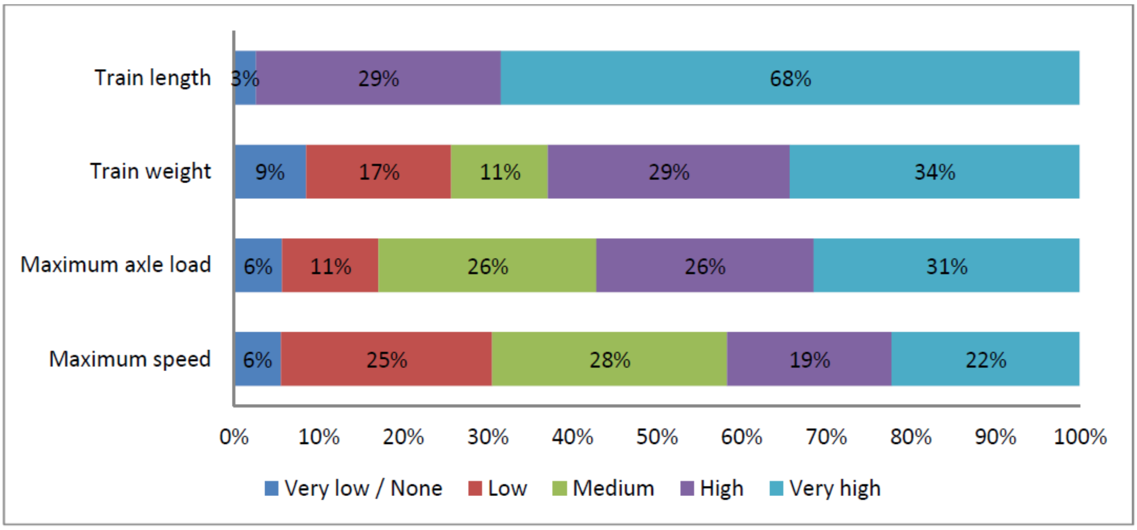

Figure 11 Assessment of the importance of technical infrastructure parameters in personal interviews (Source TMS, Figure 4-34)

The actual state of the parameters that have an impact on these topics can be found in chapter 2 (p. 2.4, 2.5, 2.6, 2.7). Train weight is a result of possibilities given by train length and axle load. The importance of the topics is underlined by the given percentages. These percentages will be taken into account in the further stages of the study on infrastructure characteristics.

4 Identification of bottlenecks

The requirements set out in the Regulation 1315/2013 Article 39 were chosen as the reference point for identifying bottlenecks:

- full electrification of the line tracks and, as far as necessary for electric train operations, sidings;
- freight lines of the core network: at least 22,5 t axle load, 100 km/h line speed and the possibility of running trains with a length of 740 m;
- full deployment of ERTMS.
- nominal track gauge for new railway lines: 1 435 mm except in cases where the new line is an extension on a network the track gauge of which is different and detached from the main rail lines in the Union.

These requirements for Core railway network must be met by 2030 in order to achieve the objectives of the trans-European transport network policy. Since rail freight corridors form the backbone of core network corridors, these requirements were chosen as a basis to conduct our analysis of infrastructure bottlenecks. For bottlenecks linked to parameters without a reference point, we give a separate explanation. The graphs in chapter 2 show clearly that today the system does not meet the harmonization requirements. It also shows where the differences between values are located. This chapter will analyze those differences and identify where they may lead to bottlenecks that hinder harmonization.

4.1 Number of tracks

When we look at the number of tracks from the harmonisation point of view we do not identify a bottleneck.

4.2 Type of power source

From the harmonisation point of view the differences in the type of power source could be called a bottleneck. But in our opinion we cannot see that these bottlenecks will be solved in terms of infrastructure (common power supply system) due to financial reasons. For the moment the problem is solved by the use of multi-current locomotives. However, the sections that are not electrified at the moment could be called “special” bottlenecks that should be solved, because the solution of multi-current locomotive does not work for these bottlenecks.

4.3 Maximum train length

From the corridor point of view the maximum train length is one of the biggest infrastructure parameter bottlenecks, because a-740-meter-train cannot run along the whole corridor. It is worth noting that this parameter was identified in the TMS as one of the major problems. RUs already expressed their need for 740 m trains on different occasions. Furthermore, in the Rotterdam declaration improving the possibility for longer trains was already agreed upon by the Ministries of Transport. Therefore, our proposal is to study this parameter in more detail and see how this can be solved all over the corridor.

4.4 Axle/meter load

From the corridor’s point of view to harmonise this topic certain measures have to be taken in Poland in order to improve the possibilities for running trains all over the corridor with the D4 axle/meter load. This is also one of the points mentioned by stakeholders in TMS interviews. The bottlenecks are planned to be removed with the investments already foreseen in Poland, but it's still to be investigated if after these investments are made all bottlenecks are removed.

4.5 Maximum speed

In the graphs we show the maximum line speed. Increasing these speeds to at least 100 km/h would be good from a harmonisation point of view and would also improve capacity. A second point is that it is not visible on the graphs that the operational speed limitations on certain parts of the section cause problems for RUs, seen from a financial point of view, and also for the IMs, seen from a capacity point of view. We see these as important issues to be solved (NB: sometimes the improvements are restricted due to natural surroundings).

4.6 Loading gauge/Profile

Analysing loading gauges/profile parameter is complicated due to the fact that some IMs give information on possible loading gauges, others on the train profiles that are possible. But it is visible that also in this area the most limitations are to be expected in Poland. This means that there is no harmonisation between the countries on the permissible dimensions of the trainload. We suggest that IMs give the information on both loading gauge and profile. Once the information is available it will be necessary to investigate if these differences are a problem.

4.7 Gradient

Since this corridor does not go through a very hilly area, the gradients are not a very big problem. Actually this parameter is not very much about harmonising but gives information on spots where the gradient could be a problem. Actually the Belgian – German border between Aachen and Montzen, coming from Germany to Belgium, is such a place. The limitation on train weight is caused by the gradient there. In practice pushing locomotives are used to facilitate also some heavier trains. It is known from previous studies that solving this gradient problem is an expensive matter. The remaining sections in Germany and the Netherlands with gradients higher than 12.5 per mille are near crossings and diversions on short sections, which do not represent operational bottlenecks.

4.8 Telecommunication system

The graph shows that all countries have a GSM-R system except Poland. Therefore this parameter is not harmonised along the whole corridor. The present solution is that all traction units which enter Polish network have to be equipped with devices that allow voice communication over the analogue 150 MHz radio (RST). For the moment, the working group cannot judge if this is a bottleneck for railway operations.

4.9 Control and command system

The control and command systems are absolutely disharmonised at the moment. Every country has its own national system. The deployment plan of ERTMS is the document we have to rely on to reach harmonisation here. All sections of the corridor, which are not yet mentioned in the deployment plan and for which no ETCS project is included in the investment plan, are considered to be bottlenecks.

5 Improvements on infrastructure

It can be seen from the Corridor Investment plan that some of the identified bottlenecks, i.e. concerning train length (train weight), electrification, axle load/meter load, train speed, ERTMS (input from WG Interoperability) are planned to be removed until 2025:

- With regards to Train length:

BE: under investigation;
NL: Redesign handover station Waalhaven Zuid,
Adjustment of the south – east curve at Meteren;
DE: All planned and realised projects of the national plan include the improvement of sidings in those sections;
PL: All planned and realised projects on the line D / PL border Frankfurt (Oder) / Rzepin – Poznań – Łowicz – Pilawa / Warszawa – Białystok – Ełk – Trakiszki border PL / LT and investment Wrocław – Jelcz – Opole include increase of possible length of trains to 740 m. For the section Rzepin – Głogów – Ostrów Wlkp. – Retkinia the possibility will be analysed during foreseen feasibility studies;
LT: none;
CZ: Kolín – Všetaty – Děčín and Praha Vysočany – Lysá nad Labem (2.phase).

- With regards to Electrification:

BE: Herentals-Mol ;
NL: Barendrecht aansluiting – Kijfhoek aansluiting Zuid: change from 1,5 kV to 25 kV
Zevenaar Oost – Zevenaar border: change from 1,5 kV to 25 kV;
DE: The ongoing construction in the section Knappenrode – Horka will close a bottleneck of missing electrification on the corridor;
PL: Modernisation of the section Białystok – Ełk – Trakiszki will include electrification of section Ełk – Trakiszki;
LT: Electrification of the railway line Poland/Lithuania border – Marijampolė – Kazlų Rūda – Kaunas;
CZ: none.

- With regards to Axle load/meter load:

BE: no projects, all lines are D4;
NL: no projects, all lines are D4;
DE: no projects, all lines are D4;
PL: The following investments:
Poznań Górczyn – Swarzędz,
Swarzędz – Łowicz - Sochaczew,
Łowicz – Skierniewice – Pilawa – Łuków,
Łuków – Terespol,
modernisation of Warsaw by-pass line,
Warszawa – Białystok,
Białystok – Ełk – Trakiszki,
new bridge in Bielawa Dolna,
Wrocław – Jelcz – Opole,
will allow at least D3. Possibility of D4 will be analysed;
LT: no projects, all lines are D4;

CZ: Praha Vysočany – Lysá nad Labem and Praha Libeň – Praha Malešice.

- With regards to Speed:

BE: no plans;
NL: no plans;
DE: no plans;
PL Poznań Górczyn – Swarzędz,
Swarzędz – Sochaczew,
Łowicz – Skierniewice – Pilawa – Łuków,
Pilawa – Tłuszcz,
Tłuszcz – Białystok,
Białystok – Ełk – Trakiszki,
Białystok – Kuźnica Białostocka,
Rzepin – Głogów,
Głogów – Leszno – Retkinia,
Wrocław – Jelcz – Opole;
LT: no plans;
CZ: Praha Vysočany – Lysá nad Labem and Lysá nad Labem – Děčín Prostřední Žleb.

6 Selection of parameters for further analysis

Taking into account the requirements set out in Regulation 1315/2013 Article 39 for the infrastructure of the core network and looking to Figure 11 Assessment of the importance of technical infrastructure parameters in personal interviews (Source TMS, Figure 4-34) the WG Infrastructure has drawn a list of parameters that will be looked in more detail:

- Train length (train weight);
- Electrification;
- Axle load/Meter load;
- Train speed;
- ERTMS (input from WG Interoperability).

6.1 Train length

The Transport Market Study showed that the stakeholders give priority to running 740-meter-trains on the whole corridor. Figure 4 Maximum train length shows that this is not possible today. Reasons for the IMs not being able to offer a train path for 740 m trains can be:

- The operation of the lines is too vulnerable to accept longer trains;
- In most cases this is caused by the fact that sidings are too short to handle 740 m trains in case of disturbance;
- Track length of the hand-over station is not enough to handle longer trains.

Therefore a separate study is required to analyse where sidings, handover stations and other infrastructure have to be improved to meet the 740 m requirement. The possibility for handling longer trains results in increased train weight, which also is a demand of the RUs.

6.2 Electrification

Figure 3 Type of power source shows there are still sections on the corridor that are not electrified. Each IM needs to investigate what measures have to be taken to remove these bottlenecks. Table 3 provides information whether projects for electrification are already included in the investment plan.

Country	Not electrified section	Project for electrification included in the investment plan	Any additional project planned
BE	Mol – Hamont Border BE/NL (Iron Rhine)	No	Possibly after 2025
D	Knappenrode – Horka - Border D/PL	Yes	
	Horka - Cottbus	No	No
	Dalheim – Rheydt (Iron Rhine)	Yes	
PL	Border D/PL (Guben) – Czerwieńsk	No	No
	Głogów – Durzyn	Yes	
	Ełk – Suwałki	Yes	
	Suwałki – Border PL/LT	Yes	
	Sokółka – Suwałki	No	No
LT	Border PL/LT - Kaunas	Yes	

CZ	Praha Malešice – Praha Žižkov	No	No

Table 3 Electrification projects

After the realization of Falkenberg – Horka in Germany the corridor line will be rerouted and the diversionary line of Cottbus – Horka is no longer in the focus of the corridor.

6.3 Axle load/Meter load

Figure 5 Axle/Meter load shows there are still sections on the corridor that are not of D4 class. Each IM needs to investigate what measures have to be taken to remove these bottlenecks. The table 4 gives information whether projects that result in axle and meter load improvement are already included in the investment plan.

Country	Section were class is less than D4	Measures already included in the investment plan	Any additional project planned
PL	Bielawa Dolna (border D/PL) – Węgliniec	Yes	
	Węgliniec – Legnica – Wrocław	No*	Under investigation
	Miłkowice – Wielkie Piekary	No	No
	Wrocław – Jelcz – Opole	Yes	
	Wrocław – Brzeg - Opole		
	Opole – Paczyna	No*	Under investigation
	Paczyna – Gliwice	Yes	
	Gliwice – Jaworzno Szczakowa	Yes	
	Border D/PL – Rzepin – Poznań Górczyn	No	Yes
	Poznań Górczyn – Swarzędz	Yes	
	Swarzędz – Łowicz	Yes	
	Łowicz – Skierniewice	Yes	
	Skierniewice - Terespol	Yes	
	Pilawa – Tłuszcz	Yes	
	Tłuszcz – Białystok	Yes	
	Białystok – Ełk – Border PL/LT	Yes	
	Białystok – Kuźnica Białostocka	Yes	
	Sokółka – Suwałki	No	No
	Rzepin – Głogów	Yes	
	Głogów – Ostrów Wlkp.	Yes	
	Ostrów Wlkp. – Zduńska Wola	Yes	
	Zduńska Wola – Łódź Kaliska	Yes	
	Łódź Kaliska – Gałkówek	No	No
	Gałkówek – Koluszki	No*	Under investigation
	Łowicz – Warszawa	Yes	
	Warszawa – Tłuszcz	No	No
	Warszawa – Mińsk Maz.	Yes	

	Mińsk Maz. - Łuków	No*	Under investigation
	Gubin (border DE/PL) – Czerwieńsk – Zbąszynek	No	No
	Poznań – Ostrów Wlkp.	No	No
CZ	Praha Vysočany – Lysá nad Labem	Yes	
	Praha Libeň – Praha Malešice	Yes	
	Praha Žižkov – Praha Malešice	No	No

* On these sections the line class is D3 (22,5 t/axle & 7.2 t/m)

Table 4 Axle load/meter load improvement projects

6.4 Train Speed

Figure 6 Maximum speed shows there are still sections on the corridor where speed is less than 100 km/h. Each IM gives an overview of the situation where allowable speed is less than 100 km/h. The table 5 gives information whether projects that result in line speed improvement are already included in the investment plan.

Country	Section were speed is less than 100 km/h	Are the measures already included in the investment plan?	Any additional project planned
BE	Visé - Montzen	No	Under investigation
NL	Maasvlakte – Barendrecht aansluiting	No	No
PL	Miłkowice – Wielkie Piekary	No	No
	Jezierzany - Legnica	No	No
	Wrocław Brochów – Czernica Wrocławska	Yes	
	Jelcz – Opole	Yes	
	Brzeg – Opole	Yes	
	Opole – Paczyna	Yes	
	Gliwice - Katowice	Yes	
	Dąbrówka Zb. – Chlastawa	No	Under investigation
	Poznań Górczyn – Poznań Starołęka – Poznań Franowo	Yes	
	Gubin Border D/PL – Czerwieńsk - Zbąszynek	No	No
	Rzepin – Czerwieńsk – Głogów - Leszno	Yes	
	Ostrów Wlkp. – Poznań	No	Yes
	Leszno - Retkinia	Yes	
	Retkinia – Gałkówek	No	Under investigation
	Poznań Franowo – Barłogi	Yes	
	Łowicz – Skierniewice – Łuków	Yes	
	Warszawa Gołąbki – Warszawa	Yes	

	Praga		
	Legionowo – Tłuszcz	No	No
	Pilawa – Tłuszcz	Yes	
	Siedlce – Łuków	Yes	
	Tłuszcz – Białystok	Yes	
	Białystok – Ełk – Suwałki – Trakiszki Border PL/LT	Yes	
	Białystok – Kuźnica Białostocka	Yes	
	Sokółka – Suwałki	No	No
LT	Border PL/LT - Kaunas	No	Under investigation
CZ	Praha Libeň – Praha Holešovice	No	No
	Praha Libeň – Praha Vysočany	No	No
	Praha Vysočany - Praha H.Počernice	Yes	
	Lysá nad Labem – Prostřední Žleb	Yes	
	Praha Libeň – Praha Hostivař	No	No
	Praha Malešice – Praha Žižkov	No	No

Table 5 Speed improvement projects

In the Netherlands the section Maasvlakte – Barendrecht aansluiting (Harbourline) is only a few years in service as a dedicated freight line. Looking to the specific circumstances of this principal line a lower speed than 100 km/h was asked during the development of this section. Lots of traffic joining the principal line comes from handover stations, while other trains leave the principal line to end their journey at the handover stations. This means that trains will use switches, and this causes slower speed for the trains. It is not planned to adjust this specific line to meet the 100km/h requirement.

In Belgium, concerning the section between Visé and Montzen border, a study is ongoing to see whether the maximum speed can be increased to 100 km/h. If so, than the necessary works could be done simultaneously with the works to equip the line with ERTMS.

In Poland study or design works are ongoing on most of the sections where investments are foreseen until 2025. These will define the exact speed after completion of works. On some sections (especially within urban nodes) 100 km/h might not be achievable. Sections Gubin Border D/PL – Czerwieńsk – Zbąszynek and Sokółka – Suwałki are to be excluded from the corridor.

In Czech Republic the speed on most lines is minimally 80 km/h.

6.5 ERTMS

The WG Interoperability has analysed the current situation and future plans regarding the ERTMS deployment in the corridor. The table below provides summary results:

Country	Line section	Present ERTMS or Class B system (AWS, ATP or ATC) +STM	Future ERTMS system		
			ETCS version	Due Date	Telecommunication system (date of implementation of GSM-R)
BE	Antwerpen Noord – Lier	TBL 1+ / Crocodile	ETCS 1 FS v. 2.3.0d	2016	GSM-R
	Lier - Aarschot	TBL 1+ / Crocodile	ETCS 2	2017	GSM-R
	Aarschot - Hasselt	TBL 1+ / Crocodile	ETCS 2	2018	GSM-R
	Hasselt – Montzen	TBL 1+ / Crocodile	ETCS 2	2020	GSM-R
	Montzen – Border BE/NL	TBL 1+ / Crocodile	ETCS 2	2020	GSM-R
	Lier – Herentals	TBL 1+ / Crocodile	ETCS 2	2018	GSM-R
	Herentals – Mol	TBL 1+ / Crocodile	partial ETCS 2 partial ETCS 1 LS	2017	GSM-R
	Mol – Hamont border	TBL 1+ / Crocodile	ETCS 1 LS	2018	GSM-R
NL	Maasvlakte - Barendrecht aansluiting	L1 - 2.3.0d	not applicable	n.a.	GSM-R
	Barendrecht aansluiting – Kijfhoek aansluiting Zuid	ATBEG + L1 - 2.3.0d	not applicable	n.a.	GSM-R
	Kijfhoek aansluiting Zuid - Zevenaar Border NL/DE	L2 - 2.3.0d	not applicable	n.a.	GSM-R
	Kijfhoek - Rotterdam	ATBEG	to be decided	tbd	GSM-R
	Rotterdam - Gaasperdammerweg aansluiting	ATBEG	to be decided	tbd	GSM-R
	Amsterdam - Oldenzaal grens	ATBEG	to be decided	tbd	GSM-R
D	Aachen Grenze - Oberhausen West	PZB	to be decided	tbd	GSM-R
	Emmerich - Oberhausen West and Osterfeld	PZB	to be decided	tbd	GSM-R

	Dalheim – Rheydt (Iron Rhine)	PZB	to be decided	tbd	GSM-R
	Oberhausen West - Löhne	PZB	to be decided	tbd	GSM-R
	Bad Bentheim - Löhne	PZB	to be decided	tbd	GSM-R
	Löhne - Bückeburg	PZB	to be decided	tbd	GSM-R
	Bückeburg - Haste	LZB, L72	to be decided	tbd	GSM-R
	Haste - Wunstorf	PZB	to be decided	tbd	GSM-R
	Bremerhaven - Wunstorf	PZB	to be decided	tbd	GSM-R
	Wunstorf - Magdeburg	PZB	to be decided	tbd	GSM-R
	Magdeburg - Saarmund	PZB	to be decided	tbd	GSM-R
	Roßlau - Frankfurt (O)	PZB	to be decided	tbd	GSM-R
	Magdeburg - Horka - Grenze D/Pl	PZB	to be decided	tbd	GSM-R
	Falkenberg - Guben	PZB	to be decided	tbd	GSM-R
	Cottbus - Horka	PZB	to be decided	tbd	GSM-R
	Falkenberg – Border D/CZ	PZB	to be decided	tbd	GSM-R
PL	Warszawa Centralna – Warszawa Zachodnia	SHP	ETCS L2 (2023)	2025	GSM-R (2025)
	Warszawa Zachodnia – Warszawa Włochy	SHP	to be decided	tbd	GSM-R (2025)
	Warszawa Centralna – Warszawa Rembertów	SHP	ETCS L2 (2023)	2025	GSM-R (2025)
	Warszawa Rembertów – Terespol (GP)	SHP	ETCS L2 (2023)	2023	GSM-R (2017)
	Warszawa Zachodnia – Chrośnica	SHP	ETCS L2 (2023)	2023	GSM-R (2017)
	Chrośnica – Kunowice	SHP	ETCS L1 (2023)	2023	GSM-R (2017)
	Warszawa Wschodnia Osobowa – Warszawa Praga	SHP	ETCS L2 2.3.0d (2015)	2017	GSM-R (2017)
	Warszawa Główna Towarowa – Warszawa Praga	SHP	ETCS (2023)	2025	GSM-R (2025)
	Swarzędz – Poznań Starołęka	SHP	ETCS L2 (2023)	2025	GSM-R (2025)
	Warszawa Zachodnia – Warszawa Włochy	SHP	ETCS L2 (2023)	2023	GSM-R (2025)
	Warszawa Zachodnia – Warszawa Rembertów	SHP	ETCS L2 (2023)	2025	GSM-R (2025)

	Warszawa Praga R201 – Warszawa Praga R15	SHP	to be decided	tbd	GSM-R (2025)
	Warszawa Praga R6 – Warszawa Wschodnia Towarowa	SHP	to be decided	tbd	GSM-R (2025)
	Warszawa Główna Towarowa – Warszawa Gołąbki	SHP	to be decided	tbd	GSM-R (2025)
	Warszawa Główna Towarowa – Warszawa Gdańska	SHP	to be decided	tbd	GSM-R (2025)
	Warszawa Wschodnia Towarowa – Warszawa Rembertów	SHP	to be decided	tbd	GSM-R (2025)
	Poznań Starołęka – Poznań Górczyn	SHP	to be decided	tbd	GSM-R (2025)
	Chlastawa – Dąbrówka Zbąska	SHP	to be decided	tbd	GSM-R (2025)
	Warszawa Wschodnia Towarowa – Warszawa Rembertów	SHP	to be decided	tbd	GSM-R (2025)
	Węgliniec – Bielawa Dolna (GP)	SHP	ETCS L2 2.3.0d	2015	GSM-R
	Miłkowice – Węgliniec	SHP	ETCS L2 2.3.0d	2015	GSM-R
	Legnica – Miłkowice	SHP	ETCS L2 2.3.0d	2015	GSM-R
	Wrocław Muchobór – Wrocław Nowy Dwór	SHP	ETCS (2023)	2023	GSM-R (2017)
	Wrocław Nowy Dwór – Legnica	SHP	ETCS L2 2.3.0d (2015)	2017	GSM-R (2017)
	Wrocław Główny – Wrocław Muchobór	SHP	ETCS L2 2.3.0d (2023)	2023	GSM-R (2017)
	Opole Główne – Wrocław Główny	SHP	ETCS L2 2.3.0d (2023)	2023	GSM-R (2017)
LT	Border PL/LT – Kaunas - Palemonas	–	ETCS 2	2020	GSM-R
	Jiesia - Palemonas	-	to be decided	tbd	GSM-R
CZ	Praha - Lovosice - Děčín hl.n Prostřední Žleb - Shöna (DB)	LS	ETCS L2 2.3.0d	2017	GSM-R (in operation)
	Praha – Lysá nad Labem	LS	ETCS L2 2.3.0d	After 2020	GSM-R
	Lysá n/L – Mělník – Děčín východ - Prostřední Žleb	LS	ETCS L2 2.3.0d	After 2020	GSM-R (in operation)

Table 6 The current situation and future plans regarding the ERTMS deployment in the corridor

Table below gives information whether projects that result in ERTMS implementation are already included in the investment plan.

Country	Are projects already included in the investment plan?	Sections of the corridor that are planned to be equipped with ERTMS	Comment
BE	Yes		The whole corridor line will be equipped with ERTMS
NL	Yes		For most sections of the corridor the ongoing study on ERTMS implementation will deliver the information in 2016
DE	Yes (in some parts)	Upgrade of Emmerich – Oberhausen Upgrade of Knappenrode - Horka	
PL	Yes	Border DE/PL – Poznań Warszawa – Terespol Warszawa – Białystok Border DE/PL – Węgliniec – Wrocław – Opole – Katowice – Jaworzno Szczakowa	As presented in table above, moreover, ETCS will be implemented on the section Warszawa Rembertów – Białystok within the modernisation project Sadowne – Białystok and remaining works until 2020.
LT	Yes	Lithuanian/Poland state border-Kaunas	The whole corridor line equipped with ERTMS
CZ	Yes	Praha - Lovosice - Děčín hl.n Prostřední Žleb - Schöna Border DE/CZ	
	Yes	Praha – Lysá nad Labem	
	Yes	Lysá n/L – Mělník – Děčín východ - Prostřední Žleb	

Table 7 ERTMS implementation projects

In Germany ETCS is an integral part in each infrastructure investment in new or upgrade of existing railway infrastructure of the national plan (via the so called “Bedarfsplan”). The remaining parts of the corridor will be equipped as soon as there are concrete financing and planning in sight. At the moment there are no precise plans for the ERTMS-equipment of RFC 8. A general commitment by the government for the ETCS - equipment of the RFC’s is still missing.

6.6 Summary of parameters' analysis

In summary, from the information provided in the sections above, we see that even after all projects within the investment plan are realised until 2025 there will still be remaining sections on the corridor that:

- Are not electrified:

Belgium: section Mol - Hamont border B/NL;
Germany: section border NL/D - Dalheim – Rheydt;
Poland: Sokółka – Suwałki,
Głogów – Durzyn (in case of negative result of feasibility study analysis or in case the investment will be postponed);
Czech Republic: section Praha Malešice – Praha Žižkov (connecting line).

- Do not meet the 22.5 t axle load requirement:

Germany: section border NL/D - Dalheim – Rheydt (allowable C4);
Poland: increase of axle load to 22.5 t is possible on some sections after maintenance works. Detailed sections are analyzed;
Czech Republic: section Praha Malešice – Praha Žižkov.

- Allowable Train speed is less than 100 km/h:

Netherlands: The Harbourline;
Belgium: section Visé – Montzen border: under investigation/possibility to increase allowable speed to 100 km/h by 2022;
Poland: Warszawa Gł. Towarowa – Warszawa Rembertów / Warszawa Praga (60 – 80 km/h due to line geometry within the city);
Czech Republic:
- Praha Libeň – Praha Holešovice no planned improvement;
- Praha Libeň – Praha Vysočany no planned improvement;
- Děčín východ d.n. – Děčín Prostřední Žleb no planned improvement;
- Praha Libeň – Praha Hostivař no planned improvement;
- Praha Malešice – Praha Žižkov no planned improvement.

- ERTMS is not deployed (input from WG Interoperability):

Germany: For the major part of lines in Germany the installation of ETCS is not decided yet;
Poland: deployment on some additional routes is not decided yet;
Czech Republic: Praha Malešice – Praha Žižkov.

7 Cost/benefit analysis of investment related infrastructure improvement

All projects included in the investment plan make up a part of national investment plans, therefore the cost and benefit analysis of those projects have already been carried out as a prerequisite for them to be included in the national plans. For this reason no separate cost and benefit analysis will be carried out for each project.
However, the WG Infrastructure has evaluated possible costs and benefits for Railway undertakings and Infrastructure managers if improvements on infrastructure are realised and parameters along the corridor are harmonised.

- **Increase of train length (train weight) up to 740 m**

RU perspective

Benefits: If a train can take more loads, the cost for a ton of freight transported could be lower, i.e. variable costs go down, and therefore RUs profits go up.
Costs: No costs identified.

IM perspective

Benefits: More demand can be accommodated with the available capacity. Demand in trains will decrease, meaning that the remaining capacity for the IM will increase.
Costs: Less trains means the income from the infrastructure fees goes down. Adjustments to infrastructure needed to accommodate longer trains, e.g. longer sidings, adjustments for handover stations.

- **Electrification**

RU perspective

Benefits: No changes of locomotives needed during the journey, therefore saving time and costs. Running electrical locomotive is cheaper than a diesel locomotive.
Costs: No costs identified.

IM perspective

Benefits: Added value created for customers – more customers more income.
Costs: No electrified parts of infrastructure have to be electrified, i.e. additional costs.

- **Higher Axle load/Meter load**

RU perspective

Benefits: If a train can take more load, the cost for a ton of freight transported could be lower, i.e. variable costs go down, therefore RUs profits go up.
Costs: No costs identified.

IM perspective

Benefits: More demand can be accommodated with the available capacity. Demand in trains will decrease, meaning that the remaining capacity for the IM will increase.
Costs: Less trains means the income goes down from the infrastructure fees. Adjustments to infrastructure needed to accommodate heavier trains, e. g. strengthen bridges, etc. Increased maintenance costs.

- **Improvement on Speed**

RU perspective

Benefits: The journey time will be shorter, therefore costs go down.
Costs: No costs identified.

IM perspective

Benefits: If the speed is more equal on the line, maintenance costs could decrease.
Costs: Adjustments to infrastructure needed to allow higher speed, e.g. straightening the curves, improving geometry, etc.

- **ERTMS**

RU perspective

Benefits: ERTMS may significantly increase reliability and punctuality, ensure interoperability on railway networks (no need to change the loco at the borders), allowing to save the time, which is crucial for customers. In the long run this could be profitable for the RUs, not having to equip trains (locomotives) to communicate with different control and command systems.
Costs: RUs will have to install ERTMS equipment onboard.

IM perspective

Benefits: Increased capacity on existing lines and a greater ability to respond to growing transport demands: as a continuous communication-based signaling system, ERTMS reduces the headway between trains enabling up to 40% more capacity on currently existing infrastructure. ERTMS may significantly increase reliability, punctuality and speed, which are crucial for both passenger and freight transport. ERTMS deployment will also provide such benefits as interoperability on railway networks, highest level of safety, less trackside equipment.
Costs: Although the ERTMS system costs are relatively large, but it will considerably reduce maintenance costs, because trackside signaling is no longer required. Also simplified approval process in Europe greatly reduces certification costs traditionally associated with the introduction of new systems.

- **Overall benefits and costs for all corridor countries in case all improvement measures are put in place:**

Benefits: If the improvements on infrastructure are done, the parameters of infrastructure will be harmonised along the corridor that will lead of railways transport being more attractive and thus more competitive. Good quality infrastructure may also give impulse for a shift in transport modes from roads onto railways. If more freight is being transported on railways than roads, the corridor countries would face benefits such as less congested roads, less pollution, potentially lower prices due to the higher competition between transport modes, etc.
Costs: Lots of investment required.

8 Conclusion

The current infrastructure parameters along the corridor are not harmonized. At the moment, based on the results of the TMS and this study on infrastructure characteristics, the Working Group Infrastructure identifies the impossibility to run a 740 meter train as one of the biggest issues for IMs. But the bigger thought behind the recommendations of the TMS is that IMs would increase the load capacity of trains. Therefore the Working group recommends carrying out a study which would identify the necessary conditions to make this increase of loading capacity possible. This is about running 740 m trains on the entire corridor but also about the upgrading of the axle load and ton/meter load. It is evident that for the customers the upgrading and harmonization of the train length parameter to 740 m will have a positive effect on their results.
Another finding of the study is that even after realisation of all projects named in the investment plan there will still be bottlenecks on the infrastructure of the corridor. Therefore, based on the information in this study, the Working Group Infrastructure advises each Infrastructure Manager to take the necessary actions to investigate the removal of the remaining bottlenecks.