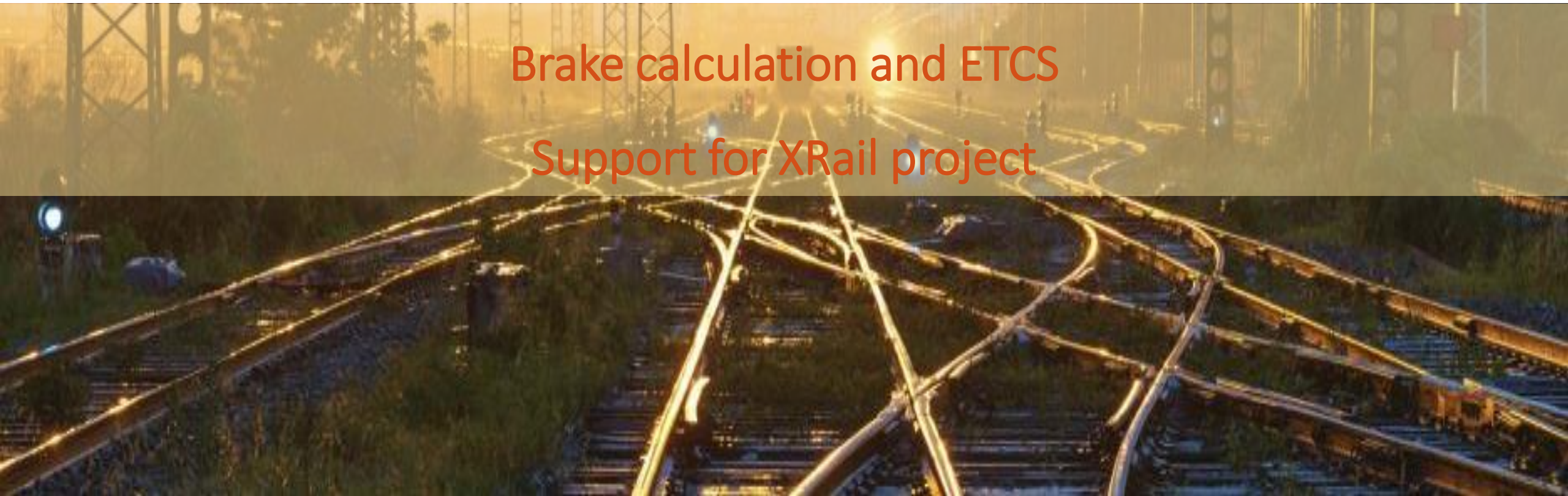




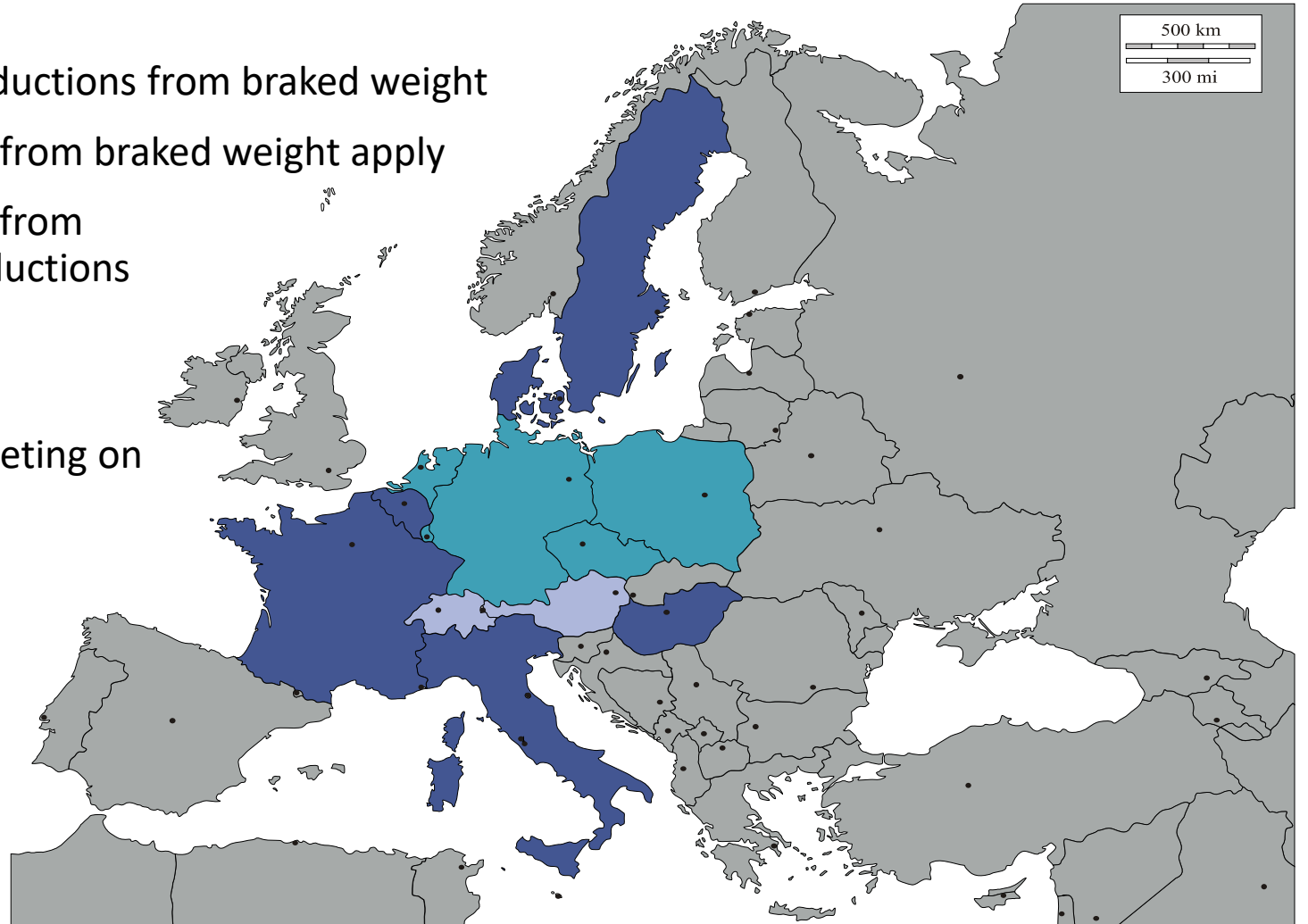
# Technical support for the interoperability Issues Log Book

Brake calculation and ETCS  
Support for XRail project



# Overview

- **Cluster A:** no train length-based deductions from braked weight
- **Cluster B:** length-based deductions from braked weight apply
- **Cluster C:** length-based deductions from braked weight apply, additional deductions for intermodal and G-braked trains
- Status as presented by Xrail in a meeting on 30.06.2021



# Further Research: General notes

- There is no need for harmonised brake calculations, when there are no through trains, like to Ireland, to Finland, from EU to Moldova, Ukraine and Belorussia, from Poland to the broad gauge network of Lithuania, and from France to the broad gauge network of Spain.
- Iberian Peninsula: there is only a need for harmonisation between Spain and Portugal, and for the standard gauge line near Port Bou.
- Baltic states: there is a need for harmonisation only among the states on their broad gauge network and between the states and Belorussia.
- Rail Baltica: there is a need for harmonisation among the Baltic states and to the B-Cluster of EU.
- Further research was based on desk research and information received by the Member States as response to an information request made by DG MOVE.
  - Member states who have answered: Spain, Portugal, Slovenia, Slovakia, Bulgaria, Romania, Bosnia and Herzegovina, Kosovo, The Netherlands, Luxembourg
  - Member states who have not answered: Greece, North Macedonia

# CIS and Baltic Countries (broad gauge network)

- No need for harmonization between CIS and Baltic 1520 mm gauge network and standard gauge network
- Brake calculation in CIS and Baltic states with 1520 mm broad gauge is harmonized, following the rulebook “Правила тяговых расчетов для поездной работы” (“Traction calculation rules for train operation”)
- First research shows that there are no length-based reductions to the brake percentages
- Further efforts needed to confirm this thesis
  
- CIS and Baltic states belong to **Cluster D** (probably same conditions as Cluster A)

# Norway

- Calculation of brake percentages is given in the “Strekingsbeskrivelse for jernbanenettet (SJN)”, which is an annex to the operational rulebook of the Infrastructure Manager BaneNOR
- [https://orv.banenor.no/sjn/doku.php?id=strekingsbeskrivelse:tillegg#oversikt\\_over\\_bremseprosent\\_og\\_bremsetabeller](https://orv.banenor.no/sjn/doku.php?id=strekingsbeskrivelse:tillegg#oversikt_over_bremseprosent_og_bremsetabeller)
- In total, there are 4 different tables for determining the required brake percentages (depending on speed, brake position and signalling of the track)
- The brake distances are 800m, 1200m and 1500m
- There is a length-based reduction for freight trains:
  - For trains between 500 and 600m, the calculated brake percentage is reduced by 5
  - For trains over 600m length, the calculated brake percentage is reduced by 10
- Norway belongs to **Cluster B**: *length-based deductions for braked weight apply*
- *No response provided to Panteia Consortium as to planned methodology on ETCS equipped trains*

# Slovenia

- According to Commission request:
- No information on the rules/methodology where the calculation is based
- „We take into account greater distance for braking, but we do not make train length-based deductions from braked weight.“
- Calculation of brake percentages can be found in the “Rules on brakes, safety devices and equipment of railway vehicles” (Art. 66f):  
<http://www.pisrs.si/Pis.web/pregledPredpisa?id=PRAV7364>
- Slovenia belongs to **Cluster A**: *no length-based deductions from braked weight apply*
- *Cluster A require no further investigation on planned methodology for ETCS equipped trains*

# Croatia

- Calculation of brake percentages is given in the “Traffic Rules” (Art. 124f) published by HZ Infrastruktura
- [http://spvh.hr/wp-content/uploads/2017/11/PROMETNI-PRAVILNIK-H%C5%BDI\\_2-od-10-12-2017.pdf](http://spvh.hr/wp-content/uploads/2017/11/PROMETNI-PRAVILNIK-H%C5%BDI_2-od-10-12-2017.pdf)
- There is a correction coefficient  $k$  (length-based reduction) for freight and passenger trains,:
  - For passenger trains between 401 and 500 m length,  $k = 0.92$
  - For passenger trains between 501 and 600 m length,  $k = 0.83$
  - For passenger trains between 601 and 700 m length,  $k = 0.72$
  
  - For freight trains up to 500 m length,  $k = 1$
  - For freight trains  $> 500$  m length,  $k = 0.95$
  - For freight trains  $> 600$  m length,  $k = 0.90$
- The corrections do not apply to EP braked trains
- Croatia belongs to **Cluster B**: *length-based deductions for braked weight apply*
  
- *No response provided to Panteia Consortium as to planned methodology on ETCS equipped trains*

# Montenegro

- Calculation of brake percentages is given in the “rules on the way of braking trains” (Art. 99, 105ff, 111) and its Annex (44 – 47)
- <https://wapi.gov.me/download-preview/1a28d343-9ae5-40ba-b672-eafbb7ef4af4?version=1.0>
- There is a correction coefficient  $k$  (length-based reduction) for freight trains,:
  - For freight trains up to 500 m length,  $k = 1$
  - For freight trains  $> 500$  m length,  $k = 0.95$
  - For freight trains  $> 600$ m length,  $k = 0.90$
  - Maximum Train length is 700 m
- Montenegro belongs to **Cluster B**: *length-based deductions for braked weight apply*
- *No response provided to Panteia Consortium as to planned methodology on ETCS equipped trains*



# Serbia

- Calculation of brake percentages is given in the “Rulebook on Brakes and Braking of Trains and Vehicles” (Art. 37)
- [http://demo.paragraf.rs/demo/combined/Old/t/t2021\\_07/SG\\_068\\_2021\\_005.htm](http://demo.paragraf.rs/demo/combined/Old/t/t2021_07/SG_068_2021_005.htm)
- There is a correction coefficient  $k$  (length-based reduction) for freight trains,:
  - For freight trains up to 500 m length,  $k = 1$
  - For freight trains  $> 500$  m length,  $k = 0.95$
  - For freight trains  $> 600$ m length,  $k = 0.90$
  - Maximum Train length is 700 m
  - Braking mass can be increased (factor 1.12) in case of EP brakes
- Serbia belongs to **Cluster B**: *length-based deductions for braked weight apply*
- *No response provided to Panteia Consortium as to planned methodology on ETCS equipped trains*

# Bosnia and Herzegovina

- Calculation of brake percentages is given in the “Rules on brakes of railway vehicles in Bosnia and Herzegovina ” (Art. 27) and “Rules on train braking” (Art. 12.3)  
<http://sluzbenilist.ba/page/akt/jBCU39Ud88U=> ; <https://pdfcoffee.com/233uputstvoupustvo-o-kocenju-vozova-pdf-free.html>
- There is a correction coefficient  $k$  (length-based reduction) for freight trains,:
  - For freight trains up to 500 m length,  $k = 1$
  - For freight trains  $> 500$  m length,  $k = 0.95$
  - For freight trains  $> 600$ m length,  $k = 0.90$
- (4) If freight cars with brakes G are added to a train with brakes P at a speed over 65 km / h, then the value of the braked mass of the car with brakes G is reduced by a factor of 0.8.
- Deductions for G-braked wagons in P-trains are a common practice in cluster B and do not represent any special rule
- Bosnia and Herzegovina belongs to **Cluster B**: *length-based deductions for braked weight apply*
- *Currently at ETCS level 0 (zero), and if the trains were equipped with ETCS, they would use the same braking methodology as present (applying the kappa factor)*

# Slovakia

Information from research:

- Calculation of brake percentages is given in the following document (from 2005):  
[http://fpedas.utc.sk/~gasparik/V15\\_1z1.pdf](http://fpedas.utc.sk/~gasparik/V15_1z1.pdf)

According to Commission request:

- The overall process for brake percentage calculation follows the UIC leaflet 544-1.
- However, the practical implementation of deductions for brake weight might vary based on the previously referenced document
- Slovakia is **Cluster A**, *no length-based deductions for braked weight apply*
- *Cluster A require no further investigation on planned methodology for ETCS equipped trains*

# Spain

- The methodology used is given in the "Technical Specification for Circulation. Calculation of braking distances" published in September 2021 by AESF (Spanish NSA).
- This specification is in accordance with UNE-EN 16834 (January 2020) and with UIC 544.1, 6th edition (October 2014)
- The kappa factor is applied to the brake weight percentage ( $\lambda$ ) of the whole train and never to vehicles.
- The kappa factor depends on the length of the train, its braking performance (P or G) and whether it is a passenger or a freight train.
- Spain belongs to **Cluster B**: *length-based deductions for braked weight apply*
- *ETCS L1 continues to follow UIC 544.1, ETCS without trackside signals will require no minimum brake weight percentage or kappa.*

# Romania

- The calculation is found in the regulations/instructions in force within the railways in Romania (Ordinul nr. 1815/2005)
- The kappa factor is not used
- Romania is **Cluster A**: *no train length-based deductions*
- *Cluster A require no further investigation on planned methodology for ETCS equipped trains*

# Bulgaria

- According to the infrastructure manager, Bulgaria is Cluster A. No additional information or reference to documents was provided.
- Bulgaria is **Cluster A**: *no train length-based deductions*
- *Cluster A require no further investigation on planned methodology for ETCS equipped trains*

# Portugal

- No need for harmonization between Iberian broad-gauge network and European standard gauge network
- The regulatory document is the Technical Operating Instruction (INSTRUÇÃO DE EXPLORAÇÃO TÉCNICA) IET 5 on Brake Tables which entered into force April 30, 2018.
- Up to speed less than 80km/h, no additional deductions based on train length apply for both P and G braked trains
- Above 80km/h, additional deductions apply for trains longer than 500m
- Additional deductions are also made for G-braked trains
- Portugal belongs to **Cluster C**: *length-based deductions for braked weight apply, additional deductions for intermodal and G-braked trains*
- *No response provided as to planned methodology on ETCS equipped trains*

# Kosovo

- Methodology for the brake calculation is according to Regulation no. 223
- No length-based deductions from braked weight mentioned
- No additional deductions from braked weight mentioned
- Kosovo most likely belongs to **Cluster A**: No train length-based deductions are made
- *Cluster A require no further investigation on planned methodology for ETCS equipped trains. Further, Kosovo strives for harmonization in future ETCS deployment.*
- *Even though as part of the Ex-Yugoslavian countries which have a harmonised system (and was also stated in the mail), Kosovo should belong to cluster B*



# Luxembourg

- Methodology for the brake calculation is not given.
- Different brake composition used for heavy trains (decision of the RU and not the IM)
- No length-based deductions mentioned.
- But according to the information from Xrail member, CFL cargo, Luxembourg belongs to cluster B
- Luxembourg belongs to **Cluster B**: *length-based deductions apply*
- *No class B system in use anymore, national network is fully equipped with ETCS baseline 2.3.0d and applies length-based deductions according to Xrail member, CFL cargo*

# Summary

- The neighbouring countries in CIS states / Baltics and Ex-Yugoslavian countries are harmonized among each other.
- Western Balkan Countries are mostly harmonized – length-based reductions apply, but in most cases the reductions are the same.
- There is no harmonisation between Rail Baltica and the existing European standard gauge network. Harmonization efforts should be made to avoid problems in the future.
- There is no need for harmonization at borders where gauge changes.
  
- Harmonization of Class-B systems is not required. The focus is harmonization of ERMTS deployment.
- **Cluster A** do not apply length-based deductions and therefore require no further investigations for ETCS deployment.

# Specific ETCS responses from Commission request

- Spain: ETCS L1 continues to follow UIC 544.1, ETCS without trackside signals will require no minimum brake weight percentage or kappa.
- Slovakia: necessary characteristics and calculating the braked weight percentage is not affected by the equipment of lines with the ETCS system
- Bosnia Herzegovina: currently at level 0 (zero), and if the tracks were equipped with ETCS, they would use the same braking percentages as present (applying the kappa factor)
- Luxembourg: No class B system in use anymore, national network is fully equipped with ETCS baseline 2.3.0d.
- Kosovo: Plans to fully implement ERTMS/ETCS conditions

# Specific ETCS responses from Commission request

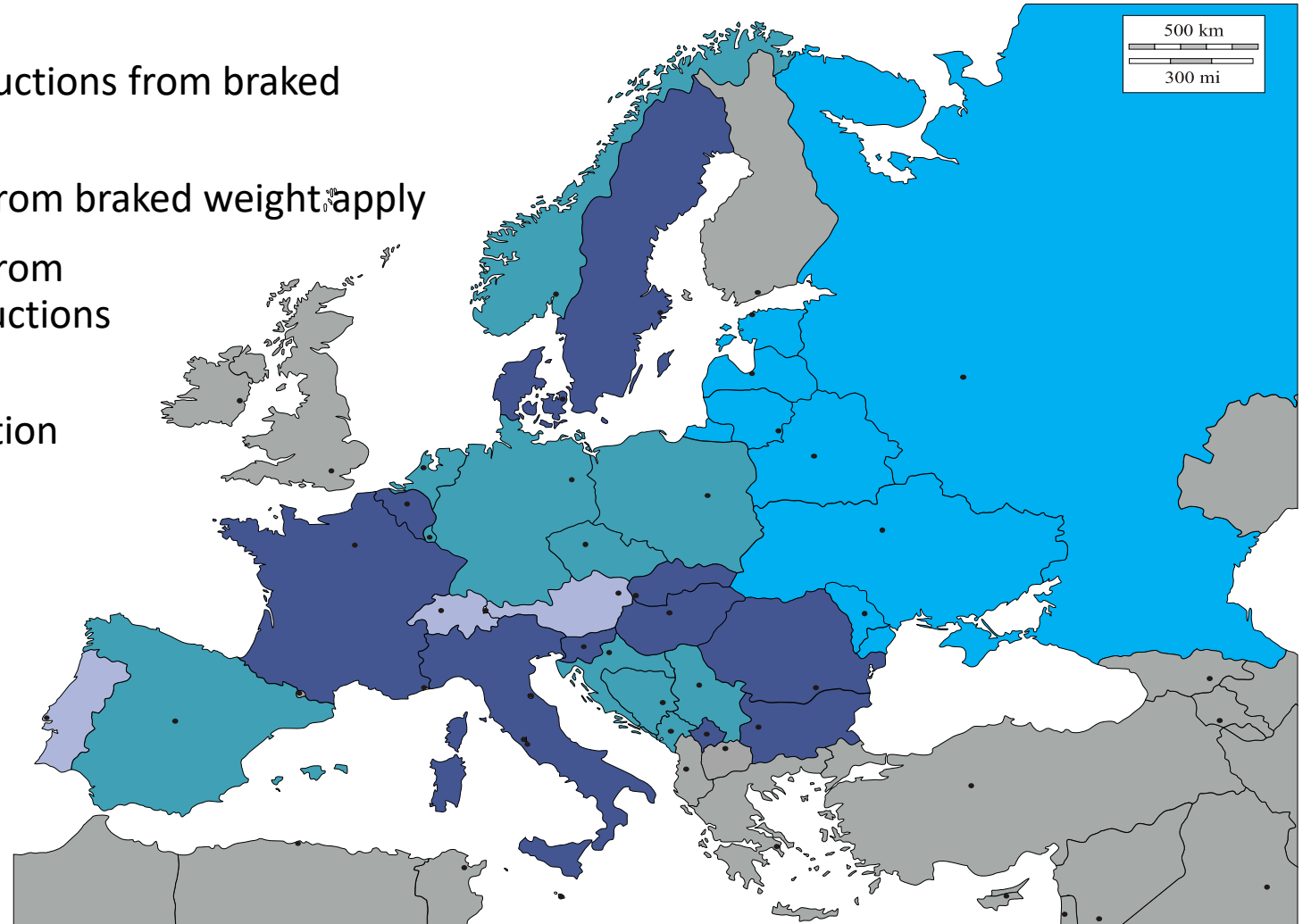
- Slovenia: cluster A - no further investigation into length-based deductions
- Romania: cluster A - no further investigation into length-based deductions
- Portugal: answer received, but no response as to planned methodology on ETCS equipped track
- Netherlands: cluster A - no further investigation into length-based deductions
- Bulgaria: cluster A - no further investigation into length-based deductions
- Other answers received directly by Xrail and the Commission (not by Panteia Consortium):
  - Austria, Switzerland (discussions ongoing), Norway, Croatia, Poland, Germany, Hungary (for details, see following slide)
- Other cluster B countries that gave no response on ETCS:
  - Serbia, Montenegro and Portugal

# Analysis done by Xrail (regarding ETCS)

- Germany: cluster B, no decision regarding correction factors yet
- Austria: cluster B, no decision regarding correction factors yet
- Czech Republic: cluster B, no decision regarding correction factors yet
- Poland: cluster B, no decision regarding correction factors yet
- Norway: cluster B, length-based deductions apply
- Switzerland: cluster B/C, length-based deductions apply
- Belgium: cluster A - no further investigation into length-based deductions
- France: cluster A - no further investigation into length-based deductions
- Denmark: cluster A - no further investigation into length-based deductions
- Italy: cluster A - no further investigation into length-based deductions
- Sweden: cluster A - no further investigation into length-based deductions

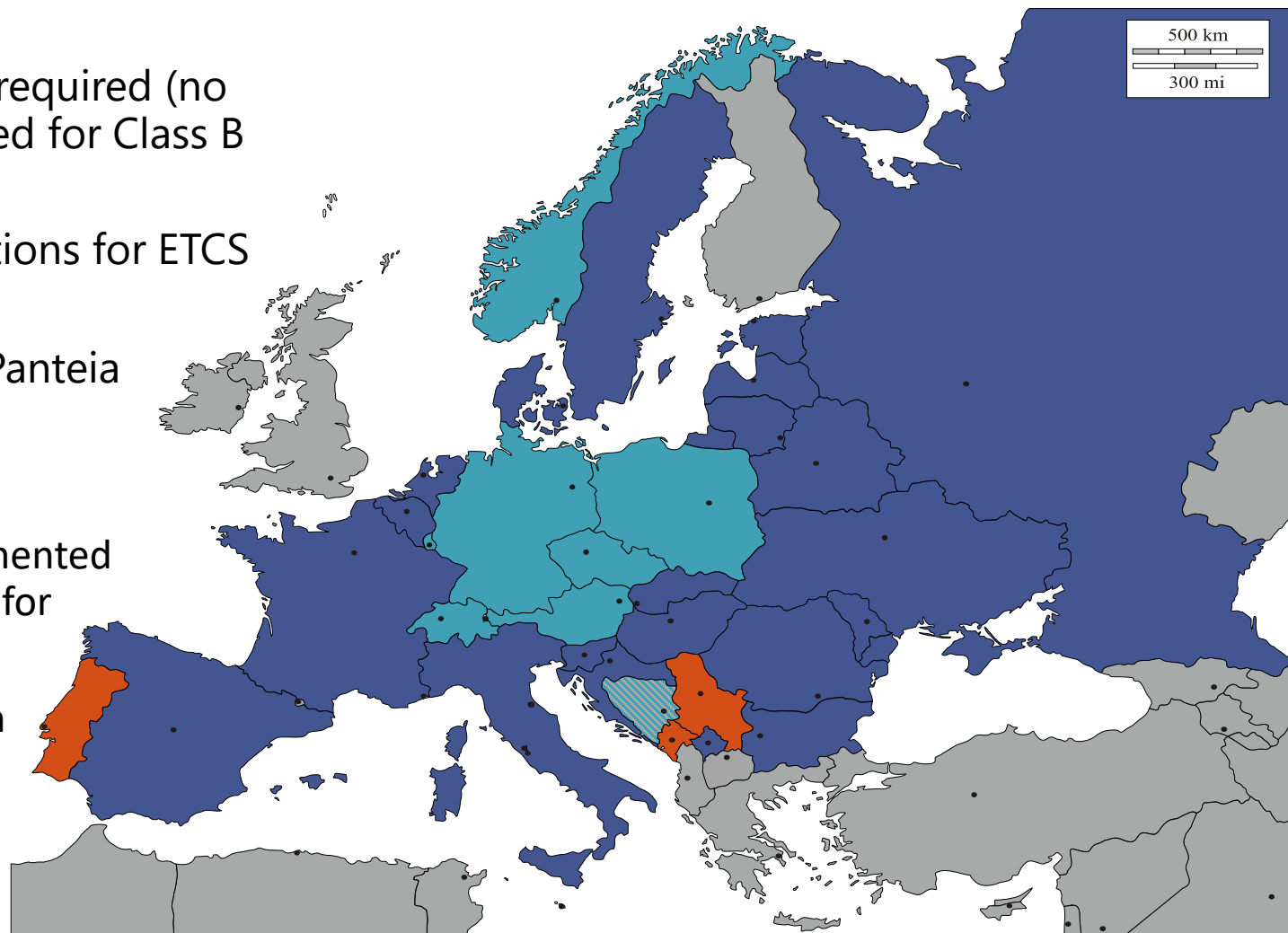
# Overview (Class B systems)

- **Cluster A**: no train length-based deductions from braked weight
- **Cluster B**: length-based deductions from braked weight apply
- **Cluster C**: length-based deductions from braked weight apply, additional deductions for intermodal and G-braked trains
- **Cluster D**: Harmonized brake calculation in CIS and Baltic 1520mm network



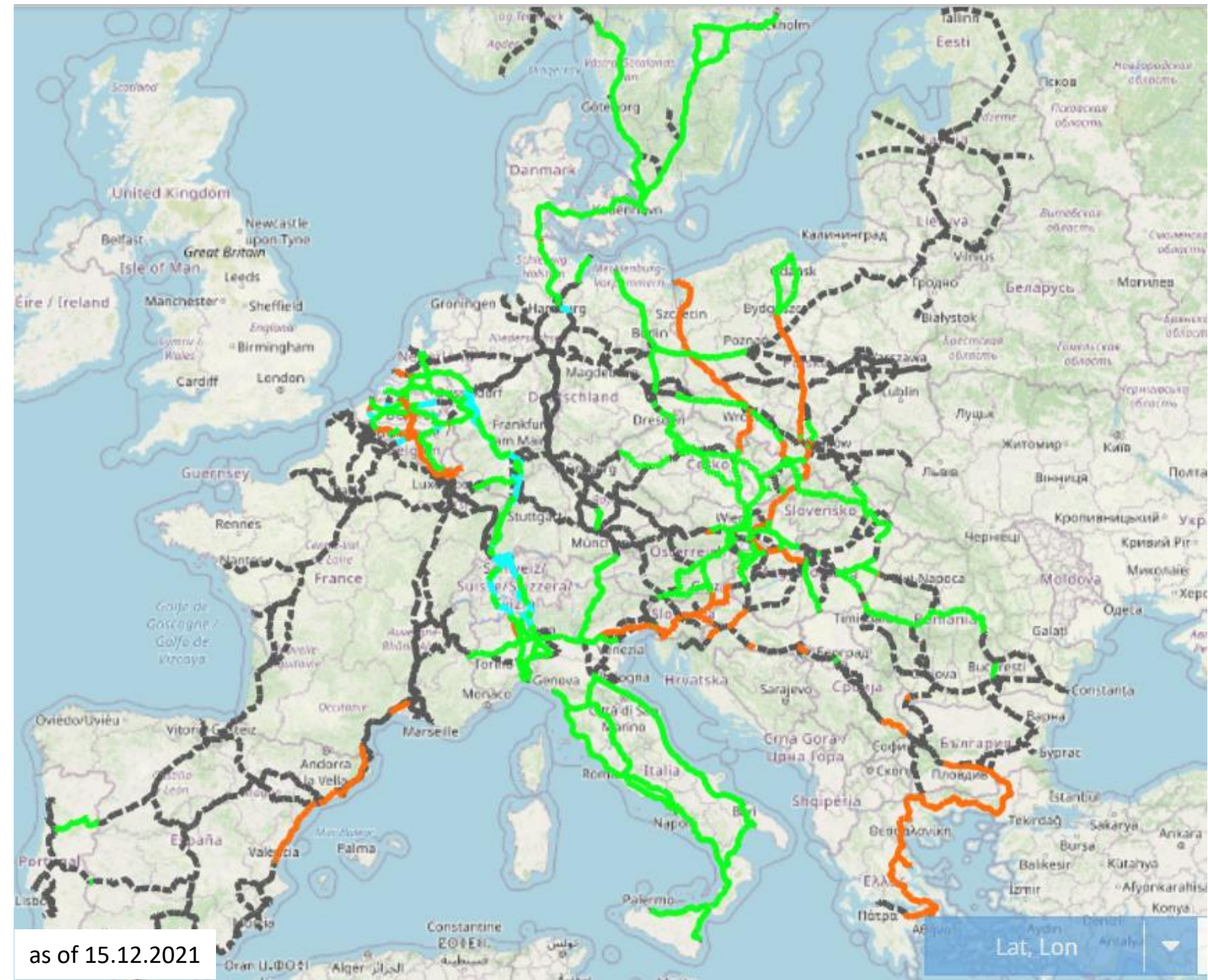
# Overview (Methodology for ETCS trains)

- **Cluster A**: no further investigation required (no length-based deductions mandated for Class B and/or ETCS trains)
- **Cluster B**: with (or planned) deductions for ETCS operation
- **No answers** on ETCS received by Panteia Consortium
- Countries which have not yet implemented ETCS should be encouraged to strive for harmonized brake calculations
- Length-based deductions in ETCS can cause interoperability barriers and thus, need further efforts for harmonization



Map from RNE showing ETCS Operational level

(see [cip.rne.eu](http://cip.rne.eu))



as of 15.12.2021



# Map from RNE showing SRS Version/ Baselines



## ETCS Deployment Type

- SRS 3.6.0
- SRS 3.4.0
- SRS 3.4.0 + Euroloop
- SRS 3.4.0 + Radio Infill
- SRS 2.3.0d
- SRS 2.2.2+
- SRS 2.2.2
- to be defined
- not applicable

as of 15.12.2021