



The German High Speed Rail System

DB International GmbH

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High Speed Rail Senior Consultant

Ottmar Grein

Personal Data

- **Professional Experience:** >30 Years
- **Position:** Senior Expert
- **Languages:** German, English



Education and Professional Experience

- **Education**
 - Civil Engineer (transportation) at Technical University of Darmstadt
- **Professional Experience**
 - Since 1981 project manager and consultant at DB International GmbH Frankfurt

Core Competences and Projects

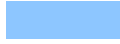
- **Core Competences**
 - Development of transportation concepts
 - High Speed Rail systems
 - Feasibility studies
- **Projects (excerpt)**
 - Commissioning of new railway lines in Germany
 - Management of the commissioning of Lötschberg-Basetunnel (Switzerland)
 - Feasibility study for a High Speed Rail system in Norway
 - Feasibility study for a High Speed Rail system in the Québec-Windsor Corridor (Canada)
 - High Speed Rail system consulting for the HS2 project (UK)

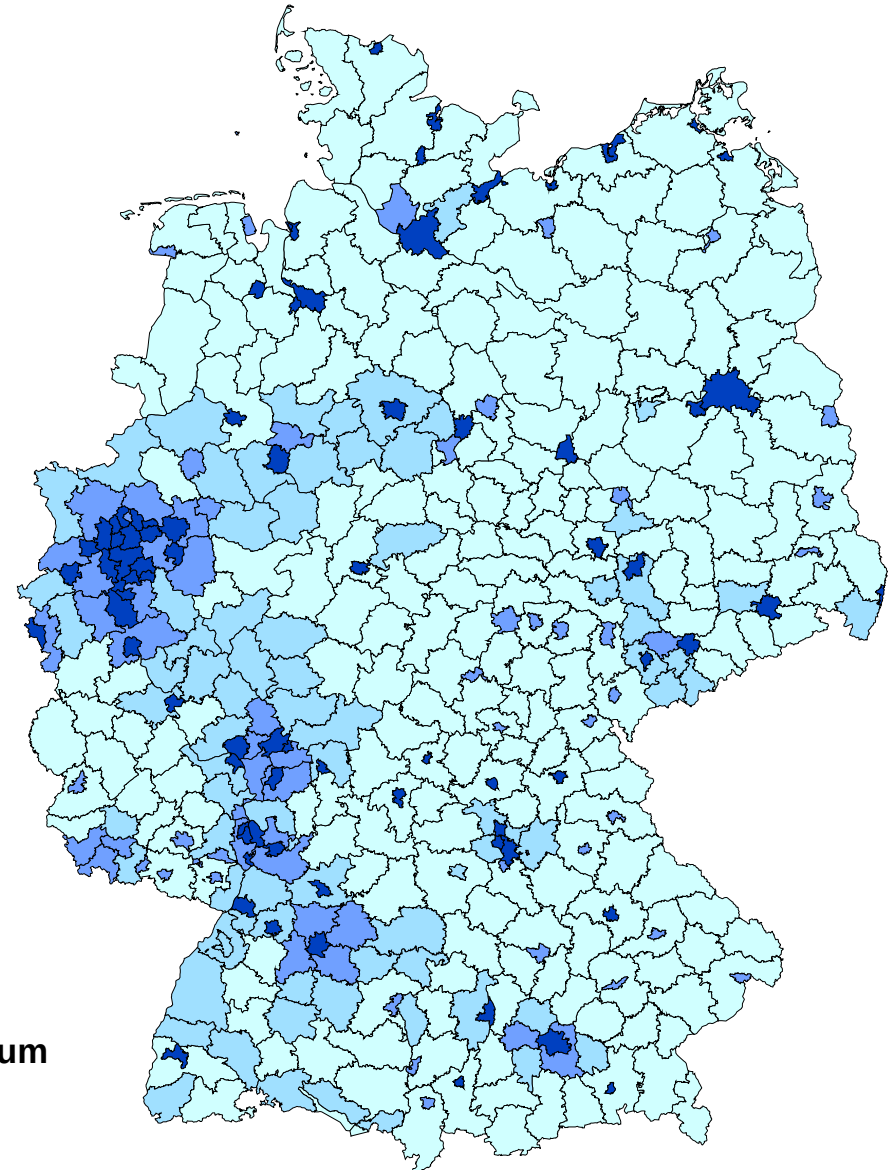
The integration of ICE traffic into the long-haul network is mostly due to the polycentric settlement structure in Germany

Characteristics of population structure in Germany:

- Several urban regions instead of one
- Few large and numerous medium- and small sized points of origin spread across the entire country
- Densely-populated urban areas prevent exclusive focus on point-to-point services

degree of centralization

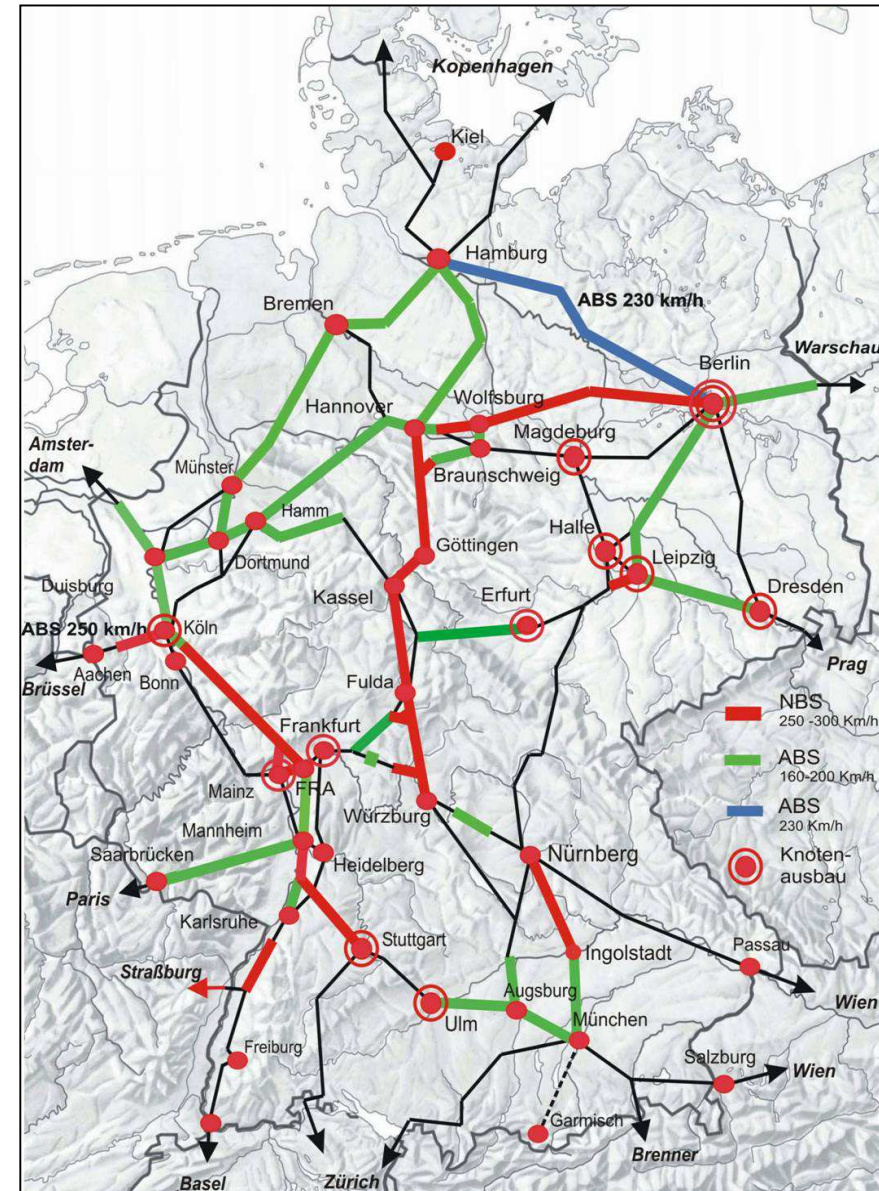
	high
	medium
	low



The settlement structure in Germany has immediate implications for long-haul rail traffic

High Speed Network in Germany 2014

A large number of access points for long distance network as a condition for sufficient utilisation of national travel demand potential



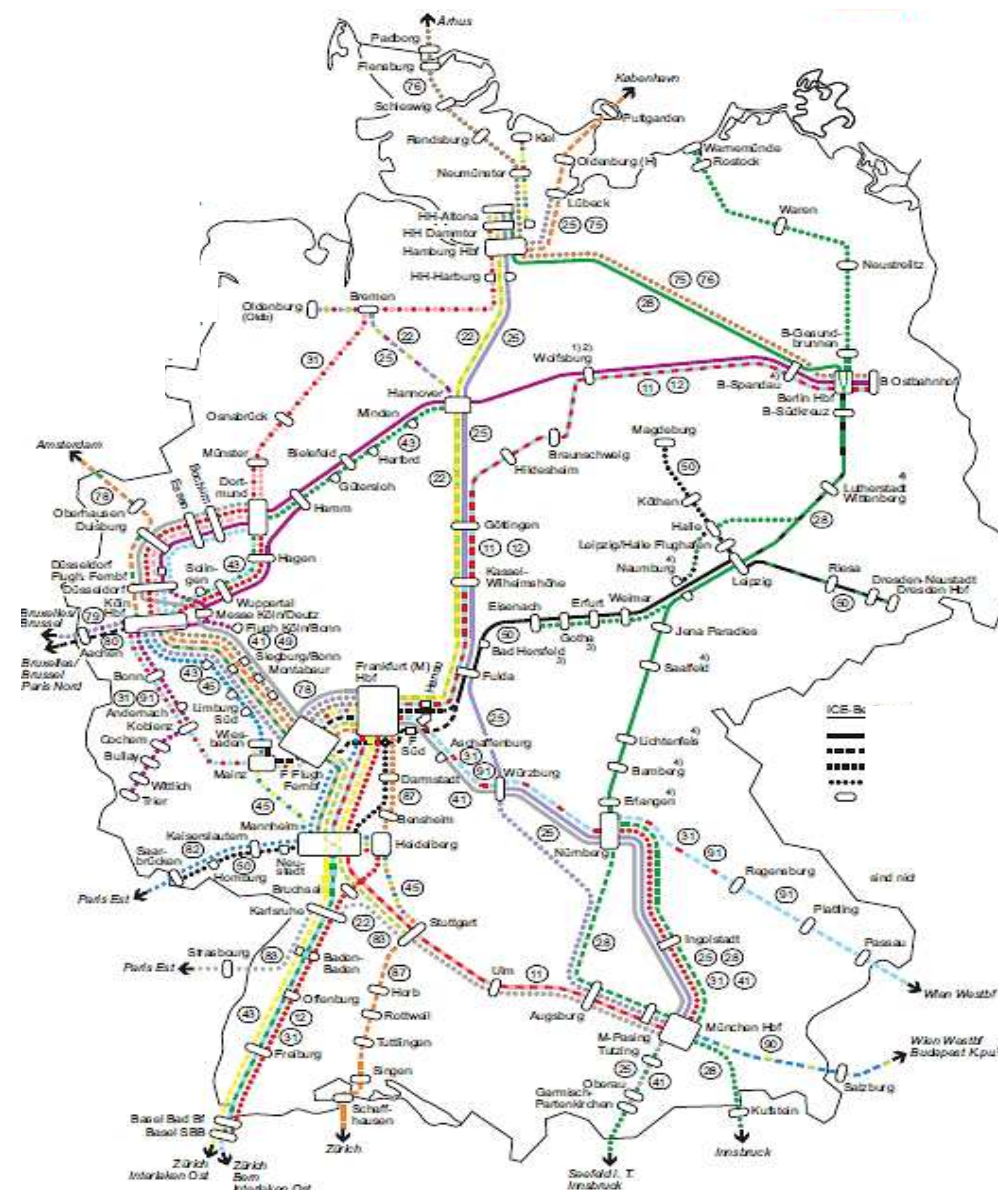
Our long distance train network for Germany – We serve the Country with high quality railway services

Legend:

-  ICE Line every hour
-  ICE Line every 2 hours
-  ICE Line every 4 hours
-  Single ICE Trains
-  System Stops

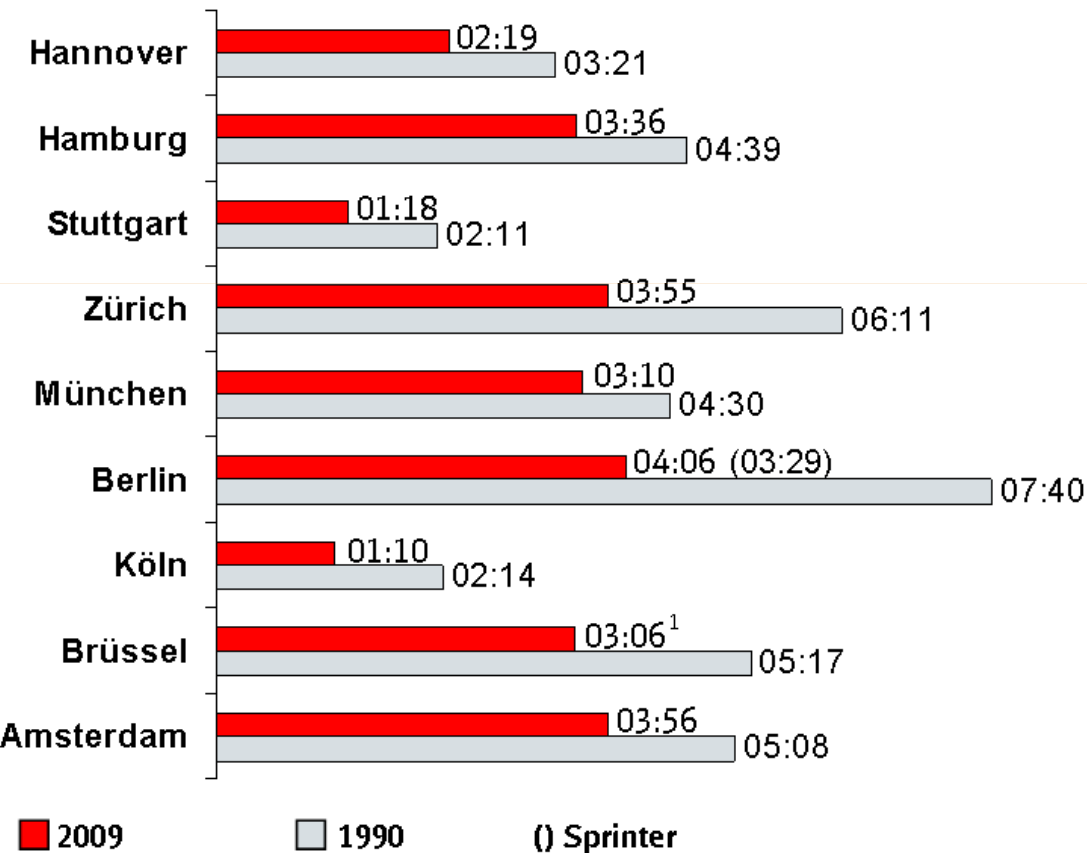
ICE Lines:

-  Linie 10
-  Linie 11,31
-  Linie 12, 91
-  Linie 20
-  Linie 22, 90
-  Linie 25, 79
-  Linie 28, 43⁶⁾
-  Linie 41, 83 (TGV)⁸⁾
-  Linie 42
-  Linie 45, 82, 90 (Railjet)
-  Linie 49, 76
-  Linie 50, 80 (THALYS)
-  Linie 75, 78,⁷⁾ 87

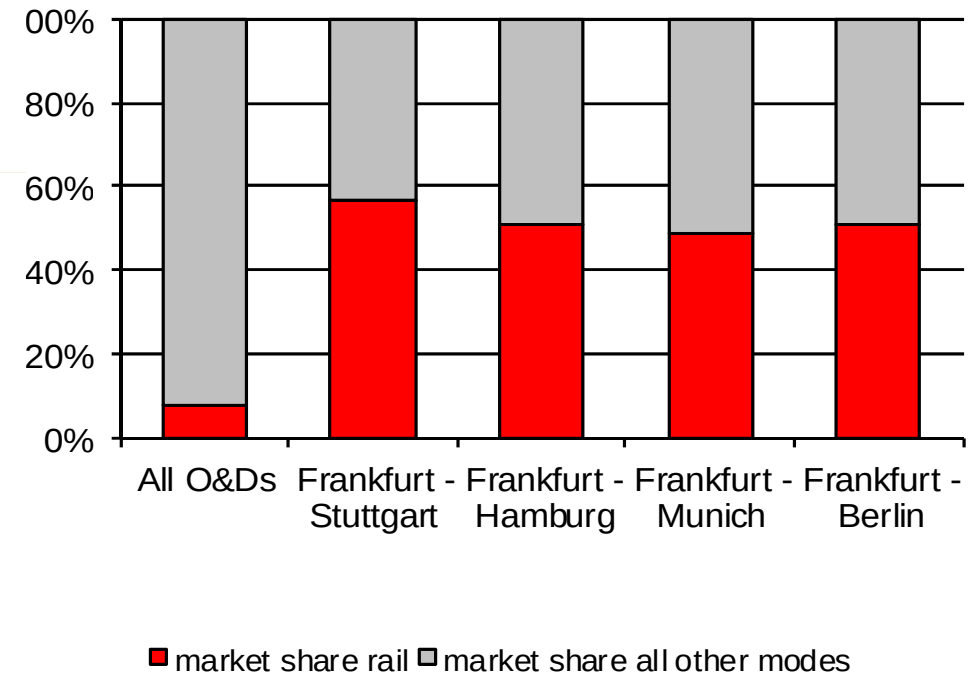


Shortened travel times are essential success factor of ICE; Attractive travel times allow high market shares

Travel times from Frankfurt to:

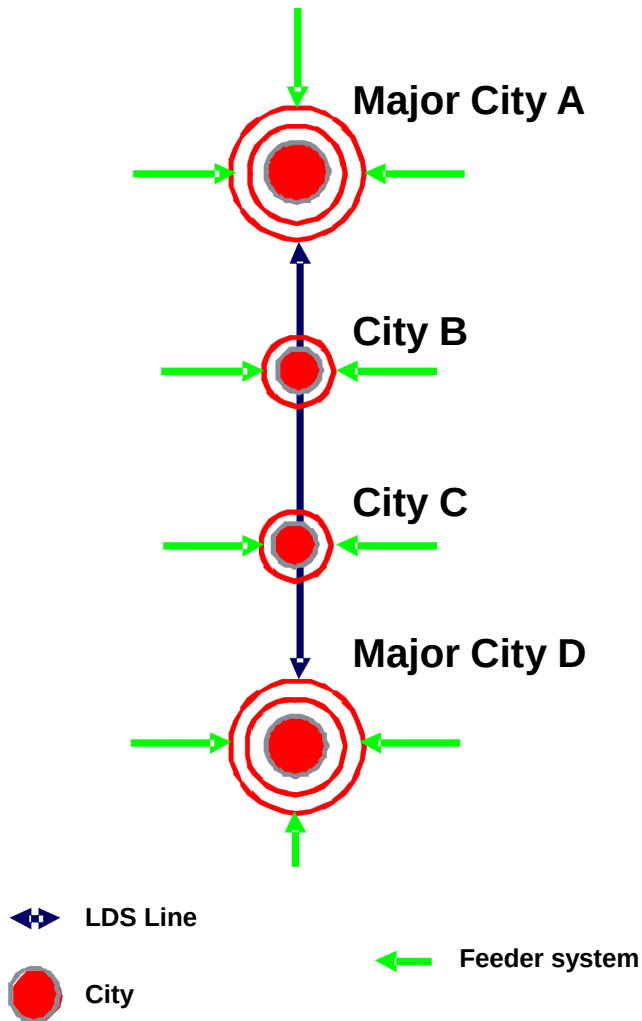


Rail market shares Passenger transport in Germany



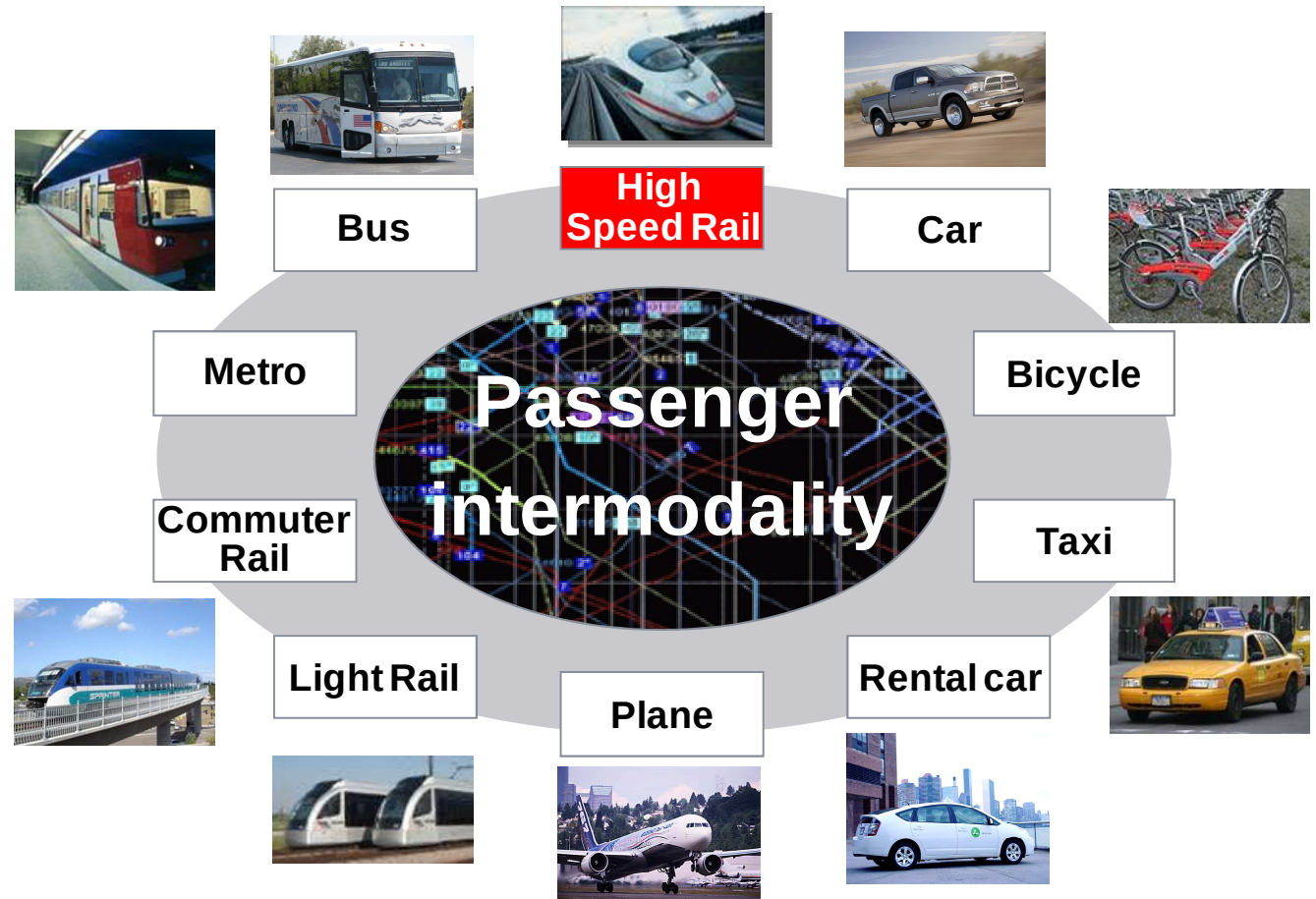
Long Distance Service is the backbone of a passenger rail system – regions get interconnected by attractive feeder systems

Integrated Feeder System



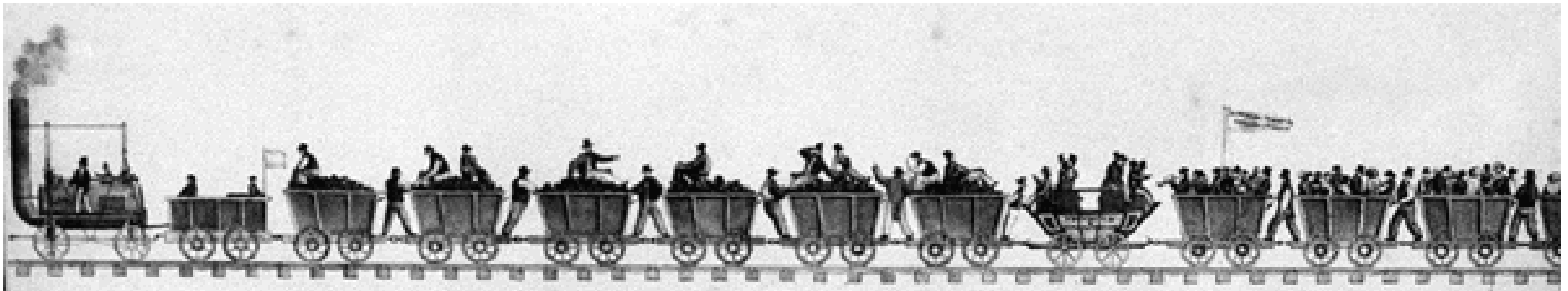
Passenger Intermodality is the key for HSR networks

- Interchange Stations to link with Feeder Systems
- Direct connection of airline hubs by rail
- Park & Rail facilities for commuters
- Car Rental / Car sharing at station
- New ticket systems, e.g. Integrated City Transit & HSR tickets



Mixed Traffic on High Speed Lines in Germany

In the beginning there was mixed traffic.



Mixed traffic in 1825

Mixed Traffic on High Speed Lines in Germany

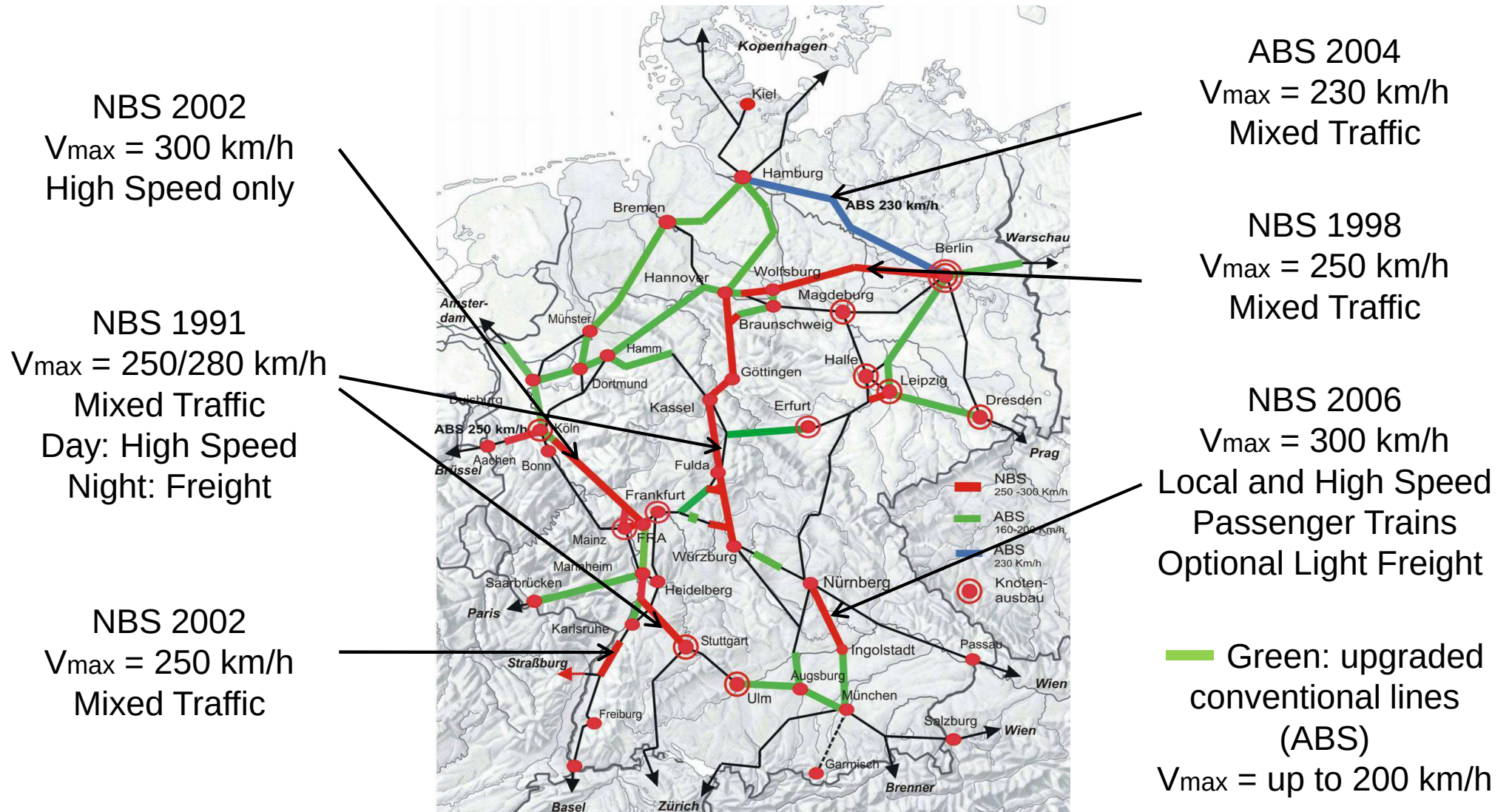
History

Development of a High Speed Network

- 1970** First ideas for a nation-wide 300 km/h High Speed network including upgrading of existing lines for 200 km/h operation
- 1973** First transport master plan including the HSL Hannover-Würzburg and Mannheim-Stuttgart
- 1975** Priority for freight operation on new lines for economical and capacitive reasons. Operation with loco hauled passenger trains at 200 km/h and all kind of freight trains.
- 1984** Decision for High Speed: ICE trains at 250 km/h and freight trains at 80 km/h.

Mixed Traffic on High Speed Lines in Germany

German High Speed Network – Mode of Utilization



Mixed Traffic on High Speed Lines in Germany

**InterCity Cargo
Express, 160 km/h
(1988)**

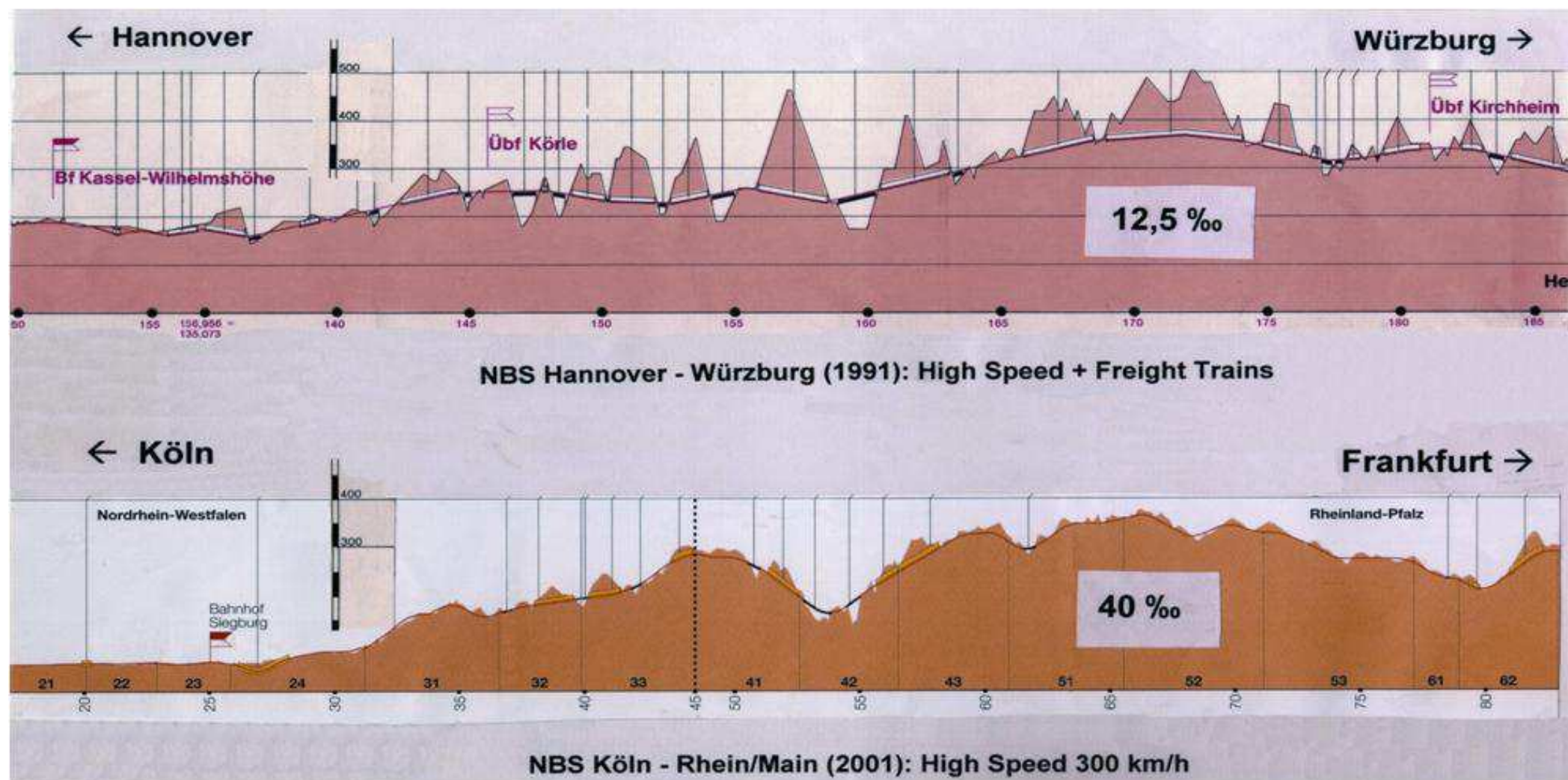
**LZB,
Axle load only 18 t**

At present: PIC



Mixed Traffic on High Speed Lines in Germany

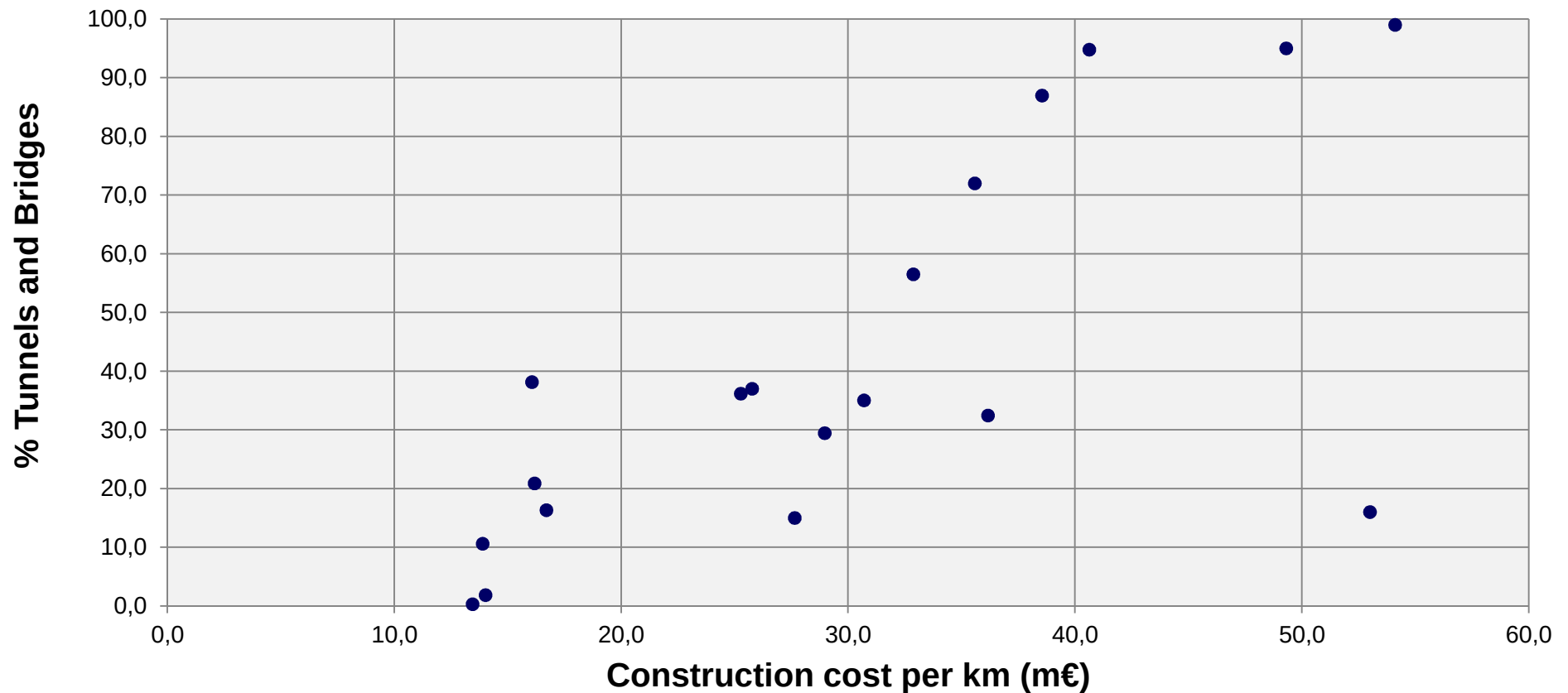
Dimensioning of Mixed Traffic Lines



Mixed Traffic on High Speed Lines in Germany

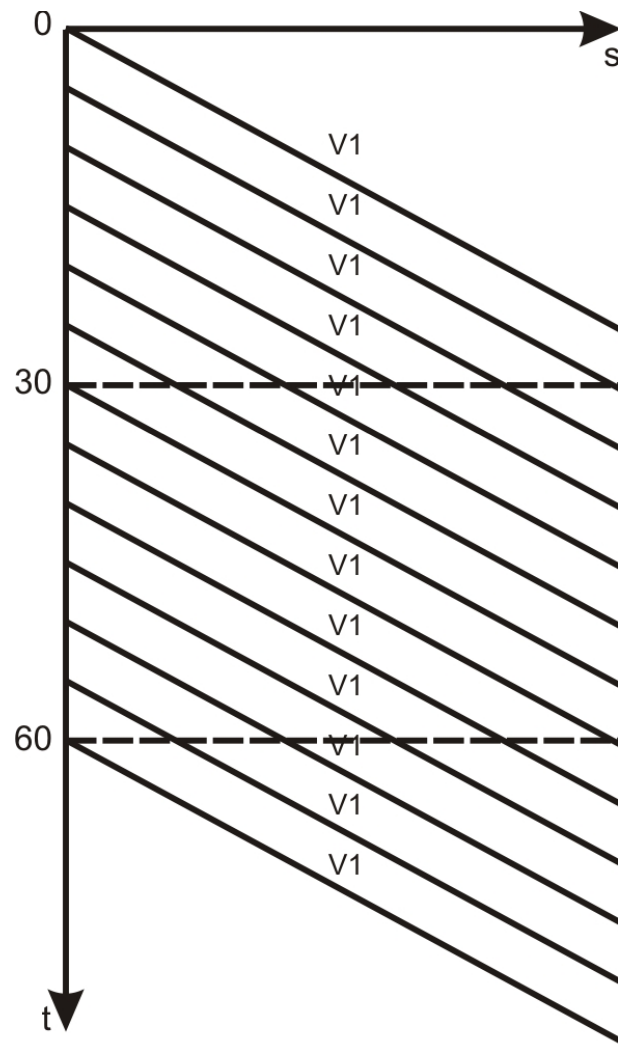
Impacts On Infrastructure Cost

Construction cost of several High Speed Lines and the corresponding share of bridges and tunnels

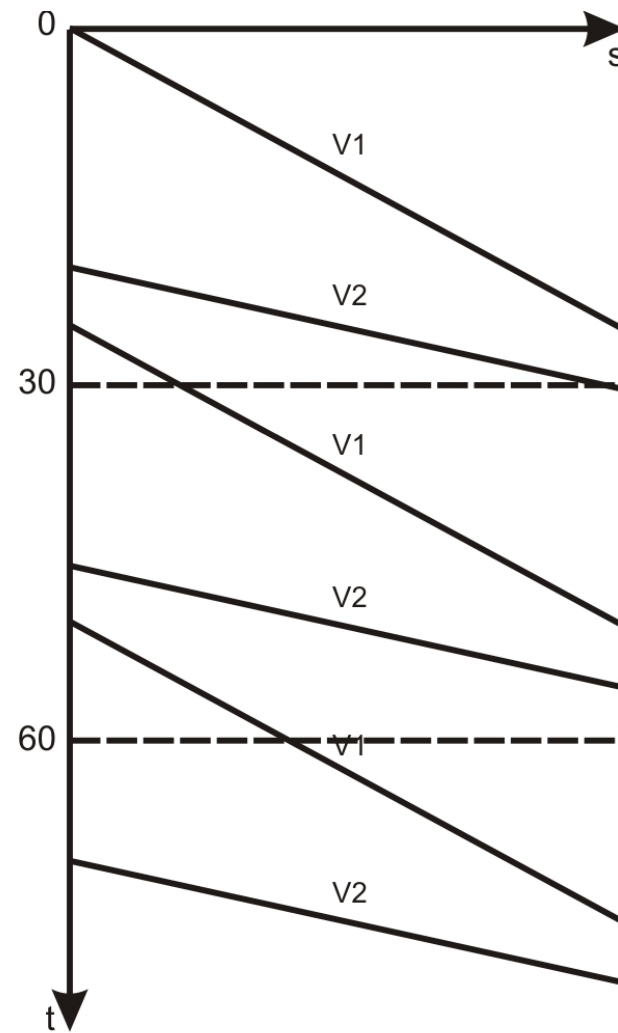


Mixed Traffic on High Speed Lines in Germany

Capacity as a Function of Different Speeds And Train Mixture



12 trains per hour



5 trains per hour

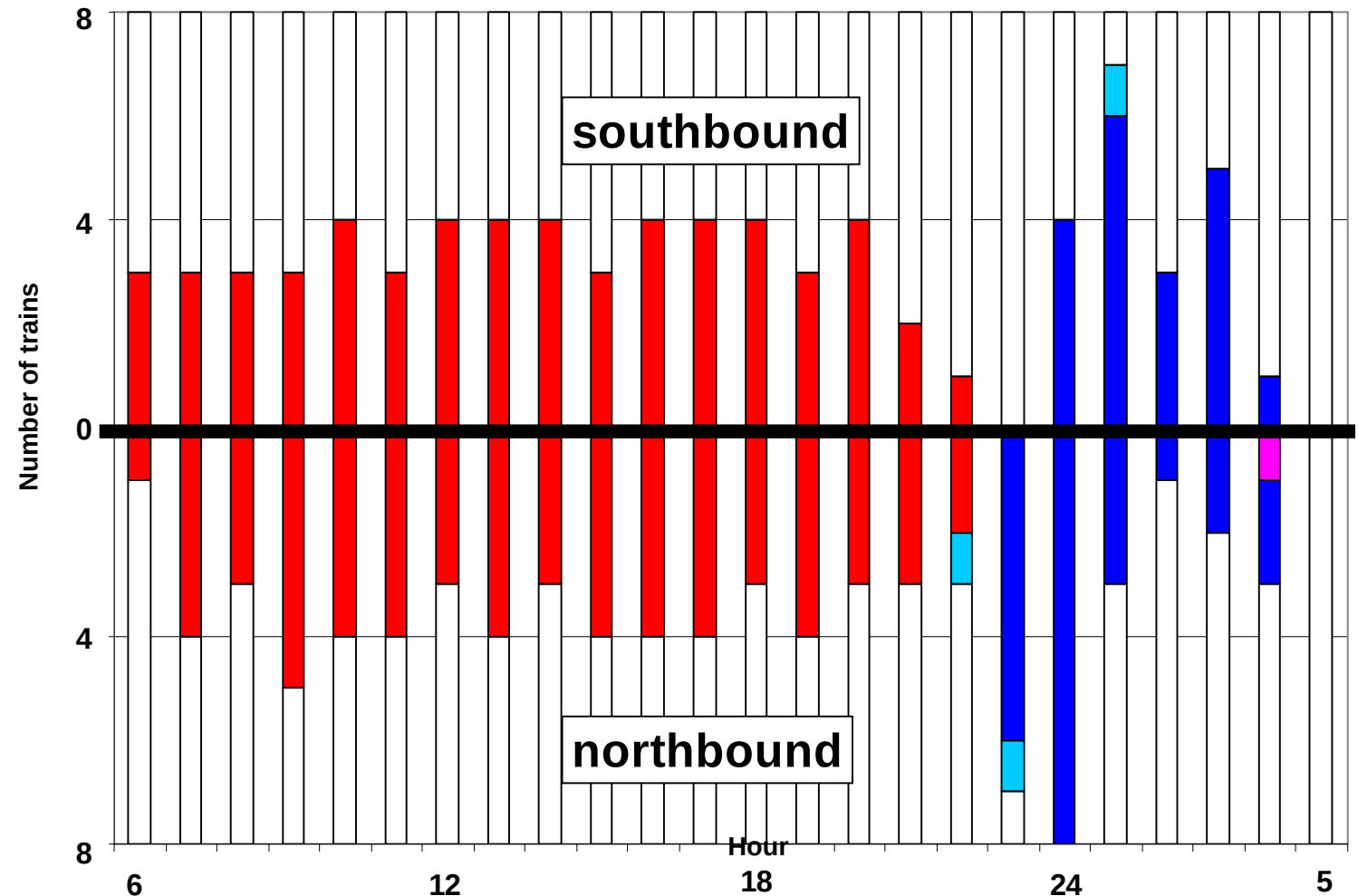
Mixed Traffic on High Speed Lines in Germany

Train Distribution on the Hannover – Würzburg Line

**Göttingen – Kassel
section, 2003**

**Red: High Speed trains
Dark blue: freight trains**

**Maintenance windows
hours 4 to 5 and 5 to 6
respectively**



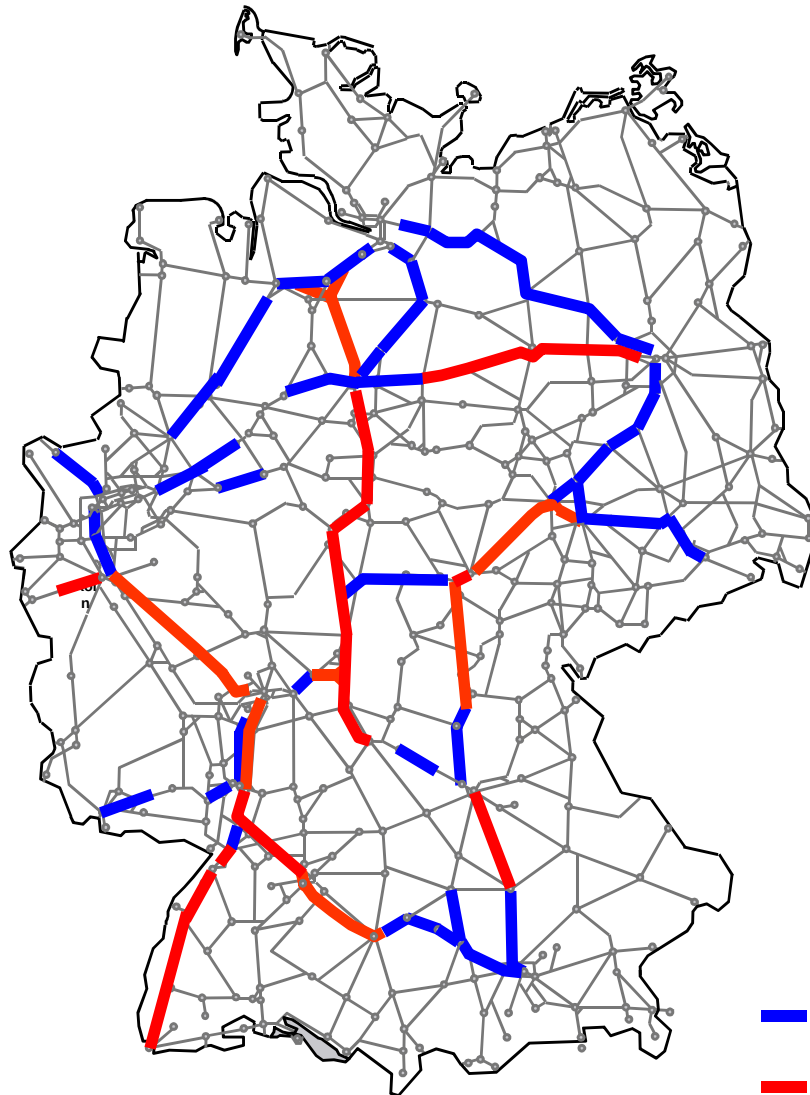
Mixed Traffic on High Speed Lines in Germany

Conclusion

Construction and operation of mixed traffic High Speed Lines show advantages but also disadvantages compared to passenger dedicated lines:

- + Higher capacity and shorter transport time for freight trains,**
- + Better utilization of expensive infrastructure (higher revenues),**
- Reduction of line capacity without segregation of fast and slow trains,**
- Higher infrastructure cost in mountainous areas,**
- Less time slots for maintenance.**

Target: Finalized HST-network in 2025



Under construction:

- Nürnberg – Erfurt – Halle/Leipzig
- Karlsruhe – Basel
- Stuttgart 21
- Stuttgart – Ulm

Planned:

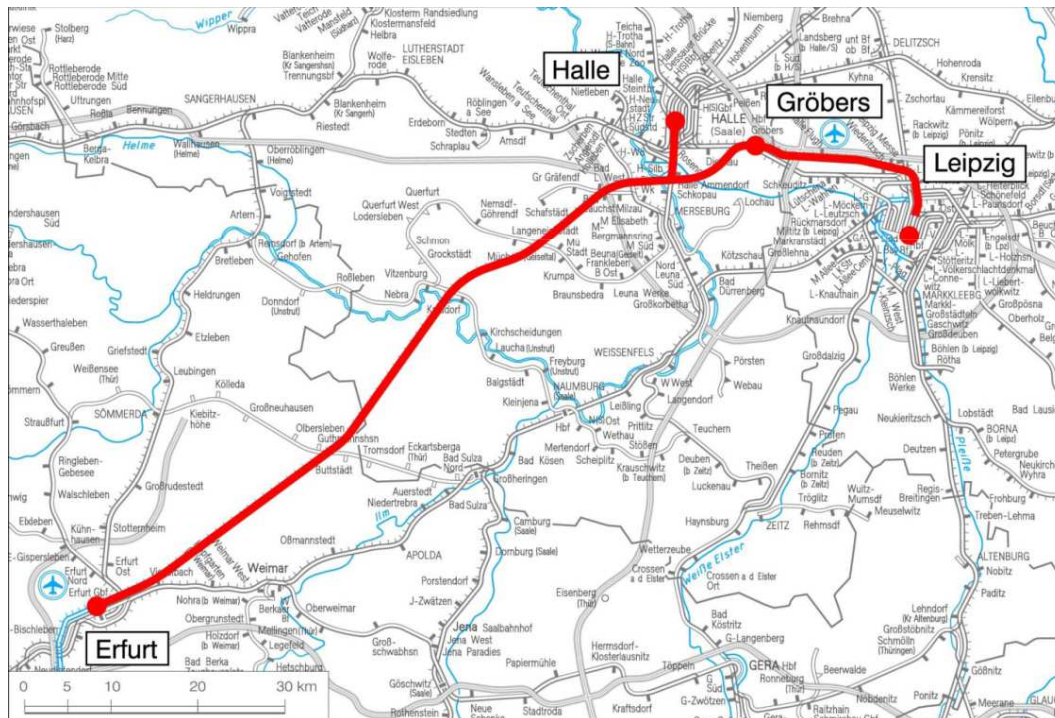
- Hamburg/Bremen – Hannover
- Frankfurt – Fulda
- Rhein/Main – Rhein/Neckar

— 200 to 230 km/h
— 250 km/h and more

VDE 8 NBS/ABS Nürnberg – Erfurt / NBS Erfurt – Halle/Leipzig

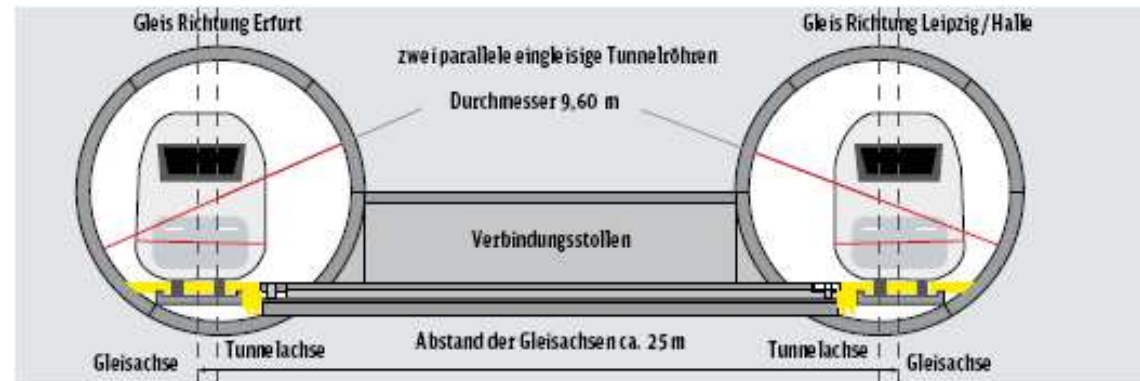


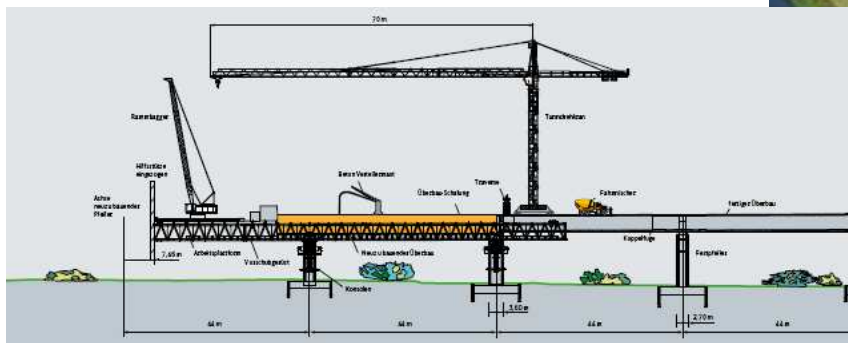
VDE 8.2 NBS Erfurt – Halle/Leipzig



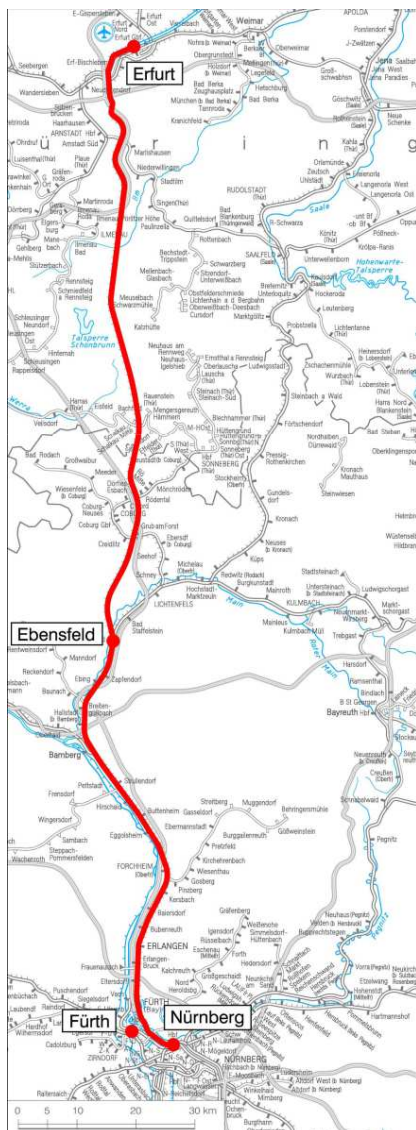
Length of line	123 km
Design speed	300 km/h
Trackwork	Slab track
Tunnels	3 (total length 15.4 km)
Bridges	6 (total length 14.4 km)
Commissioning (Gröberts-Leipzig)	2015 since 2003)
Total costs	2.7 Bil. €
Running times	
Erfurt – Halle	31 min (today 77 min)
Erfurt – Leipzig	39 min (today 66 min)

VDE 8.2 NBS Erfurt – Halle/Leipzig



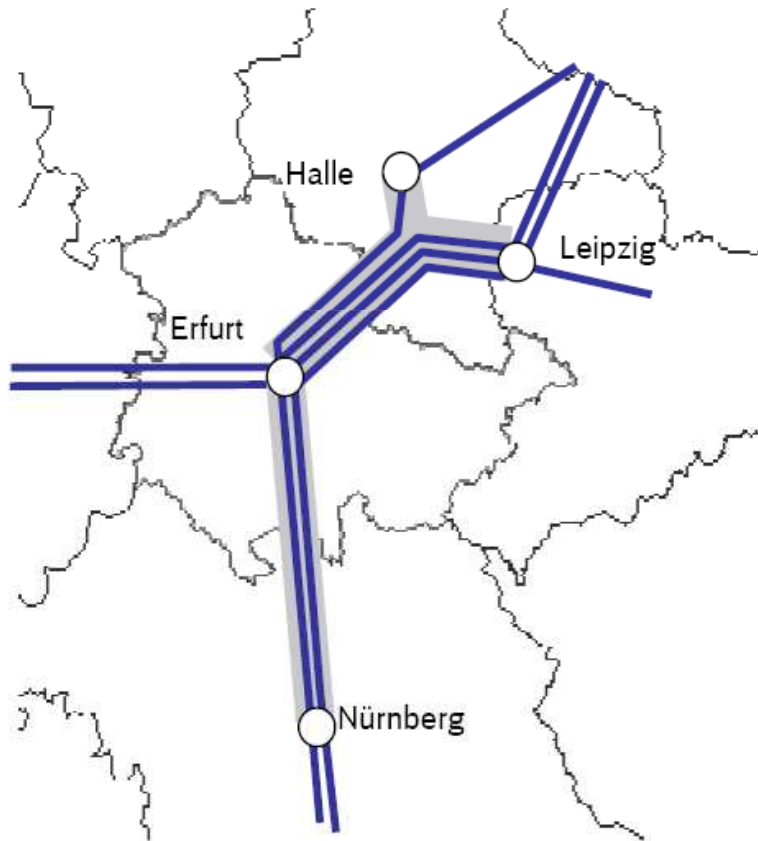


VDE 8.1 ABS/NBS Nürnberg – Erfurt



Length of line	190 km
Thereof NBS	107 km
Design speed	NBS 300 km/h
ABS	230 km/h
Commissioning	2017
Total costs	5.3 Bil. €
Running times	
Nürnberg-Erfurt	66 min
(today via Fulda)	172 min)

NBS Erfurt – Halle/Leipzig



Reduction of Travel Times by VDE 8

	Today	New
Berlin – Munich (Sprinter)	6:00	4:15 3:45)
Leipzig – Frankfurt	3:30	3:00

The HST fleet of DB Fernverkehr was gradually developed according to the requirements

- Since 1991 the ICE fleet of currently 275 trains has constantly grown: another 130 trains are on order. The fleet is managed centrally
- The fleet was designed according to the requirements and consists of train sets with concentrated traction and of train sets with distributed traction.
- The ICE fleet has the following key data:
 - 200 – 330 km/h max. speed
 - 100 – 375 m train length
 - 200 – 700 seats

ICE 1



59 trains since 1991
358 m, 705 seats
280 km/h, 9,6 MW

ICE 2



44 trains since 1996
205 m, 368 seats
280 km/h, 4,8 MW

ICE 3



59 trains since 2000
200 m, 430-440 seats
330 km/h, 8,0 MW



17 trains since 2015
200 m, 460 seats
320 km/h, 8,0 MW

ICE T



59/11 trains since 1998
133/184 m, 250/357 seats
230 km/h, 3,0/4,0 MW

ICE TD



19 trains since 2001
107 m, 195 seats
200 km/h, 2,0 MW

ICx



45/85 trains from 2016
200/343 m, 500/724 seats
200/250 km/h, 5,0/8,3 MW

Thank you

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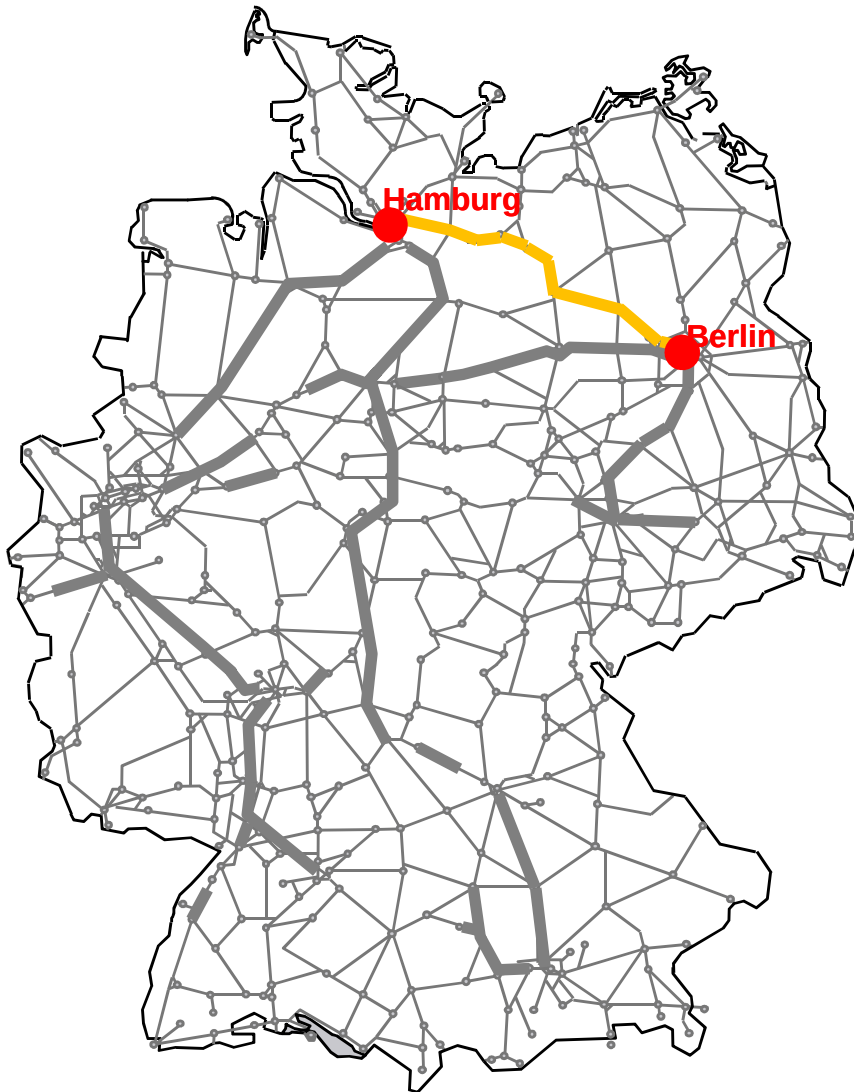
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Back Up

The Berlin – Hamburg Line gives a good example for our focused Investment Strategy

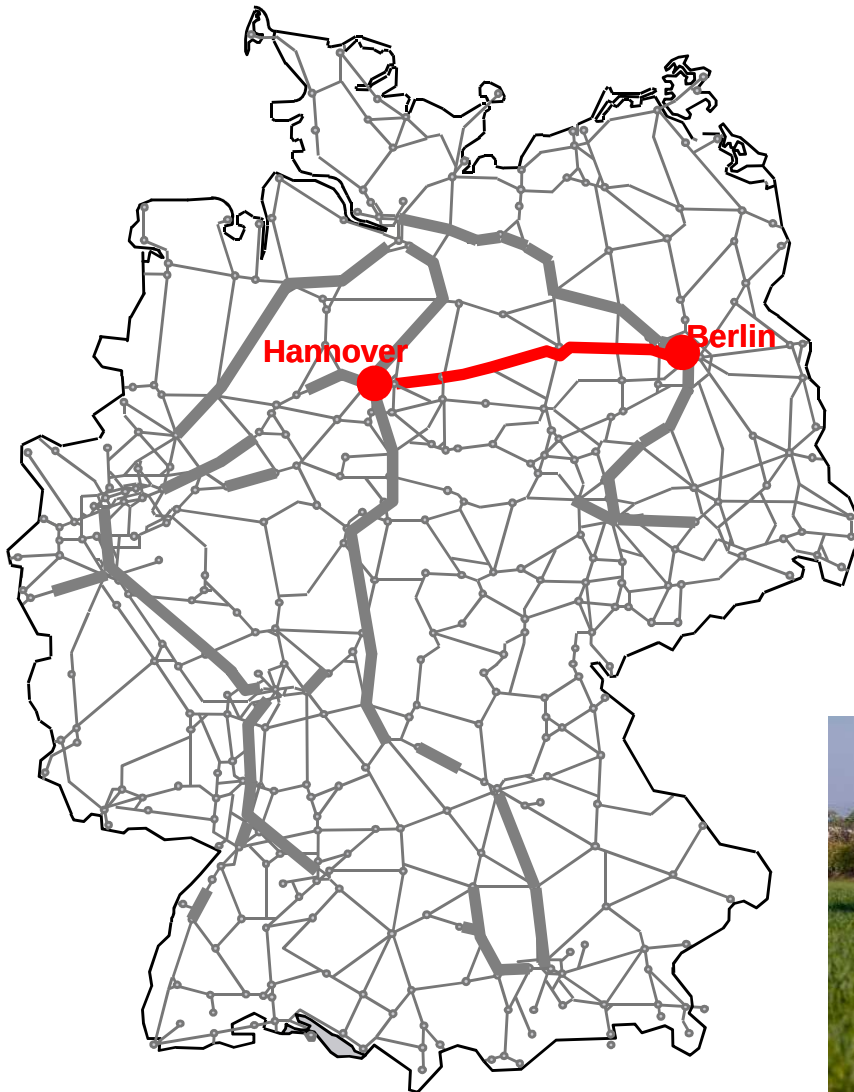


Case Study: Berlin – Hamburg

- Upgrade of an existing Railway Line
- Mixed Operation
- Terrain: rather flat
- Length: 270 km
- Operational: Speed 230 km/h
- Travel Time: 90 min.
- Investments: 650 mio. €
- Costs per Km: 2.4 Mio. € per km



In flat terrain also High Speed Lines have reasonable costs

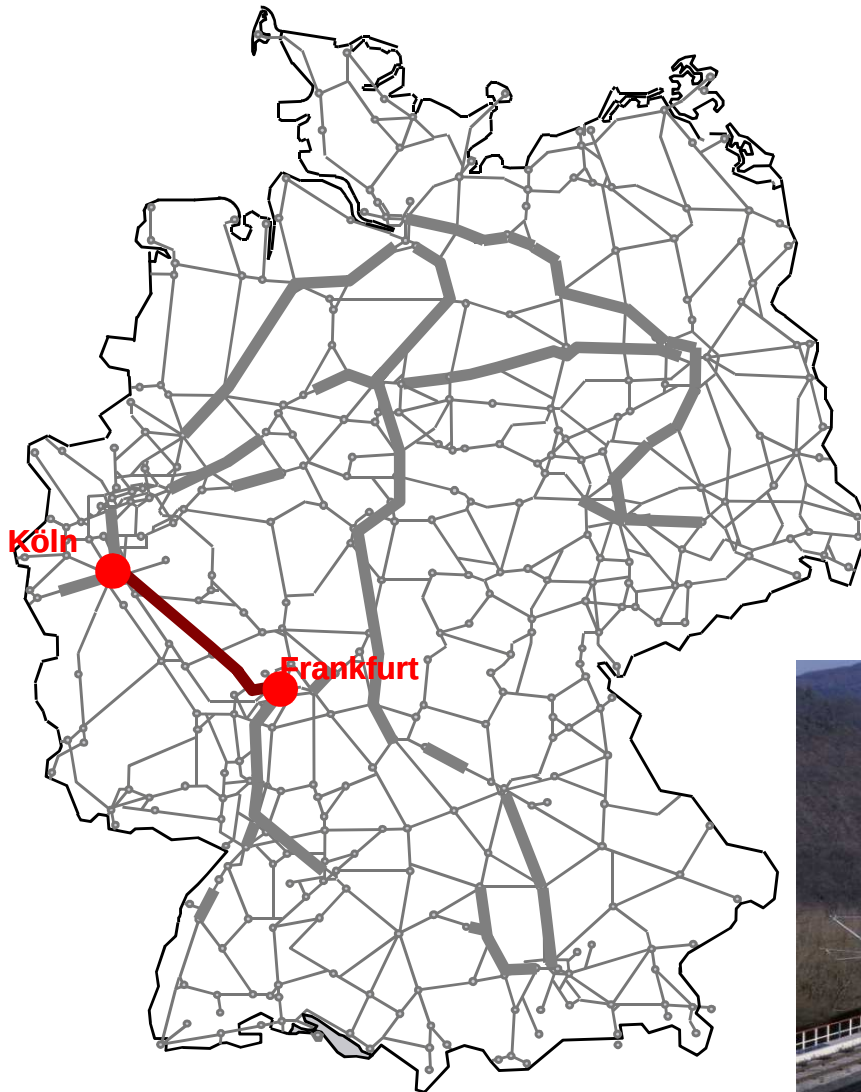


Case Study: Berlin – Hannover

- New Construction of a High Speed Line
- Mixed Operation
- Terrain: rather flat
- Length: 260 km
(200 km new, 70 km upgrade)
- Operational Speed: up to 250 km/h
- Travel Time: 90 min.
- Investments: 2.6 bn. € (1992-1998)
- Costs per Km: 9.7 Mio. € per km



Hilly terrain is a challenging frame for High Speed Traffic and results in a higher construction effort



Case Study: Frankfurt – Köln

- New Construction of a High Speed Line
- Passenger Dedicated High Speed Line
- Terrain: hilly
- Length: 180 km
- Operational Speed: 300 km/h
- Travel Time: 75 min.
- Investments: 5.1 bn. € (1995-2002)
- Costs per Km: 28.3 Mio. € per km



..... IC bus

Improved international rail service on various corridors

