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Eidgenössisches Departement für  
Umwelt, Verkehr, Energie und Kommunikation

**Bundesamt für Verkehr**



# ETCS Migration in Switzerland Solution for Gotthard Tunnel

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# Agenda

- Swiss standard gauge network
- Swiss migration targets
- Swiss migration strategy
- Implementation of ETCS L2
- Migration to ETCS L1 LS
- Success factors for the Swiss ETCS migration
- Gotthard Base Tunnel and ETCS
- Conclusion





# Swiss standard gauge network

- Length: 3'200 km
- Max. speed on network in the past: 160 km/h
- Mixed railway traffic,  
Network with many complex nodes,  
Trend: continuously increasing traffic density
- Approximately 14'000 signals  
protected by Class B system (Integra/ZUB)
- Less than 3'000 signals equipped with  
brake curve supervision (risc based selected)







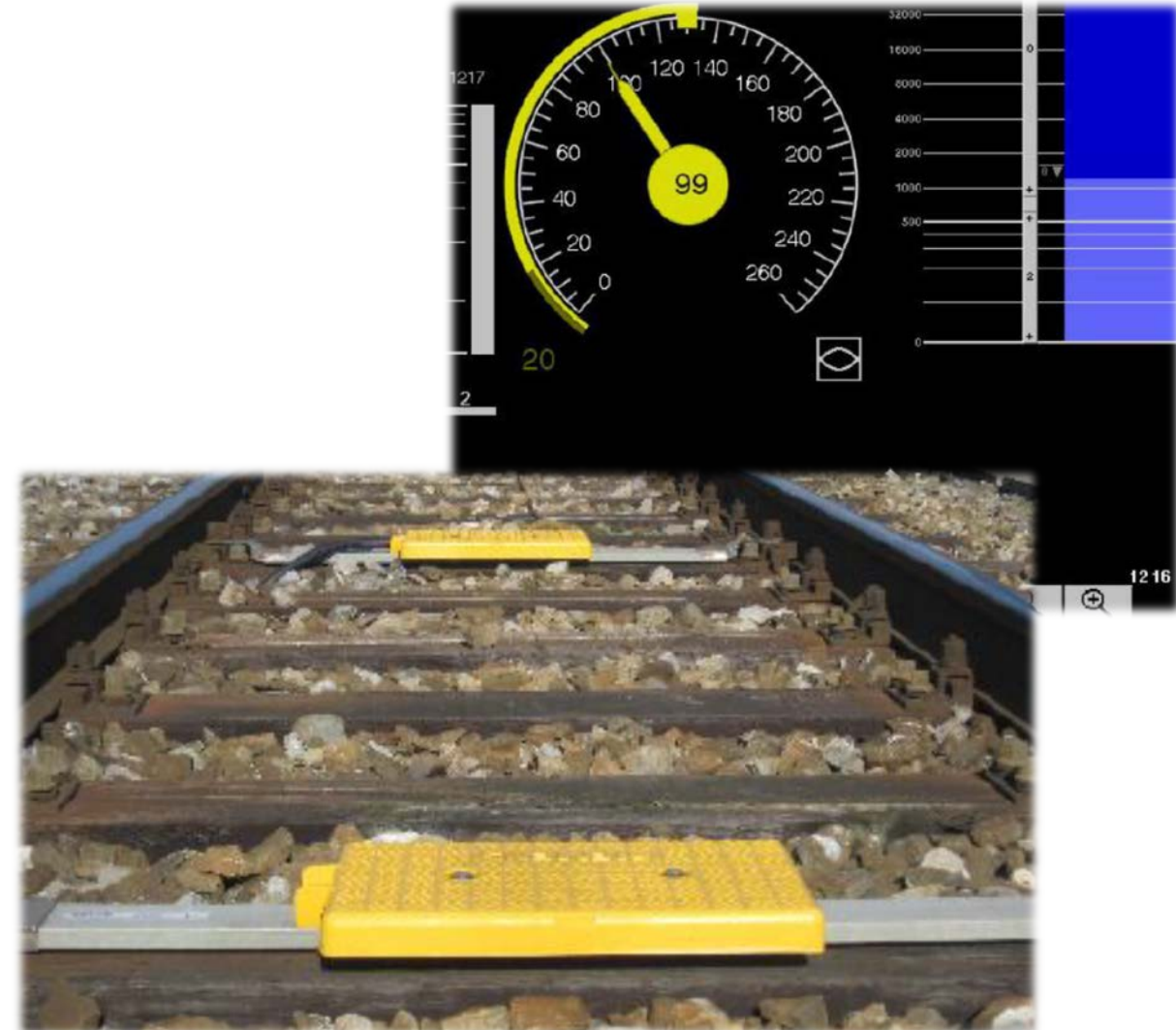
# Swiss migration targets

- Supporting Interoperability due to be part of the european rail network
- Replacing the existing class B systems (Integra/ZUB)
- Increase maximum track speed on new lines to 200km/h or 250km/h
- Increase infrastructure capacity by reducing the headway to 2 Min at 200km/h
- Keeping the high safety level with increased traffic volume



# Swiss Migration strategy (1)

- New lines directly equipped with ETCS L2
- Existing lines first migrated to ETCS L1 LS, Migration completed by end of 2017
- A systemwide rollout of ETCS L2 on the existing network will be done later on, Criterias:
  - Interlocking systems reach the end of life,
  - Increased capacity demands on different lines.





# Swiss Migration strategy (2)

2003

## 1<sup>st</sup> step

All vehicles get ETM + Euroantenna (P44)

2007

## 2<sup>nd</sup> step

Vehicles for L2-operation get ETCS-onboard (BL2)



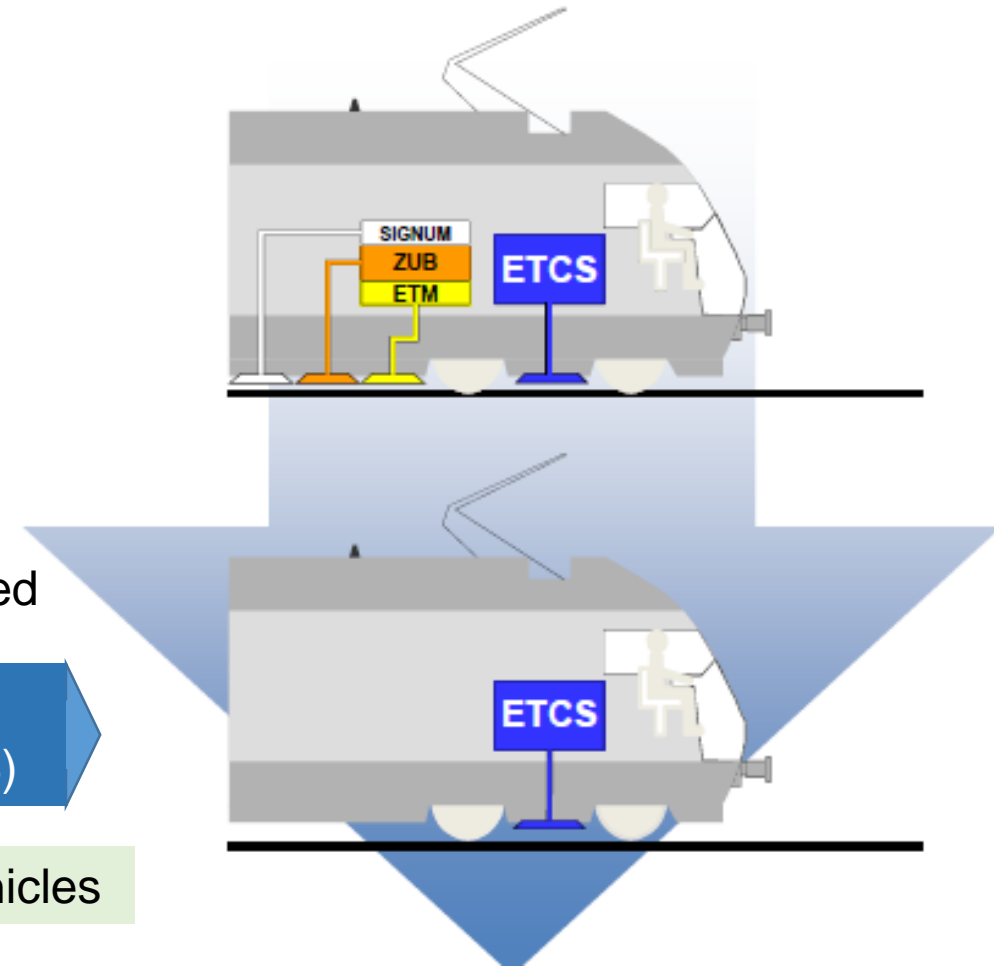
Infrastructure Migration completed

starting  
2017

## 3<sup>rd</sup> step

Vehicles for ETCS-only-operation get ETCS-onboard (BL3)

Class B-Systems (Intgra + ZUB) can be removed from vehicles



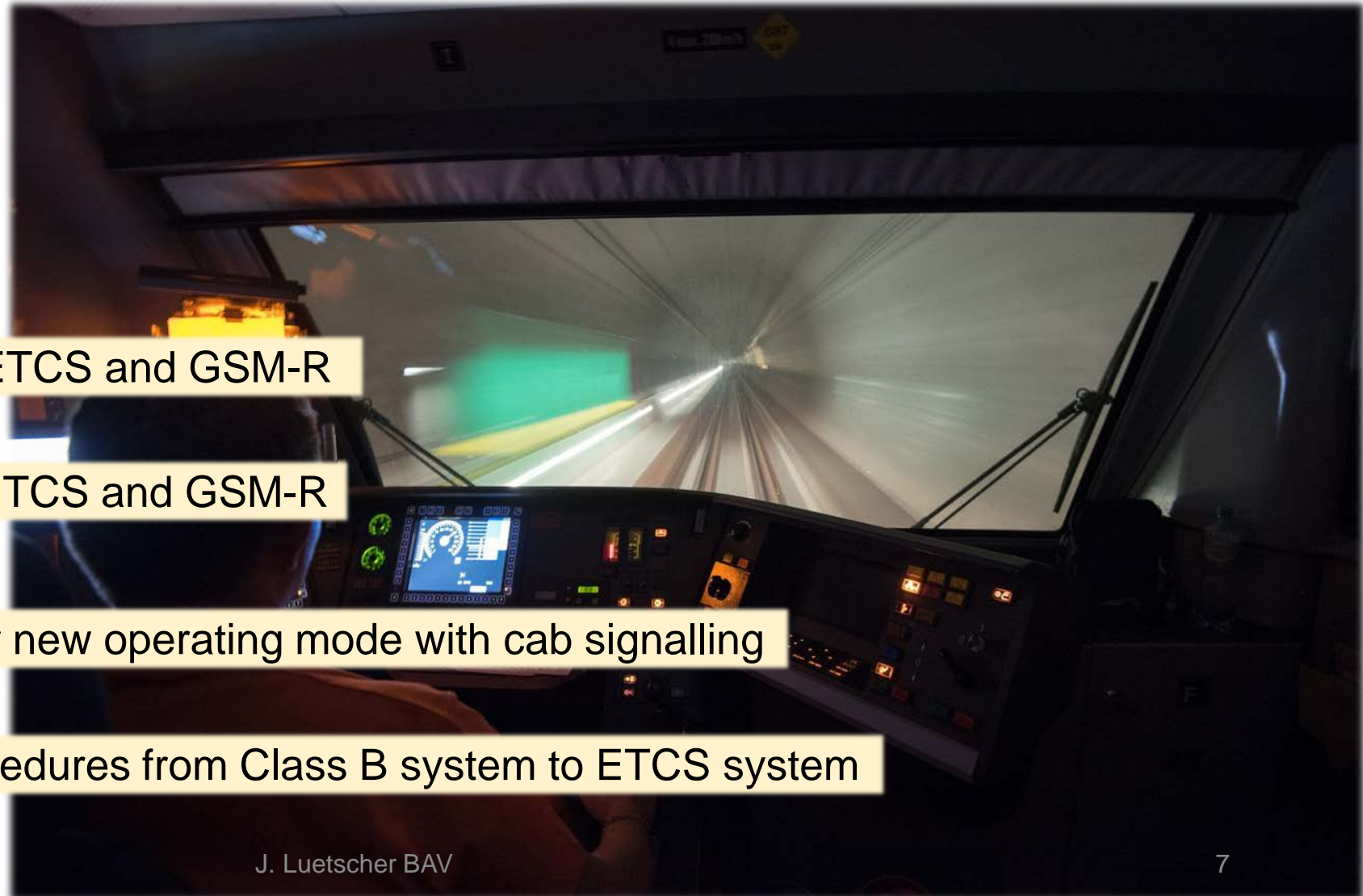




# Implementation of ETCS L2 (1)

## Challenge:

- Trackside installation of ETCS and GSM-R
- On-board installation of ETCS and GSM-R
- Specifying regulations for new operating mode with cab signalling
- Specifying transition procedures from Class B system to ETCS system





# Implementation of ETCS L2 (2)

## Swiss ETCS L2 applications:

- Olten – Bern (NBS) in service since 2006
- Lötschberg Base Tunnel (LBL) in service since 2007
- Gotthard Base Tunnel (GBT) in service since 2016
- Ceneri Base Tunnel (CBT) to go in service 2020
- 1000 vehicles with onboard ETCS in service
- Vehicles with ETCS (Baseline 2 or 3) can operate on L2 lines



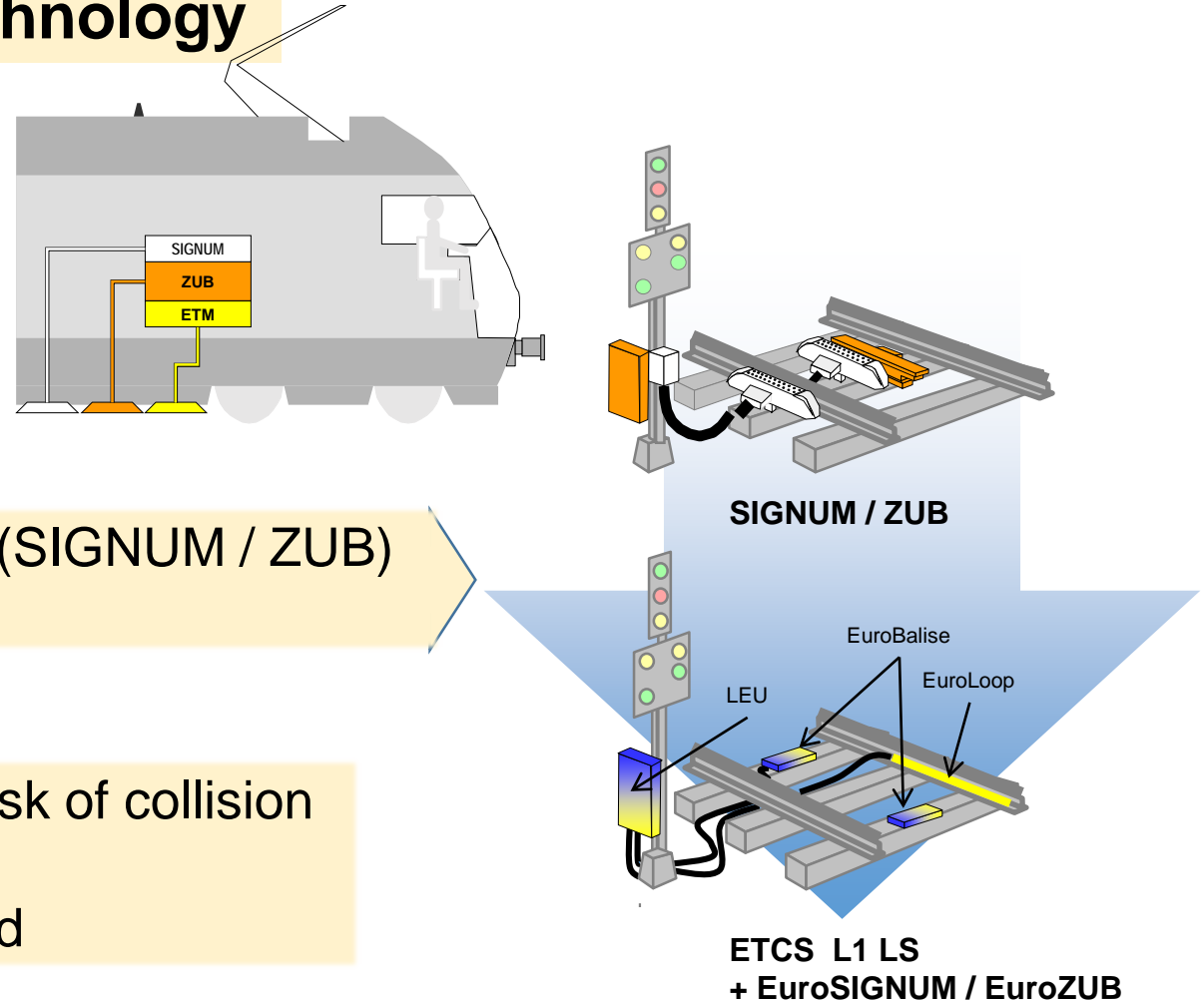




# Migration to ETCS L1 LS (1)

## Replacing Class B systems by ETCS technology

- Class B on-board equipped with ETM to read national package P44
- Trackside replacement of Class B transmitter (SIGNUM / ZUB) by ETCS balises and EuroLoop
- Brake curve supervision at signals with high risk of collision  
Method: Risk based selection  
Actually more than 50% of all signals equipped





# Migration to ETCS L1 LS (2)

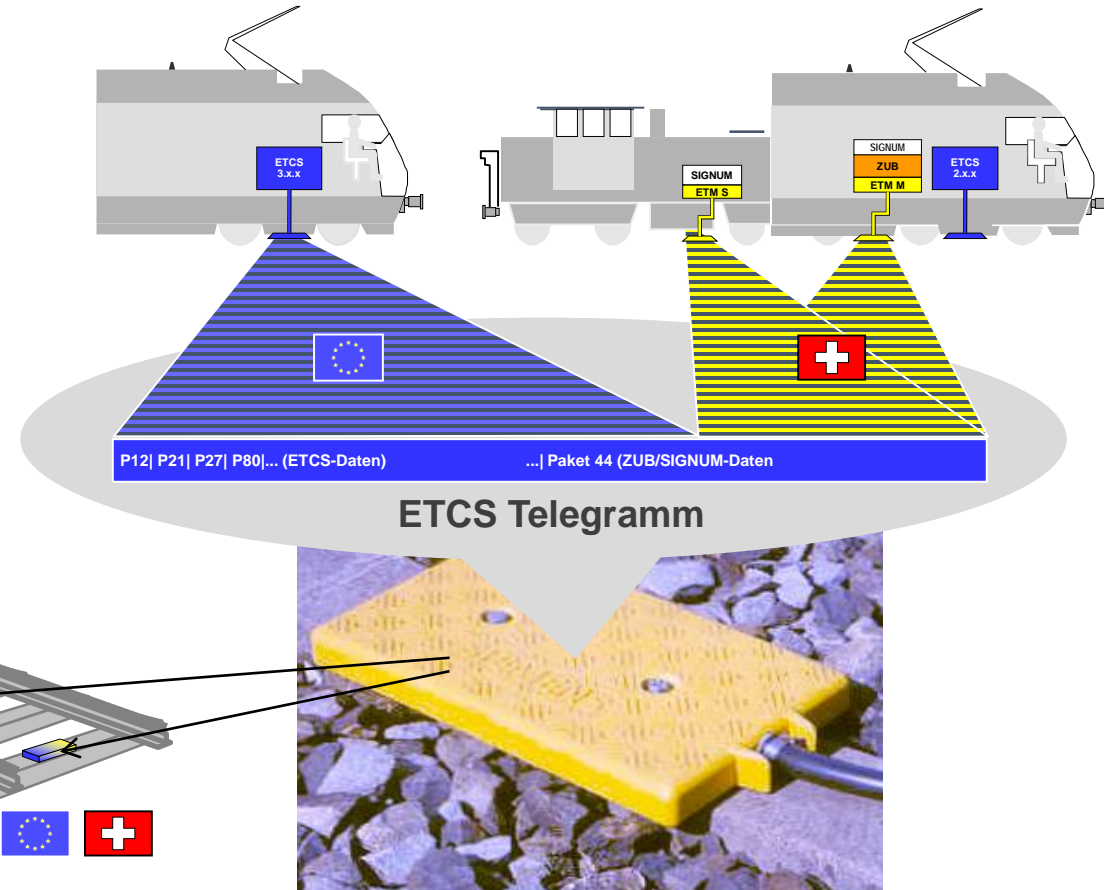
- Vehicles with ETCS BL3 on-board read european Package

or

- Vehicles with Class B on-board read national Package P44

supervising two versions of vehicles with the same trackside equipment

**Replacing Class B systems by EuroSIGNUM / EuroZUB and ETCS L1 LS**





# Migration to ETCS L1 LS (3)

## Facts and figures regarding ETCS L1 LS migration:

- More than 3'000 vehicles refitted with Onboard ETCS-antenna and Eurobalise transmission module (ETM) to read P44  
Timespan: 2000 – 2003
- trackside replacement of Class B transmitter by ETCS balises  
Start: 2003
- Industrial process to replace ZUB/Integra transmitter by ETCS components started in 2012 (up to 15 signals per day)
- Trackside migration to be completed by end of 2017
- Vehicles with ETCS on-board (Baseline 3) can operate on whole network  
From 2018 onwards







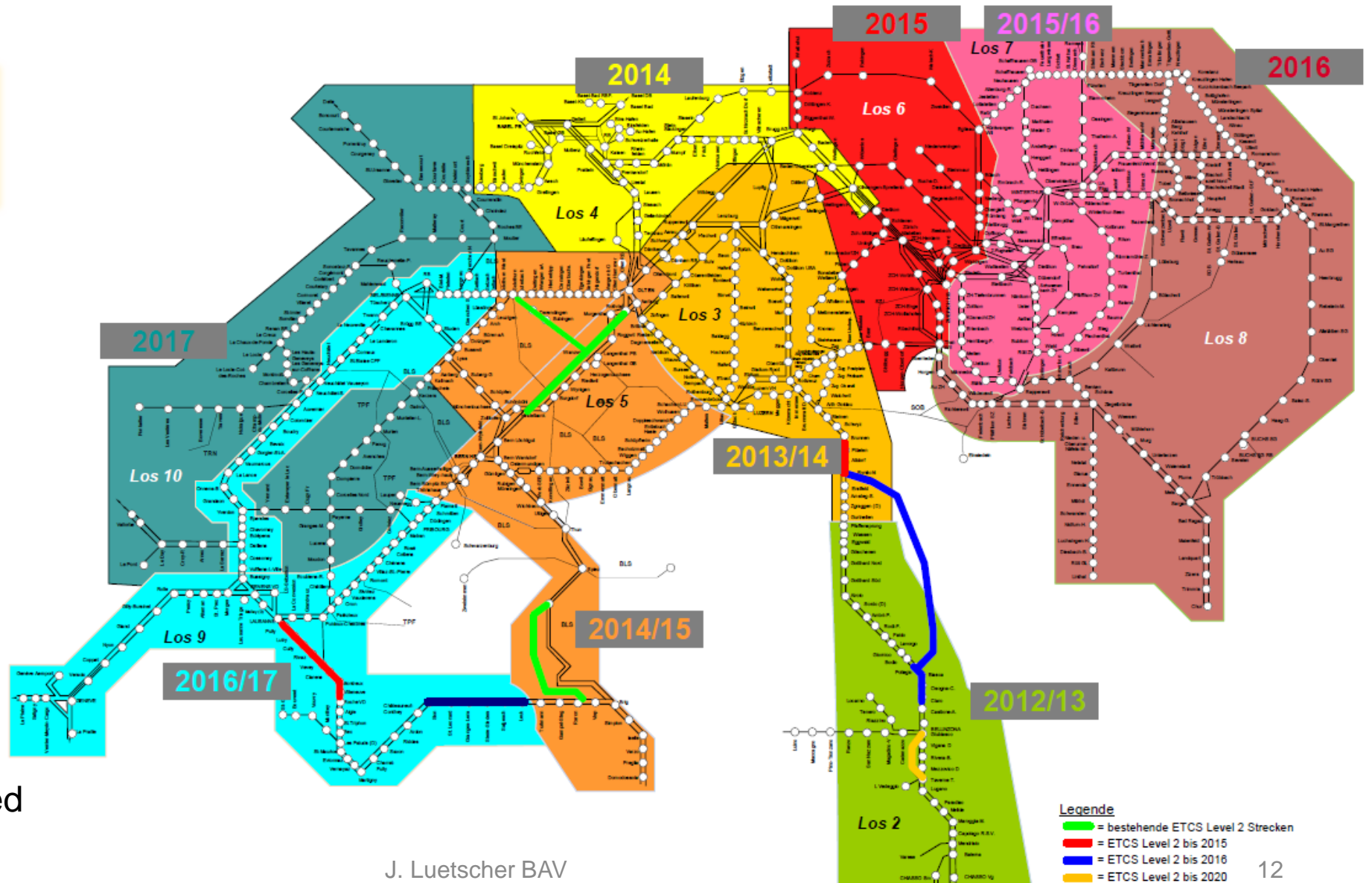
# Migration to ETCS L1 LS (4)

Roll out map  
SBB Infrastructure  
2012 – 2017

Work done in  
ten regional lots

Work done by  
railroad industry

Generic engineering  
processes to be applied





# Success factors for Swiss ETCS migration

- FOT contracted at beginning of the migration the ETCS System Leader (SBB)
- System Leader developed uniformed rules (operation + engineering) for trackside ETCS applications (L1 LS and L2)  
→ the Swiss ETCS lines are compatible!
- To demonstrate interoperability and to proof the system-reliability, on-board ETCS units have to be tested in the laboratory of trackside ETCS suppliers (so called IOP-test)  
→ for an on-board unit once tested, there is no need for further testing in case of placing in service an additional ETCS-line






# ETCS and Gotthard Base Tunnel (1)

## Gotthard Base Tunnel:


- Part of European Rail Freight Corridor 1 (RFC 1)
- Maximum speed 250 km/h (tested but not yet operated)
- Mixed traffic (200 km/h passenger + 100 km/h freight trains)
- High capacity (260 freight + 65 passenger trains per day)



ETCS L2  
defined for  
Gotthard Base Tunnel

## Gotthard Base Line:

- For capacity reasons ETCS L2 is also installed on the feeding lines north and south of the base tunnel



Migration under  
full operation  
200 trains per day

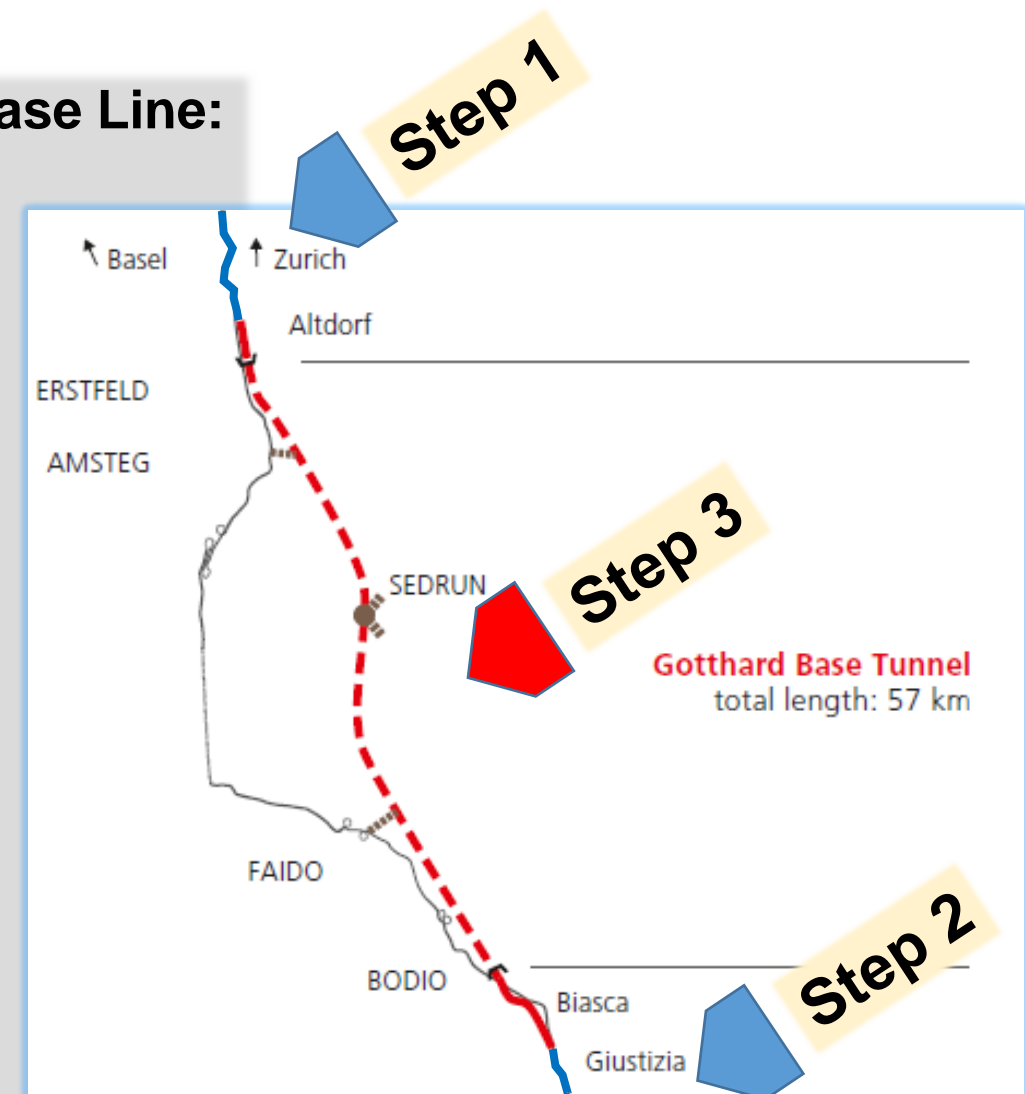




# ETCS and Gotthard Base Tunnel (2)

## Steps to go into operation with ETCS L2 on Gotthard Base Line:

- northern approach (Brunnen – Erstfeld) in service since August 2015
- southern approach (Pollegio – Castione) in service since December 2015
- Gotthard Base Tunnel in Service since Mai 2016
- Inauguration of Gotthard Base Tunnel at 1<sup>st</sup> June 2016 and start of operational tests
- Scheduled operation of Gotthard Base Tunnel started at 11<sup>th</sup> December 2016





# Conclusion

## Lessons learned:

- Rules for operation and engineering are essential to achieve interoperable ETCS solutions
- The test-specifications in the current TSI CCS does not ensure the technical interoperability and the required suitability – too many product failures remain uncovered
  - ➔ For this reasons Switzerland defined the IOP-testing process
- The current TSI's are not yet complete, there are relevant gaps or obscurities
  - ➔ Additional national requirements are necessary – see NNTR-CH
- Taking into account the above mentioned issues, it is possible to achieve a very successful ETCS

