

# ERTMS Conference Leipzig

## Experiences of ERTMS in Switzerland

ERTMS  
Opportunities

ETCS L2  
Pilot Line

Further  
Steps



# ERTMS Opportunities for SBB

## Reduction of cost

...due to creation of true competition amongst several suppliers for procurement.

## Interoperability

...to simplify transnational rail traffic on international main line corridors.

## Increase of Capacity

...by cab signalling on high speed lines and/or conventional line with high train density.

## Increase of safety

...by harmonisation of operational rules and conditions and by applying ETCS L2 (continuous supervision)

## Renewal of signalling

...with ETCS Level 2 and L1 LS allowing significant cost reduction compared with traditional line-side signalling.

## Renewal of rolling stock

...with ETCS train borne equipment in order to get operational interoperability.

# ERTMS

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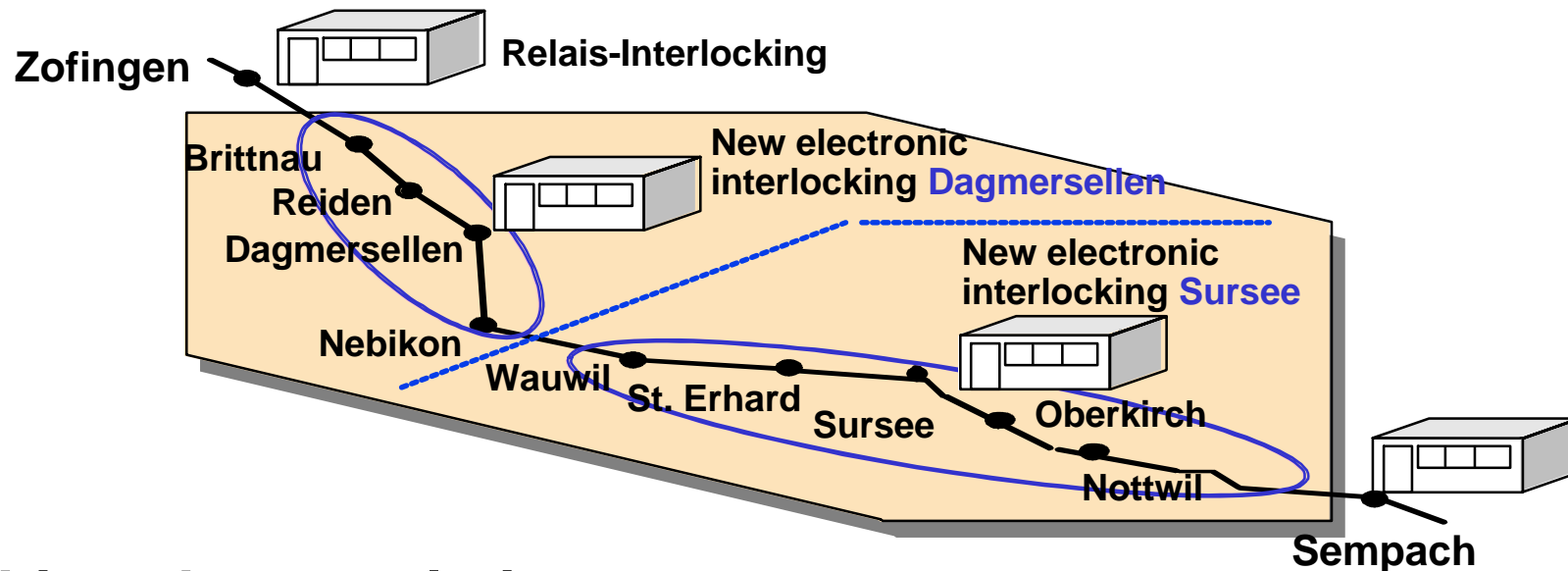


# Main objectives for pilot line

## Getting ready and minimising risks for the new line Berne – Olten (Comm. By Dec. 2004):

- Implementation of ETCS Level 2 - Technology and the related new operational rules
- System and process approval and homologation based on the European CENELEC Standards EN 50126, 50128 and EN 50129
- Build-up of know-how in ERTMS and training of specialists and users
- Gaining of operational experience at a technical and procedural level
- Proof of interoperability with other new lines

# Project perimeter



## Line characteristics:

- 35 km double track with 9 stations
- 140 trains per day, 3 Mio passengers and 240'000 t freight per year
- 2 electronic interlockings Alcatel Electra 1, 70 train routes
- Max. line speed 160 km/h, max. gradient 10 pro mille

# Challenges

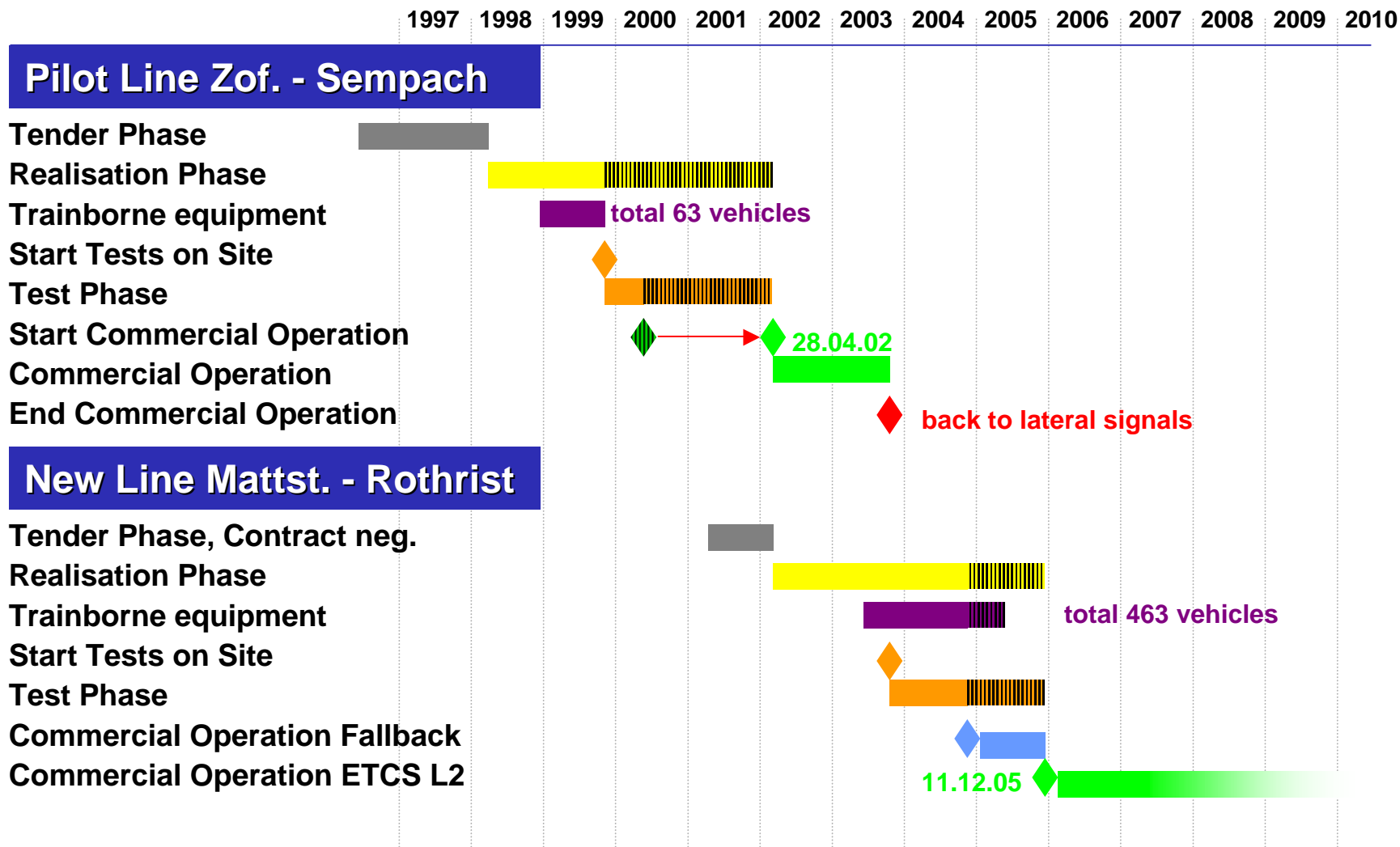
## Special Challenges with the pilot project:

- Development of SIL4 system with high reliability and availability (hardware and software)
- **Integration of ETCS Level 2 into the existing production environment of SBB**
- **Development and implementation of the processes handling degraded situations**
- Training of SBB personnel regarding proper actions to be taken in degraded situations

# Scope of the Project

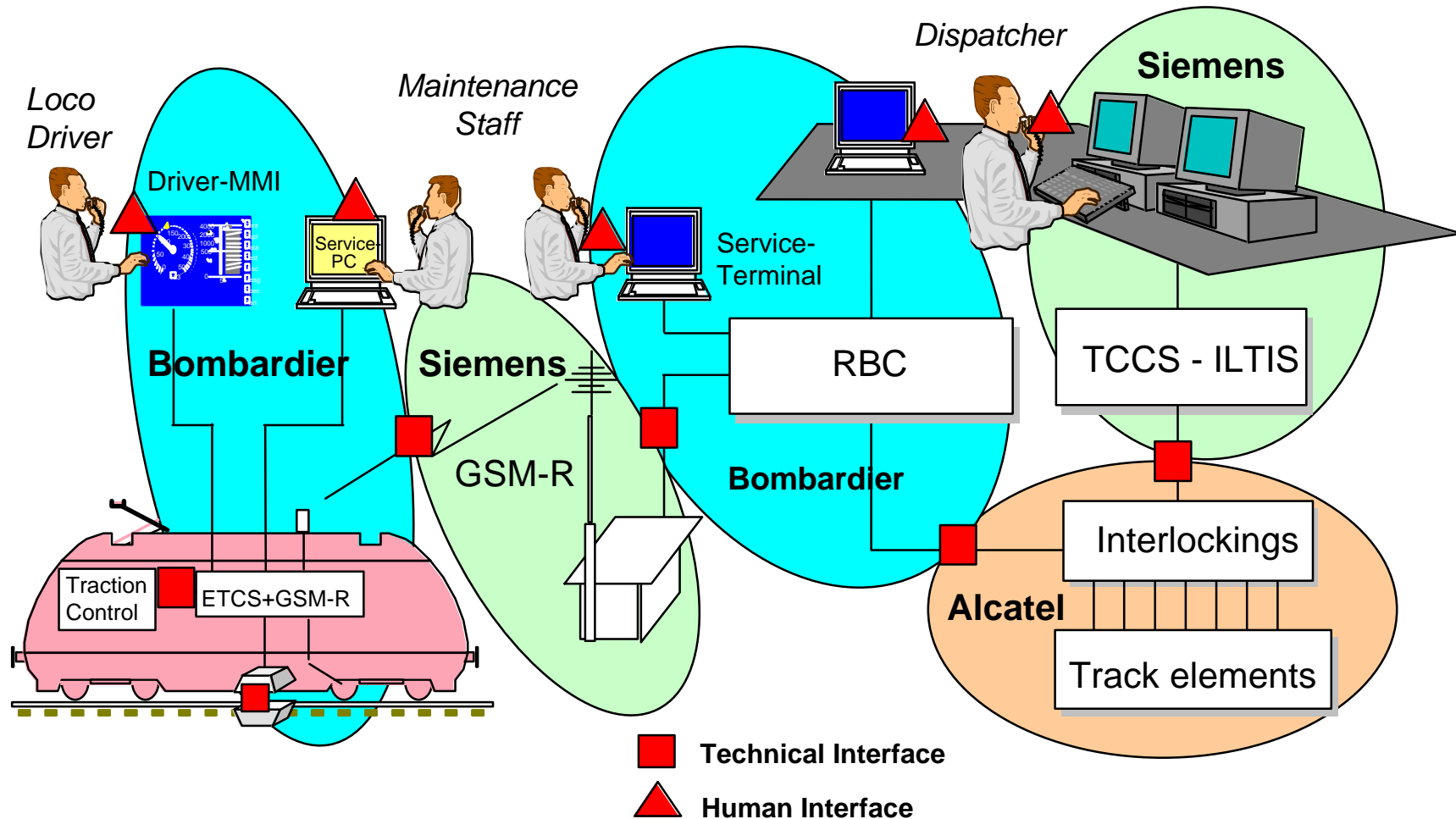
- Adaptation to track layout and renewal of installations
- Replacement of old mechanical interlockings
- Process engineering for ETCS Level 2 (Use cases)
- Development of ETCS Level 2 System  
(Bombardier)  
(Specification Versions: A200 SRS 4A → SRS 5A → UNISIG Class P)
- Planning, installation and testing of GSM-R data
- Adaptation to interlocking and TCCS-System to ETCS L2
- Trackside installation and equipment of 63 vehicles
- Demonstration of safety
- Training of staff and commissioning

# Project schedule L2 Implementation





# System overview



Main interfaces managed by SBB to gain knowledge and expertise

SBB Infrastructure – ERTMS



SBB CFF FFS

# Lessons learned at project level

**Time frame initially allocated was way too short in the given circumstances:**

- SRS were not stable and consolidated (4A, 5A, class P)
  - Breaking new ground regarding operational rules
  - First project to follow new CENELEC Standards for approval process and homologation in Switzerland
  - New partnership SBB – Bombardier Signalling: Differences in domain knowledge and signalling philosophy
  - Shortage of qualified personnel within SBB and industry
- Adequate management attention from the beginning - with all parties involved!**

# Performance and experience

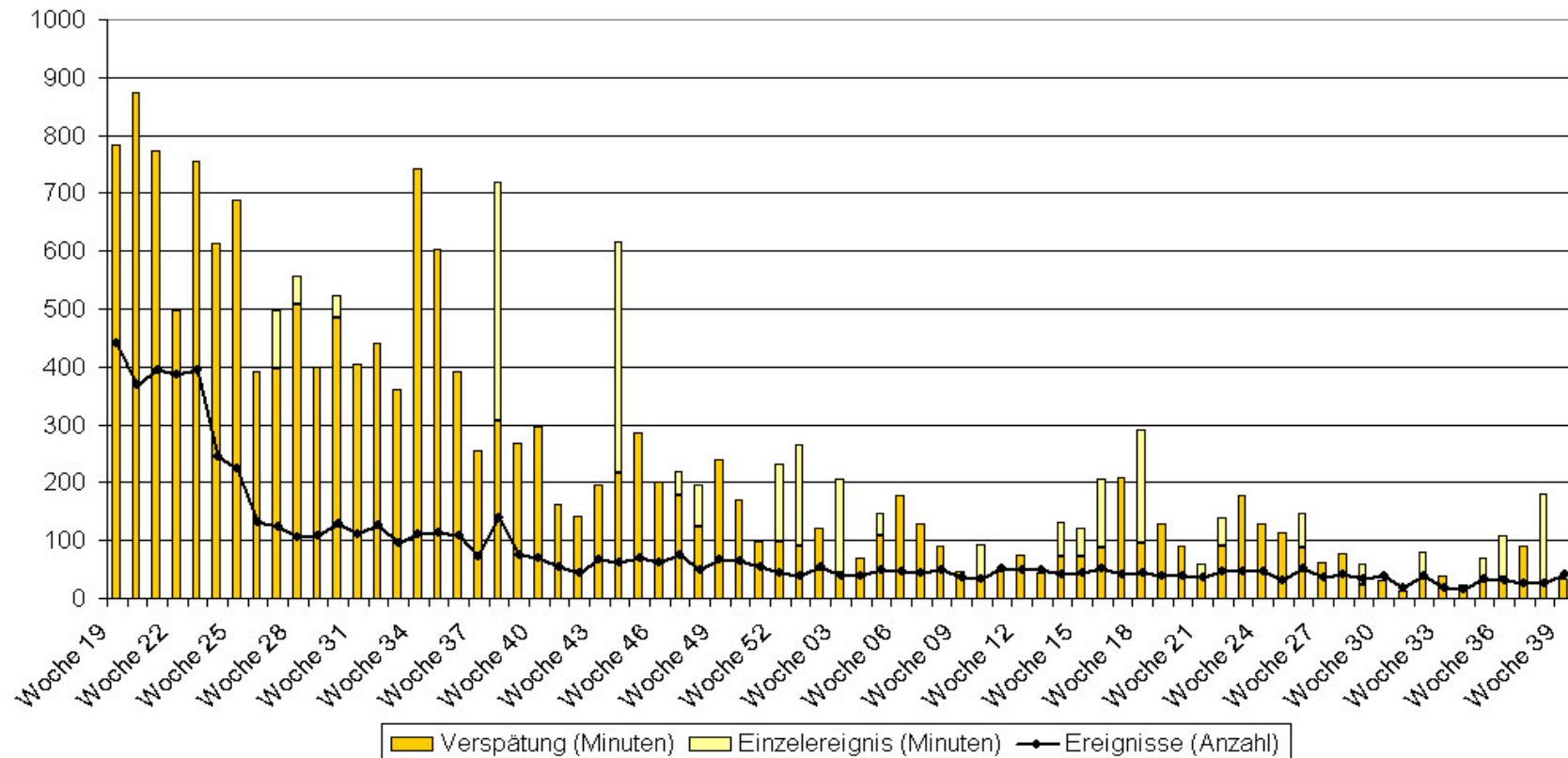
- 95% of the challenges were trainborne
- GSM-R problems in the beginning (train announcement, handovers)  
➔ all solved

Up to 60 different singular errors. They occurred only every 100<sup>th</sup> to every 10'000<sup>th</sup> train run:

- Could not easily be found before start of commercial operation (3'300 test cases executed)
- With 1'000 trains a week a time frame of 3 months is required to find and analyse an error that occurred only once in 10'000 train runs!  
Improved diagnostics and tools ar a key success factor!
- Rare errors were blanketed by more frequent errors

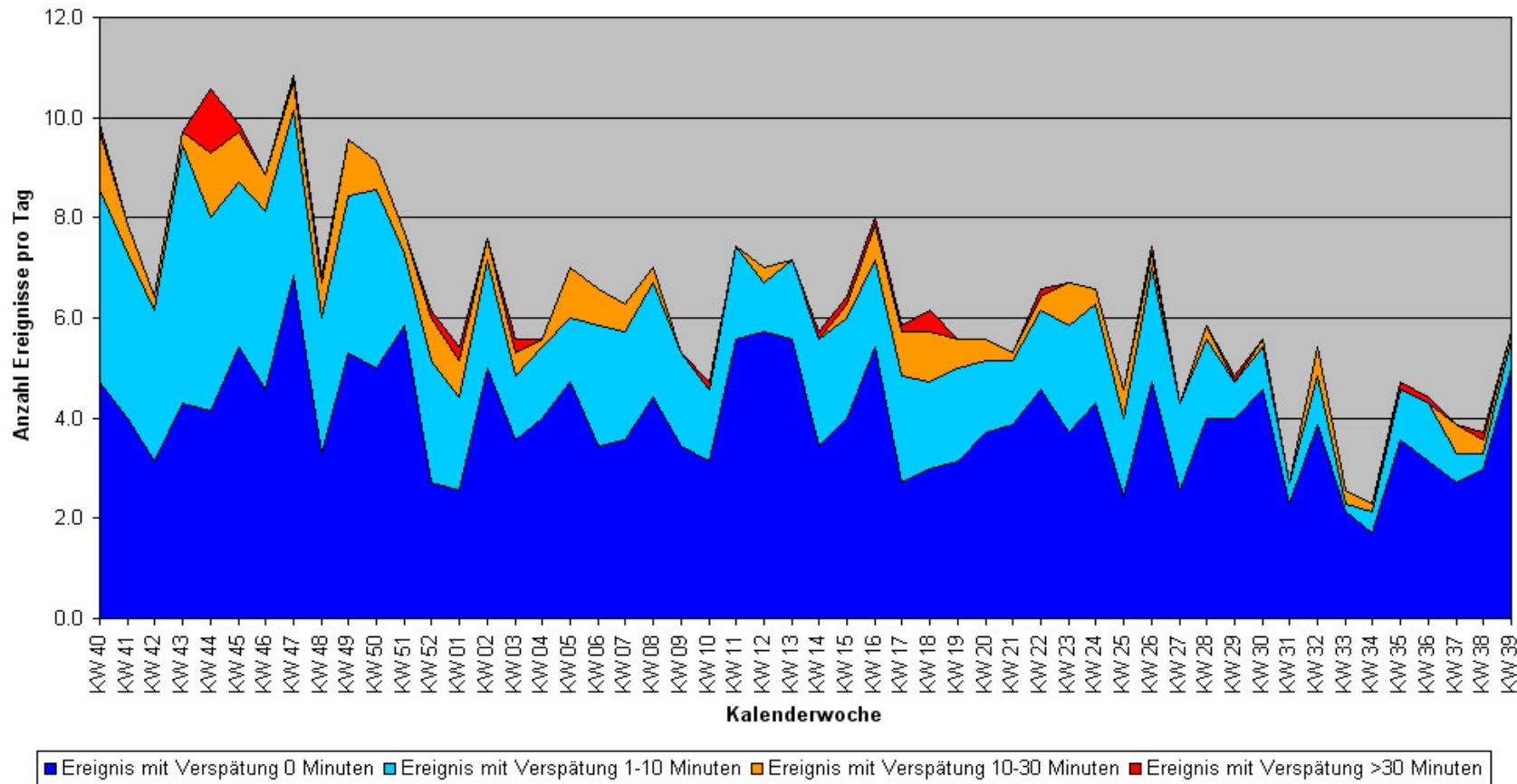
# Primary delay minutes per week

Verspätungsminuten / Ereignisse pro Woche gemäss Hotline

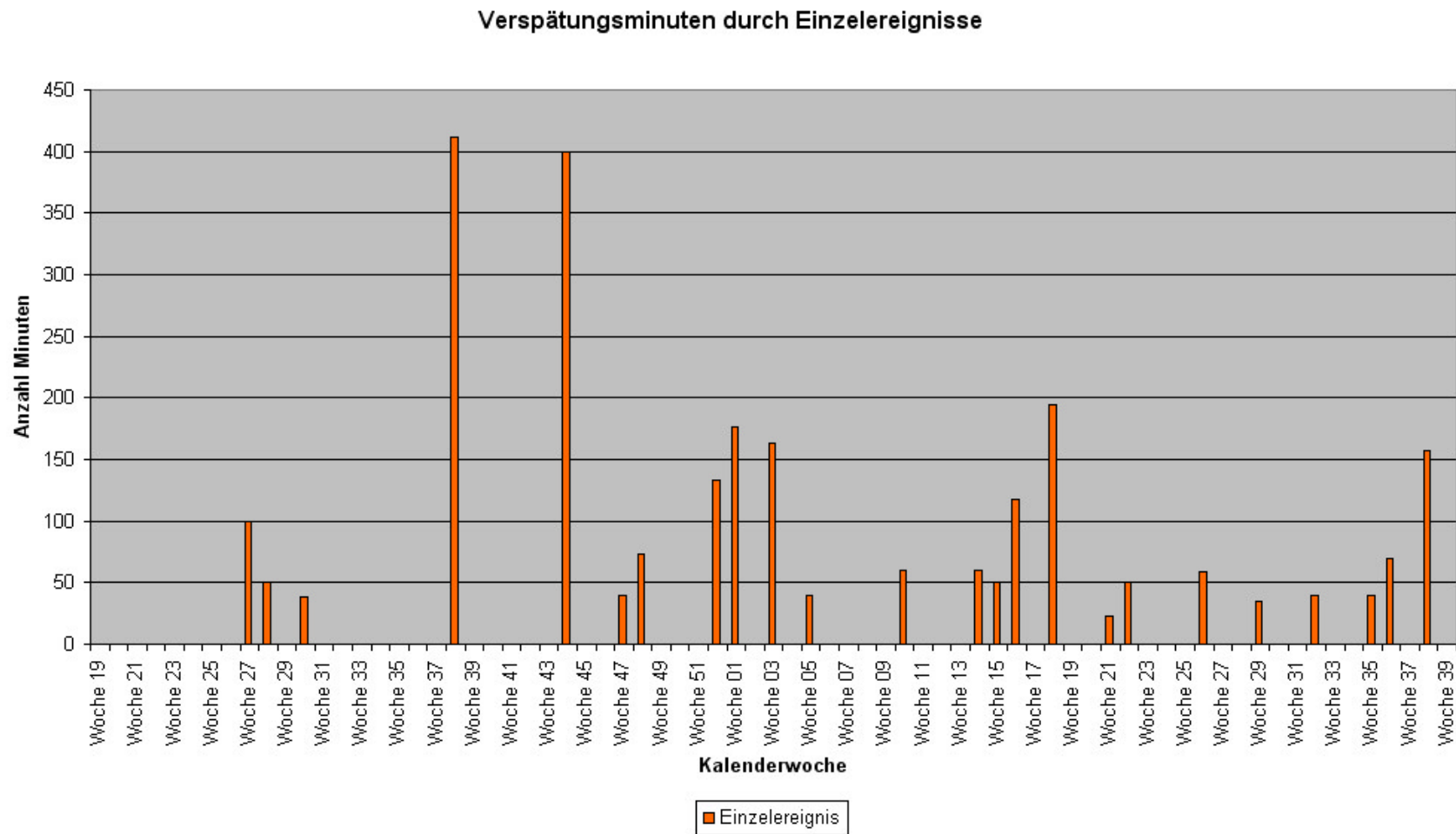


# Number of events by category and day

Ereignisse nach Verspätungskategorien

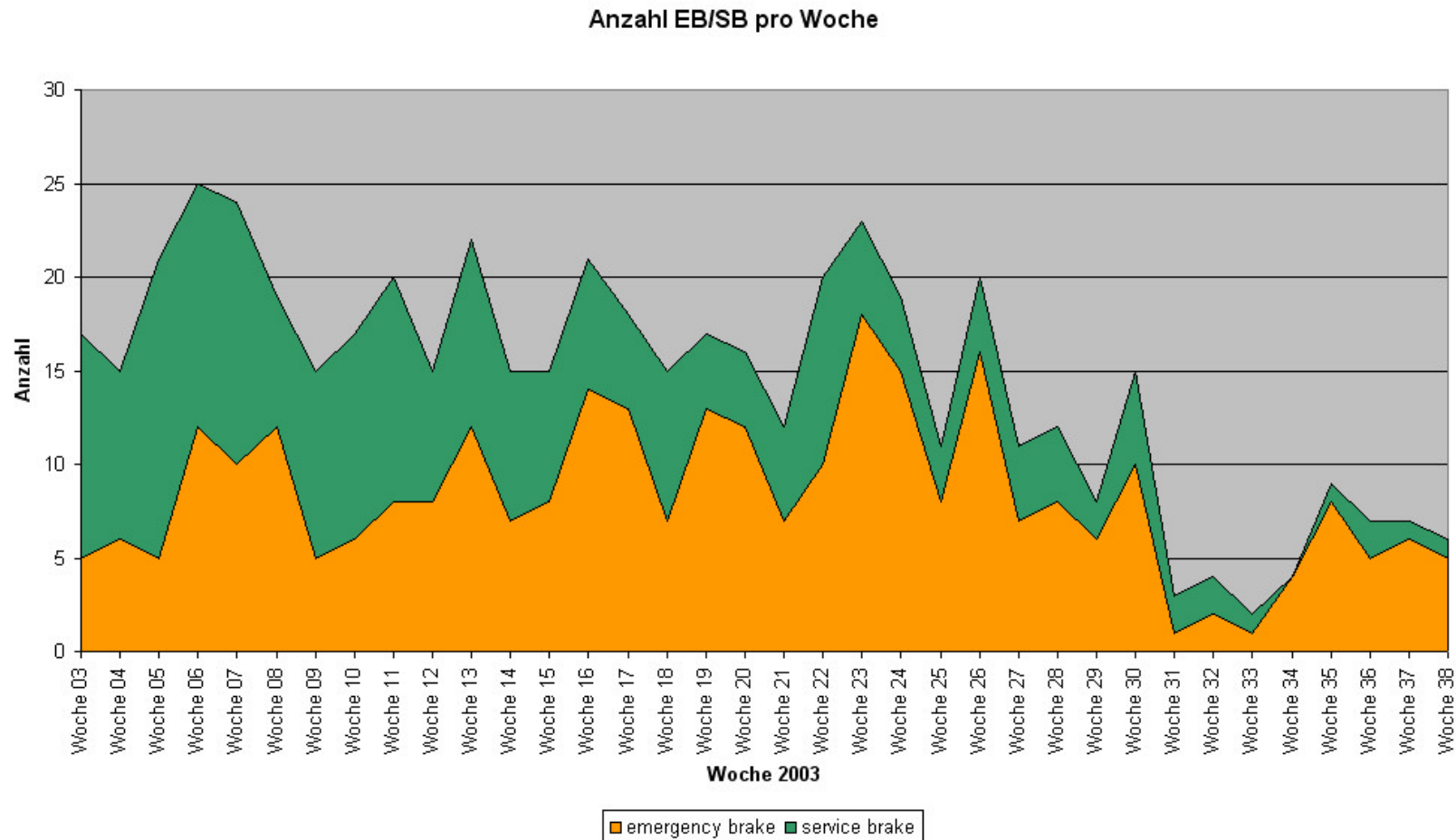


# Delay minutes due to one-off events



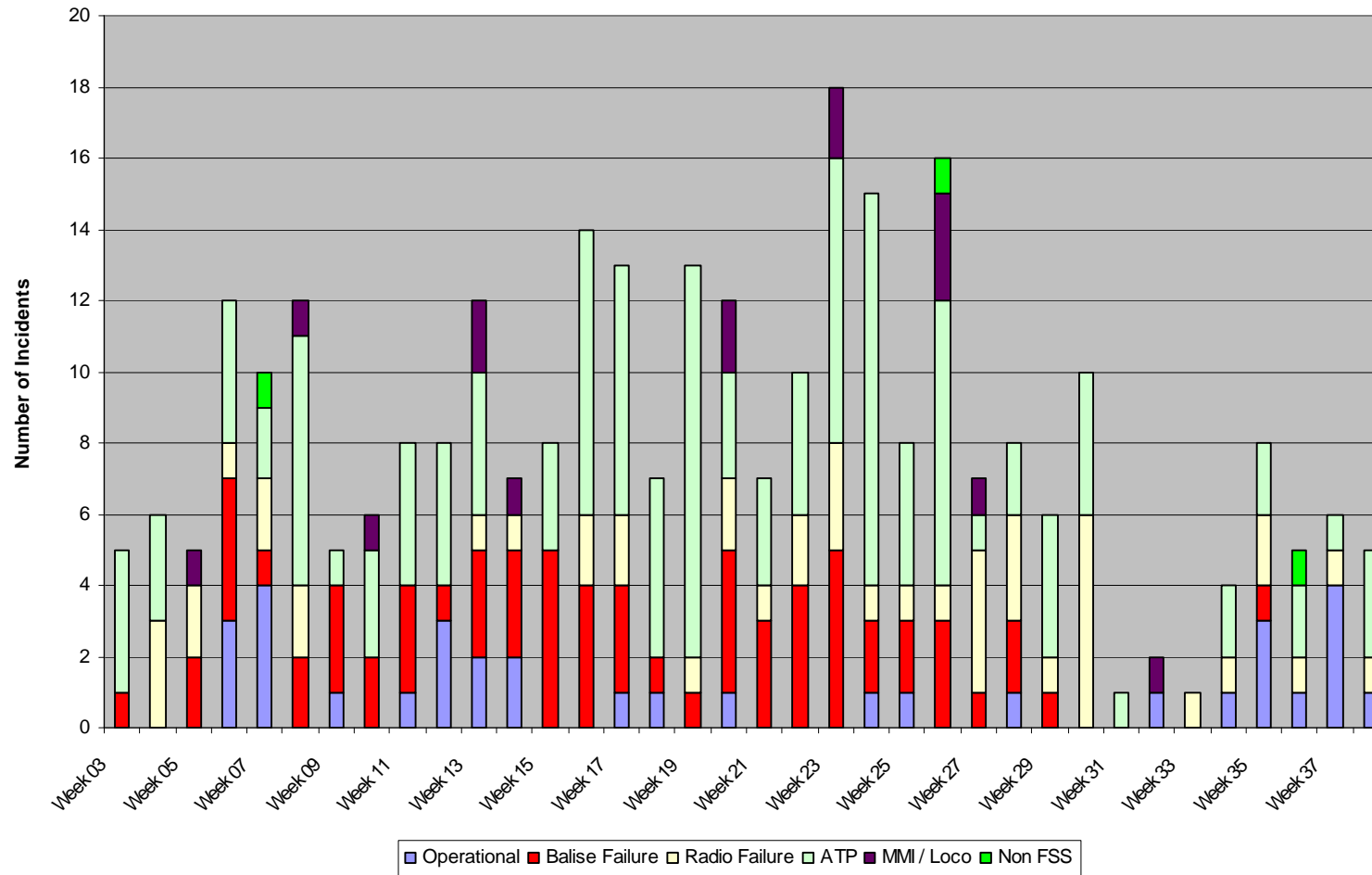
# Service and emergency brakes per week

## Year 2003



# Emergency brakes by category

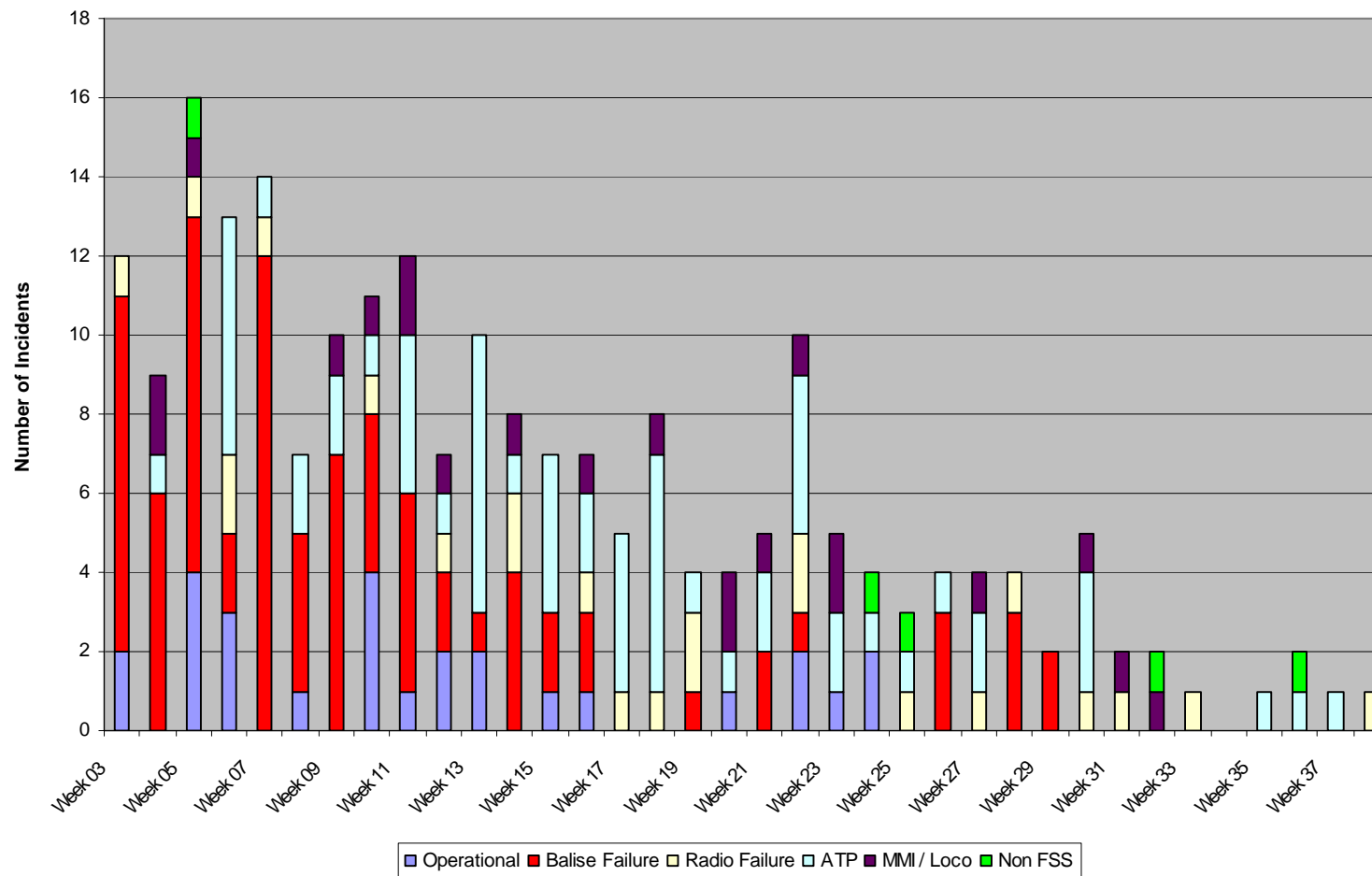
Emergency Brakes by Category (Week 03 - Week 38)





# Service brakes by category

Service Brakes by Category (Week 03 - Week 38)



# Pilot line acceptance criterias

The acceptance criterias shall be under full control of the system supplier, they shall NOT depend on the customer performance (ie training, degraded mode handling).

Primary delay minutes and overall availability are NOT considered as sound acceptance criterias, they depend strongly on the interaction of supplier and customer.

**On the pilot line, the following acceptance criterias were finally defined:**

- Functionality of ETCS L2 system (acceptance tests cases pass successfully)
- Number of EB/SB brake applications per month based on timetable
- Number of one-off incidents per month
- Reliability of overall system und subsystem components
- Successful training of SBB personnel (certification)
- As-built product and system documentation
- Correction of known non-conformities and implementation of change requests
- Identical and traceable hard- and software configurations

# Experience after 18 months

## Success so far:

- Not a single safety relevant failure or incident
- No defects found to call suitability into question
- Big learning effect regarding SBB-internal processes and procedures (operation, maintenance, exception handling)
- High acceptance by drivers and dispatchers despite the number of errors during operation at the beginning
- Important knowledge and insights gained for the benefit of the new high speed line Mattstetten–Rothrist
- GSM-R works as data link for ETCS Level 2

- About 1'000 train runs needed for operational verification before a new SW-release can be downloaded on the fleet
- Incident management and failure handling have to be well defined including responsibilities between infrastructure, train operators and industry.  
They have to be trained and practiced before start of commercial service!
- Key success factor: adequate management attention (from all parties) is needed from the beginning:  
lean organisation, direct communication link to top management, fast decisions based on empowerment of project leaders, top management back up / support.

- On site support is mandatory for
    - Project engineering
    - Project management
    - Testing
    - Site management (SW-release changes)
  
  - An on site command centre (“war room”) is mandatory for an efficient system performance improvement process.
- ➔ All parties involved have to be present on site !

# Summary and Conclusions

- The ERTMS Pilot Project has faced several challenges in new technology, processes and procedures
- Initially frequent disturbances are now removed and most problems are solved
- Today on the Pilot Line, ERTMS L2 delivers more than 98 % of all trains on time without any fallback system!
- Very valuable experiences gained for the network-wide migration to ERTMS
- SBB is committed to ERTMS for achieving their strategic objectives

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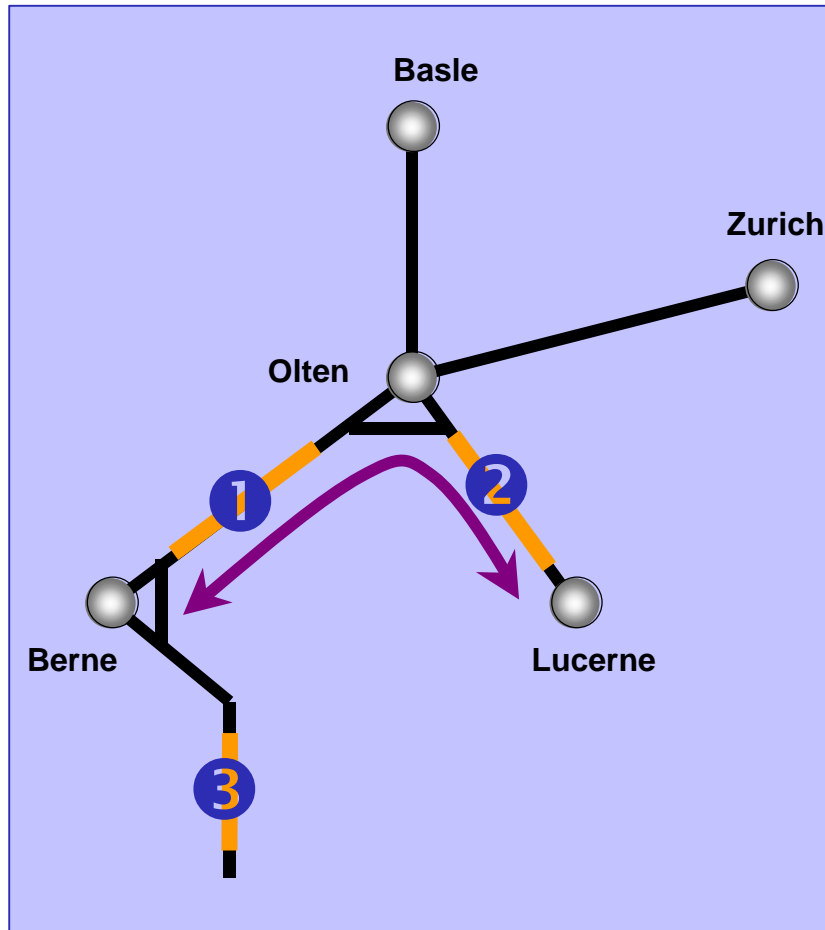
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# Further steps: ETCS L2 Implementation



## Rail 2000 time table

new offer: direct trains from Berne to Lucerne  
commissioning: by End of 2004

1

### New Line: Mattstetten-Rothrist

- today: under construction
- target: **ETCS Level 2 SRS 2.2.2**
- Commissioning L2: End of 2005

2

### FSS Pilot Line: Zofingen-Sempach

- today: ETCS Level 2 based on **SRS 5A**
- target: **lateral signals**
- Commissioning lat. Signals: Nov. 2003

3

### Lötschberg Base tunnel

- today: under construction
- target: **ETCS Level 2 SRS 2.2.2**
- commissioning: May 2007



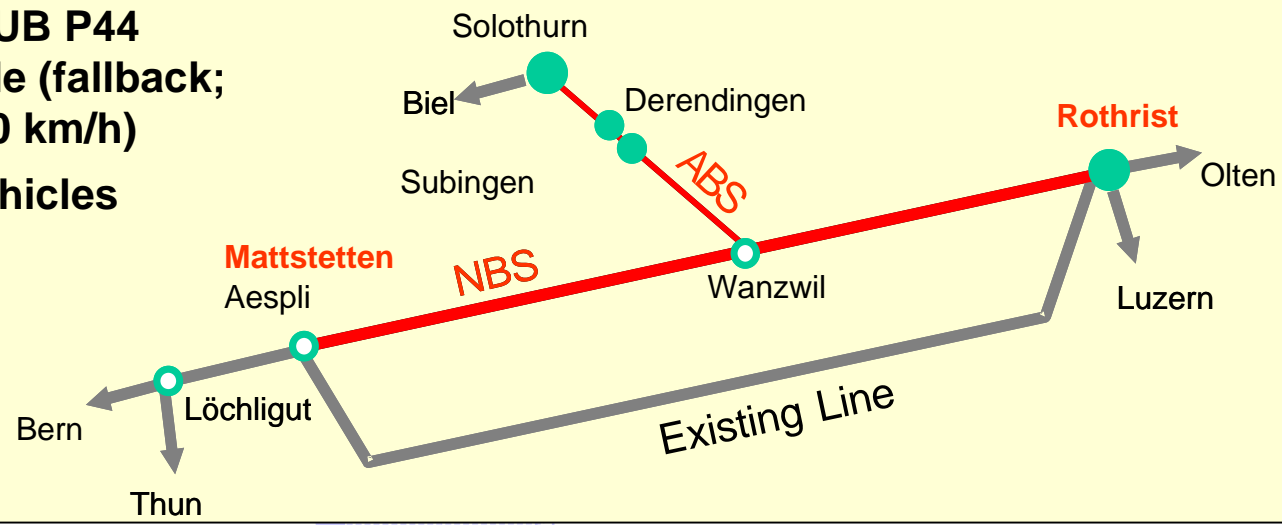
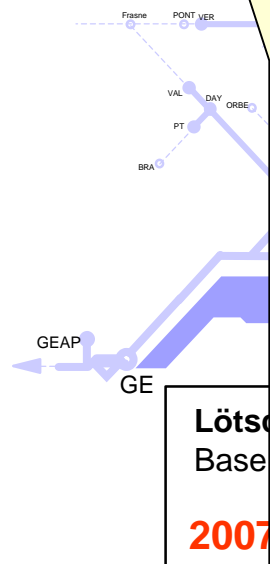
# Next steps ETCS Level 2

Mattstetten-Rothrist

Rail 2000  
2005

## New Line Mattstetten – Rothrist (NBS)

- Commissioning of ETCS L2 in December 2005
- 45 km length
- 14.5 km tunnel
- 242 trains per day (⇔), headway 2 min. at 200km/h
- ERTMS Level 2 acc. SRS 2.2.2 and signals, EuroZUB P44 lineside (fallback; v = 160 km/h)
- 463 vehicles



ETCS Level 2

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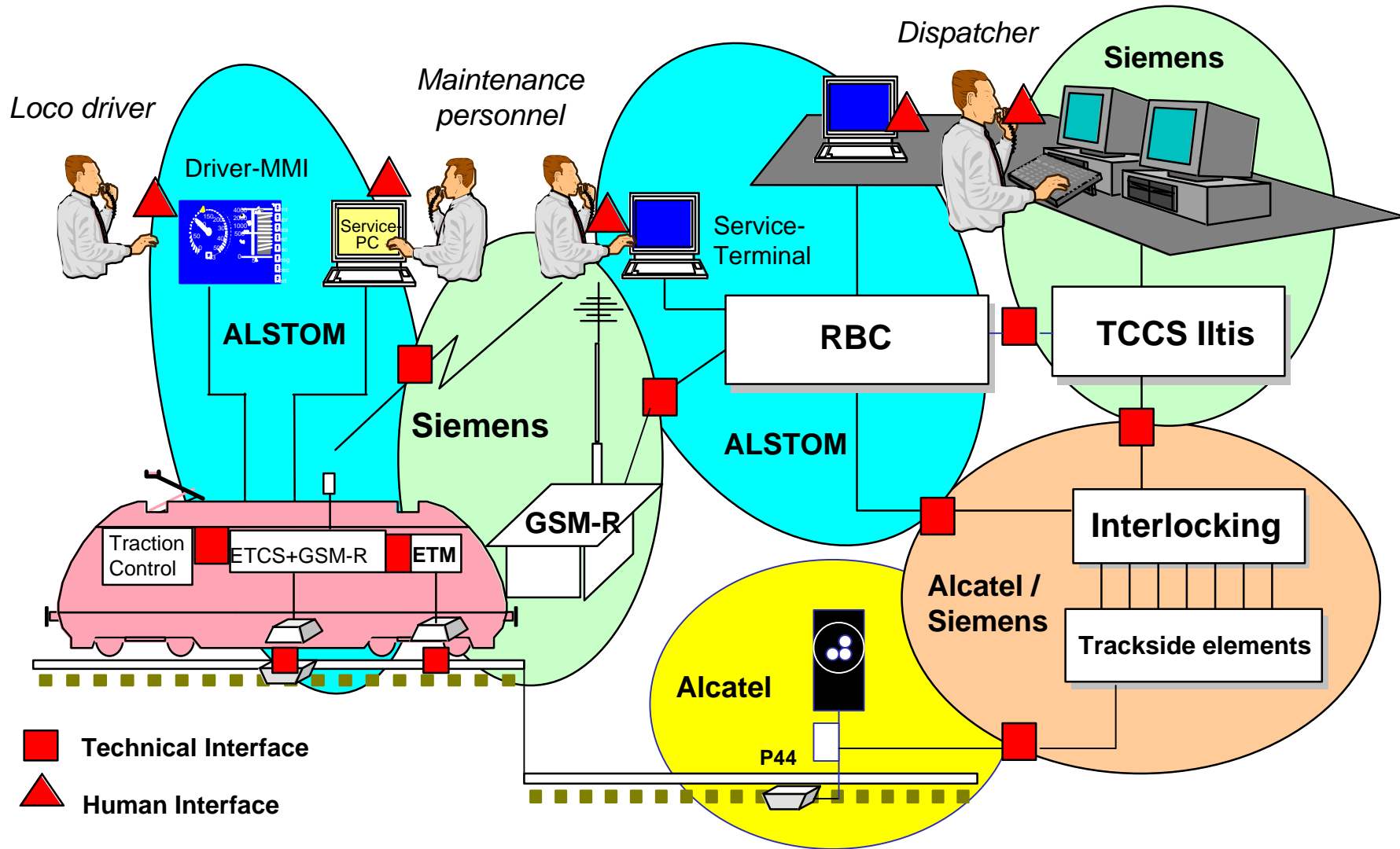
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# NBS Scope of supply

## Project topics / scope of supply

- Equipping 463 vehicles with
  - ETCS L2 trainborne system (EVC, JRU, TOU, GSM-R Data, MMI's)
  - Dual mode cab radio (analogue / GSM-R voice)
  - ETM for EuroZUB (inverted STM)
- Electronic interlocking Electra 2
- Radio block centre
- Eurobalises, redundant axle counters AZLM
- Train command and control system ILTIS
- Lateral signals type "N", EuroZUB train protection system (Eurobalises P44)

# NBS System Overview, Product Suppliers

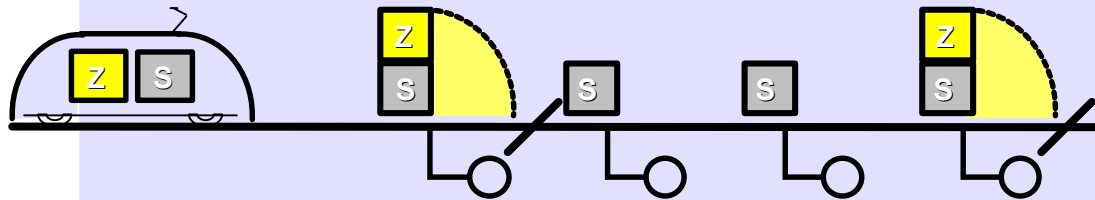


# NBS project situation

- Board decision end of 2002: Lateral signals and EuroZUB for fallback, ETM on all rolling stock to minimize risks of late delivery
- Development and implementation of trainborne equipment delayed
- Overall SBB risk assessment in September 2003 for Rail2000 implementation:  
Board decision to start commercial operation with lateral signals, ETCS L2 will follow end of 2005

**Despite this difficult situation: SBB and FOT will stick to the implementation of ERTMS in Switzerland**

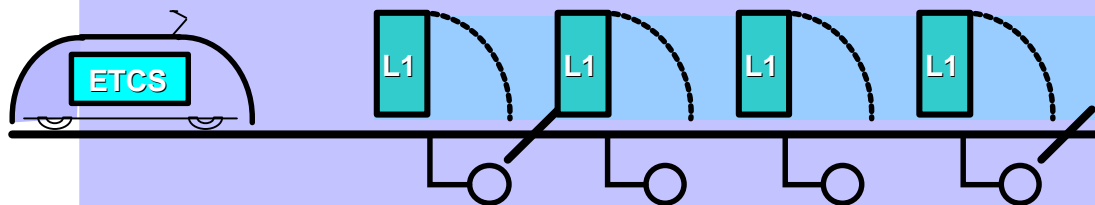
# ETCS - Limited Supervision Mode



## today situation

total of 12000 signals equipped with SIGNUM train warning/stop, 2200 signals are equipped additionally with ZUB train protection system (high risk locations)

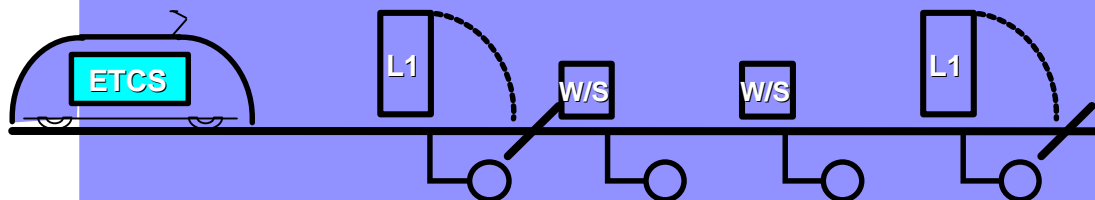
→ **obsolete or systems to be replaced!**



## Today's ETCS solution

ETCS Level 1 full supervision with continuous supervision of speed all along the line (all signals).

→ **no solution for migration of the existing system!**



## future ETCS solution

ETCS Level 1 limited supervision with spot use of Level 1 augmented by ETCS train warning/stop

→ **change request** pending!

# ETCS - Benefits of Limited Supervision

## **simplified migration**

...due to scalable solution (from text messages to full supervision)

## **easy implementation**

...as the use of limited supervision does not require site specific engineering in many instances

## **reduced investment**

...due to adaptation to control level according to risk potential

## **no national solution**

...partial harmonisation in replacement of existing systems (KVB, Indusi, ASFA, TBL, Crocodile, TPWS...)

## **Interoperability**

...can then already be achieved with reduced investment compared to a full installation of ERTMS/ETCS.

## **fast replacement**

Obsolete systems can be replaced quickly in a cost effective way.

## **Network-wide**

Limited Supervision is the economical solution for ETCS on conventional lines.

# ETCS Level 1 Limited Supervision

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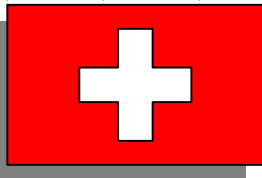


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# ETCS – Migration CH

2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020

short-term



## Preservation of Asset

- track-side replacement of ZUB
- train borne equipment to be upgraded with ETM (reverse STM) in order to read P44
- Prepare of ETCS-project engineering tools and confirmation of acceptance

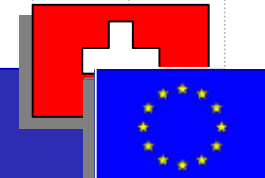
mid-term



## Interoperability

- track-side replacement of SIGNUM
- Net-wide implementation of ETCS Level 1 Limited Supervision
- Newly built or Renewal lines to be equipped with ETCS Level 2

long-term



## Increase of capacity

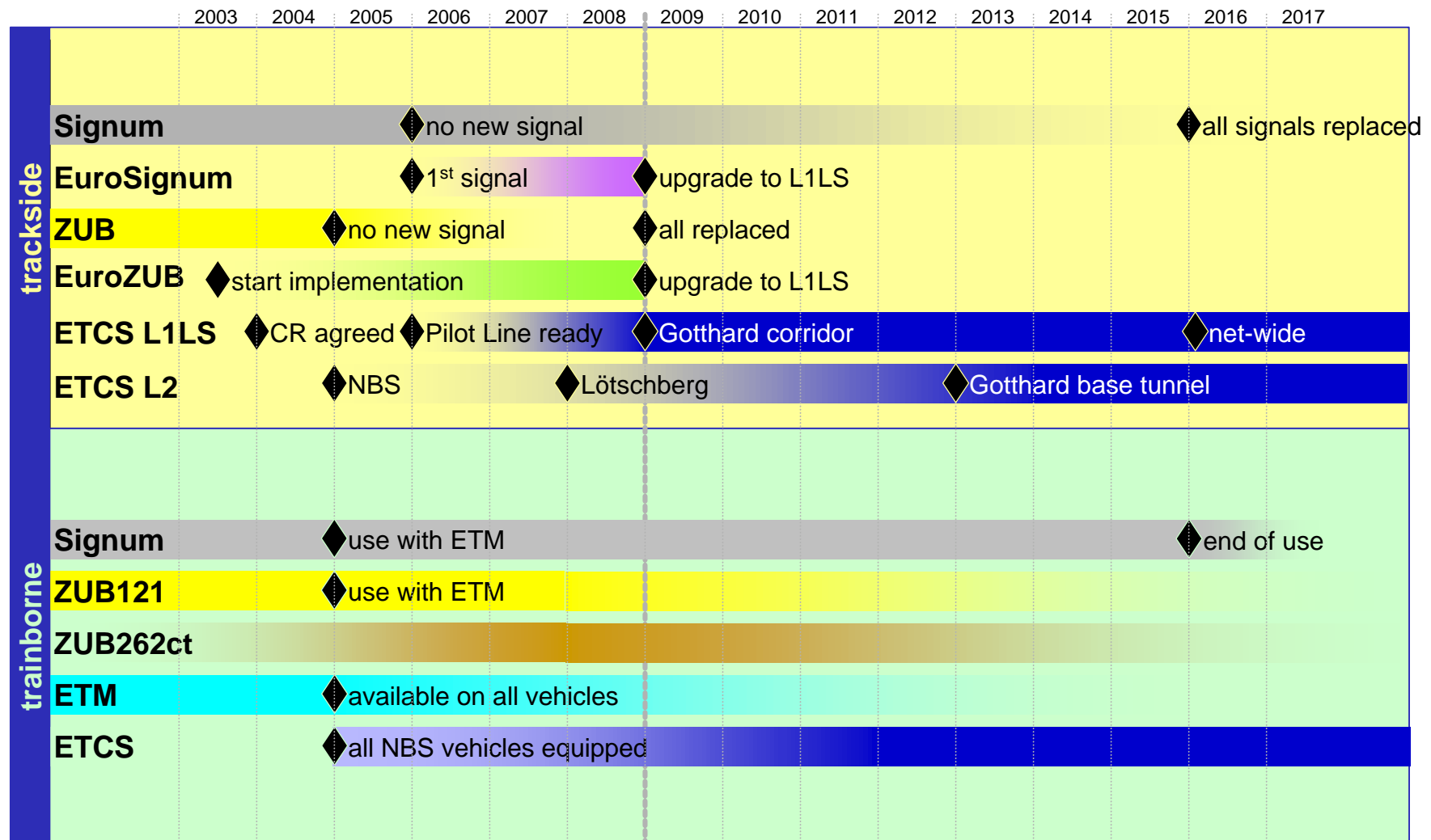
- Implementation of ETCS Level 2 on core network (lines and hubs)

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# ETCS – Migration schedule CH





# Future of ERTMS: some statements

## President of UIC:

“Due to my experiences with ERTMS I pretend that we are in a deep crisis. Key issues like system redundancy, availability and migration scenarios were badly neglected.

We risk that under the nice title of interoperability we will generate huge additional costs that never can be carried by the market revenues.”

# Future of ERTMS: some statements

- ERTMS is NOT a high speed application issue: migration scenarios MUST include national lines and stations/hubs (end-to-end problem!).  
If this is not considered, national systems will NEVER be replaced, ETCS will just be an expensive add-on!
- ERTMS migration scenarios MUST be established and committed between infrastructure managers and TOC's, otherwise ERTMS migration will fail!
- ERTMS implementation must carefully be managed between infrastructure managers and TOC's. Changing standards and crossborder traffic will be the challenges for the coming years!

# Future of ERTMS: some statements

- High Speed applications following TSI 96/48 will not create the business case for ERTMS: national markets will drive the ERTMS implementation
- The UNISIG members are asked to provide ERTMS solutions/options to satisfy the individual needs of the railways for cost effective migration periods
- ERTMS lead users shall not be punished by carrying huge development costs; a cost share model shall be established between EU, railways and UNISIG

# Future of ERTMS: some statements

- No doubt: ERTMS migration WILL COST money. The trackside AND trainborne migration costs (and only these...) shall be funded / prefinanced by the EU. Replacement of obsolete end-of-lifecycle systems shall not be covered by the EU.

Mid/Long term: the investments will lead to lower system life cycle costs, lower rolling stock purchase costs and interoperability and therefore competition.

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**Thank you  
for your attention!**



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