

Migration to ETCS with mode Limited Supervision

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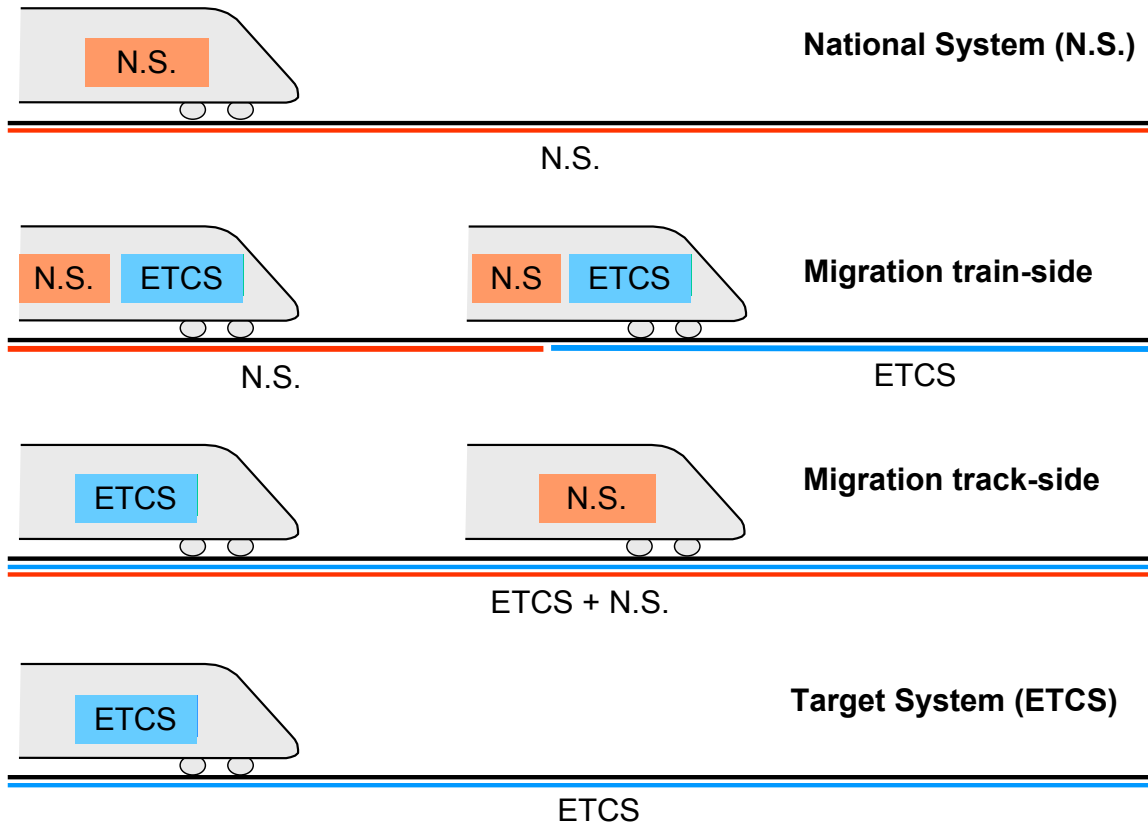
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Migration to ETCS with mode Limited Supervision

Basic principle for ETCS migration (1)

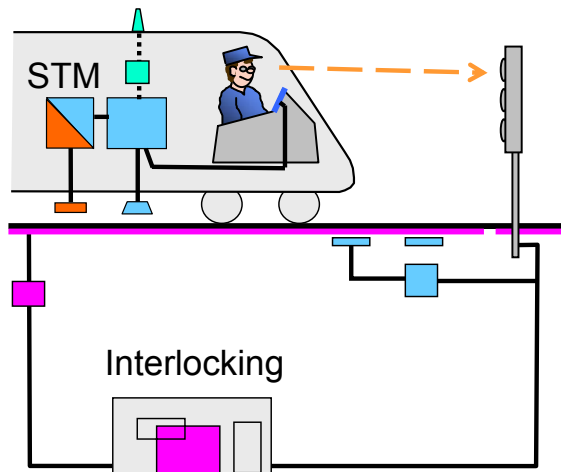


Migration to ETCS with mode Limited Supervision

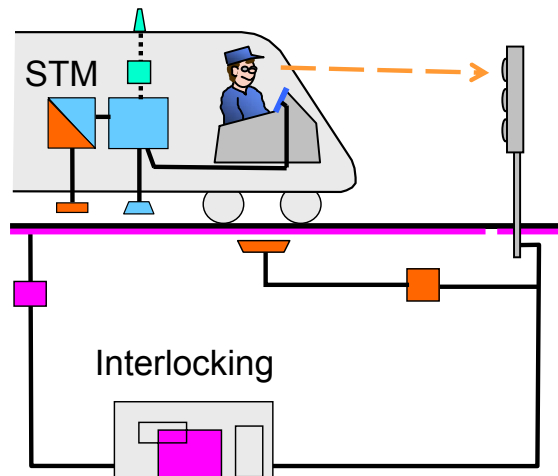
Basic principle for ETCS migration (2)

ETCS migration onboard with use of Specific Transmission Module STM

Line with ETCS



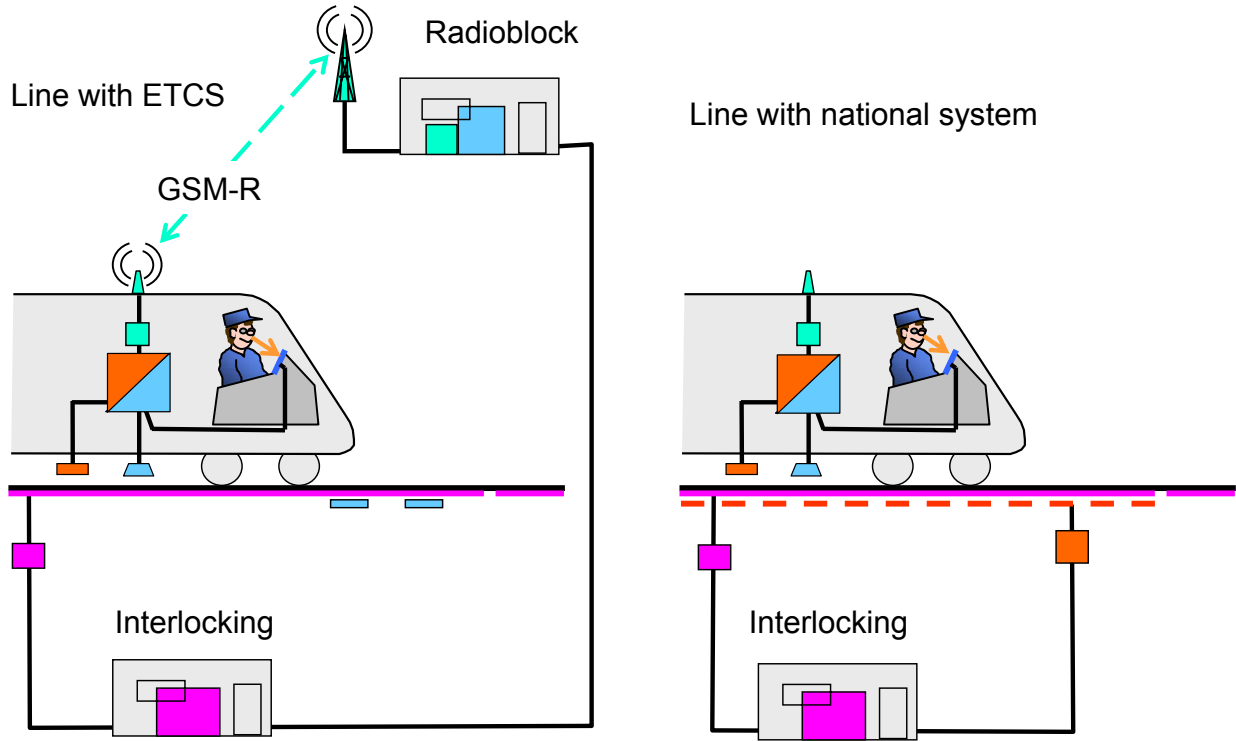
Line with national system



Migration to ETCS with mode Limited Supervision

Basic principle for ETCS migration (3)

ETCS migration onboard with bi-modal cab equipment

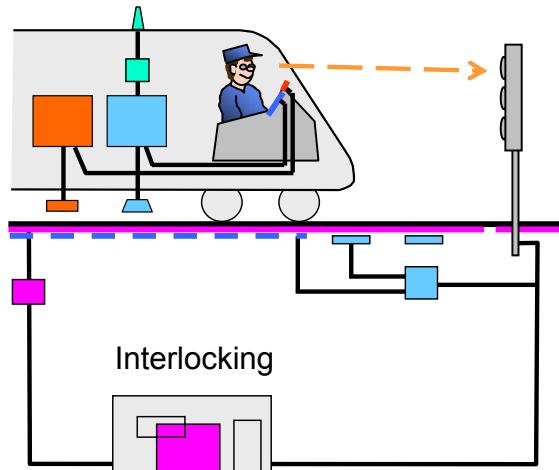


Migration to ETCS with mode Limited Supervision

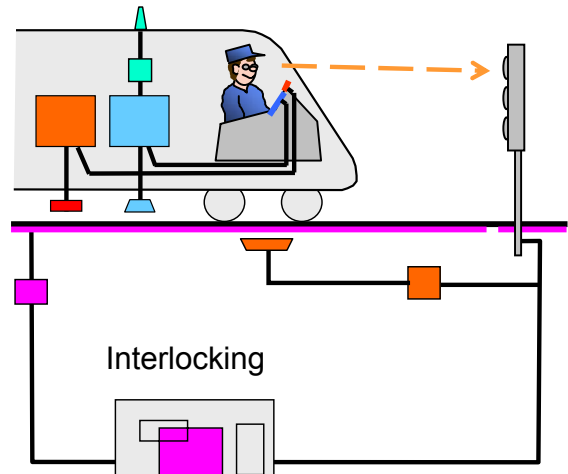
Basic principle for ETCS migration (4)

ETCS migration onboard with juxtaposition of legacy system to ETCS

Line with ETCS



Line with national system

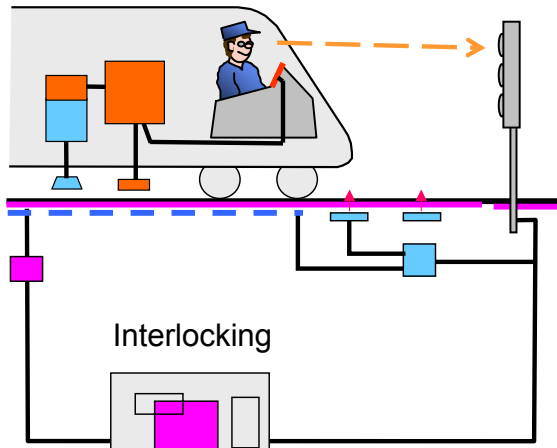


Migration to ETCS with mode Limited Supervision

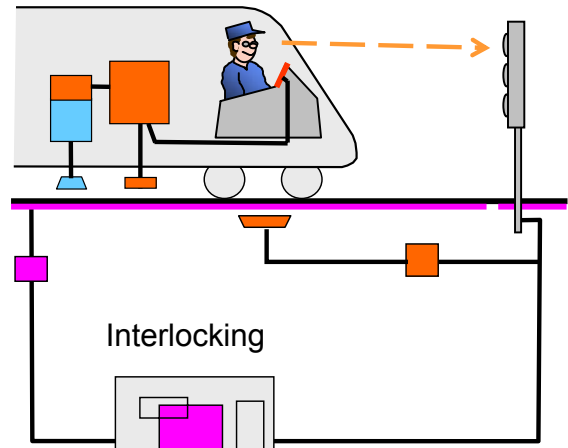
Basic principle for ETCS migration (5)

ETCS migration onboard with use of “reverse STM”

Line with ETCS



Line with national system

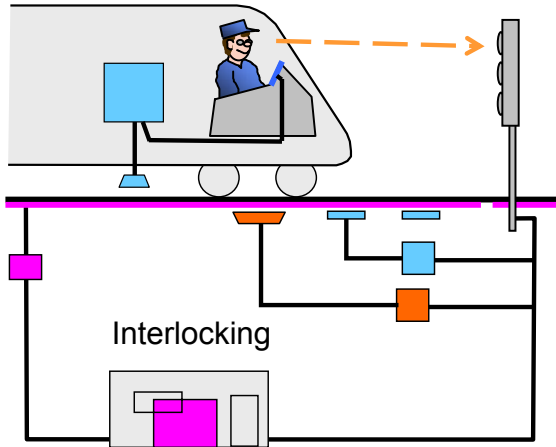


Migration to ETCS with mode Limited Supervision

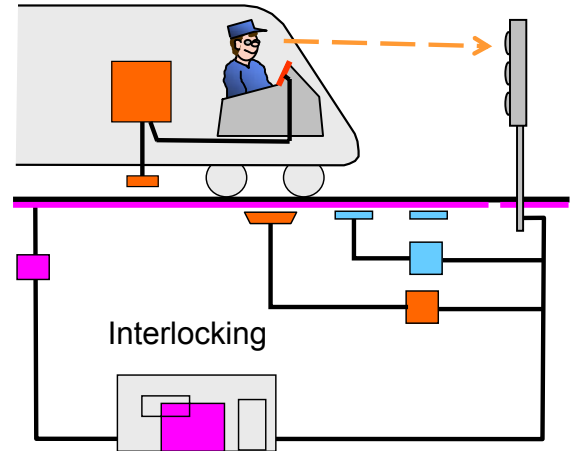
Basic principle for ETCS migration (6)

Trackside migration with ETCS level 1 overlaid to the national system

Train with ETCS



Train with national system



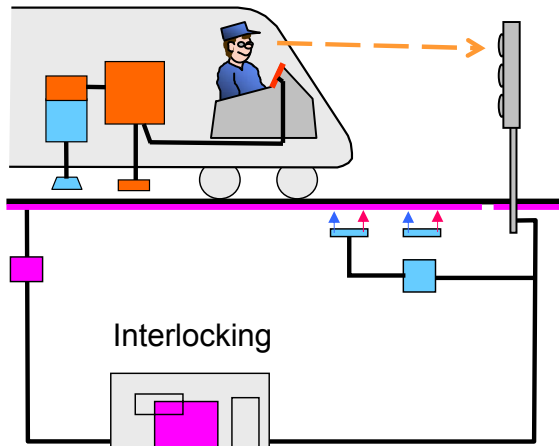
Migration to ETCS with mode Limited Supervision

Basic principle for ETCS migration (7)

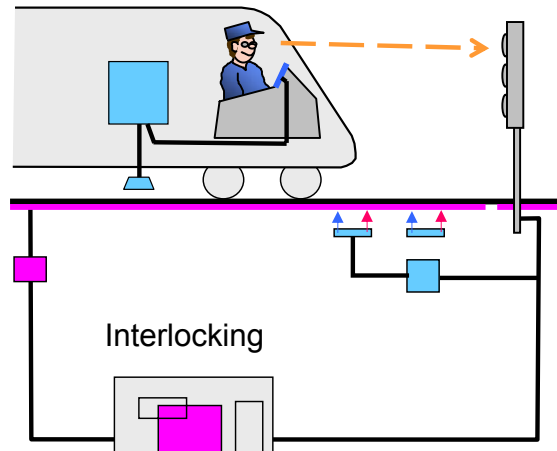
Trackside migration with ETCS level 1 and use of national telegram package

Train with national system and
ETCS data transmission

“reverse STM”



Train with ETCS

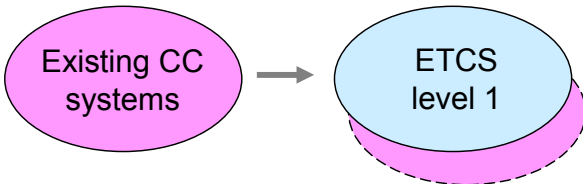


Migration to ETCS with mode Limited Supervision

Basic principle for ETCS migration (8)

Strategies for ETCS implementation on track side

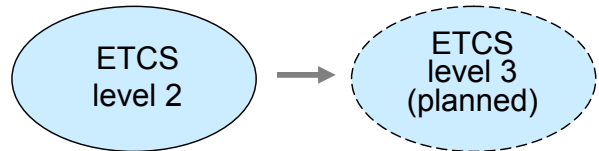
Level 1 strategy



- *Line-side signals*
- *No adaptation of interlocking*
- *Existing CC-system can be used in parallel during the migration phase*

Level 1 can be installed and operated relatively easy in parallel to the legacy signalling installation. The track side migration is in general achievable by maintaining the legacy system in operation. The planned new mode Limited Supervision will facilitate this even more.

Level 2 strategy



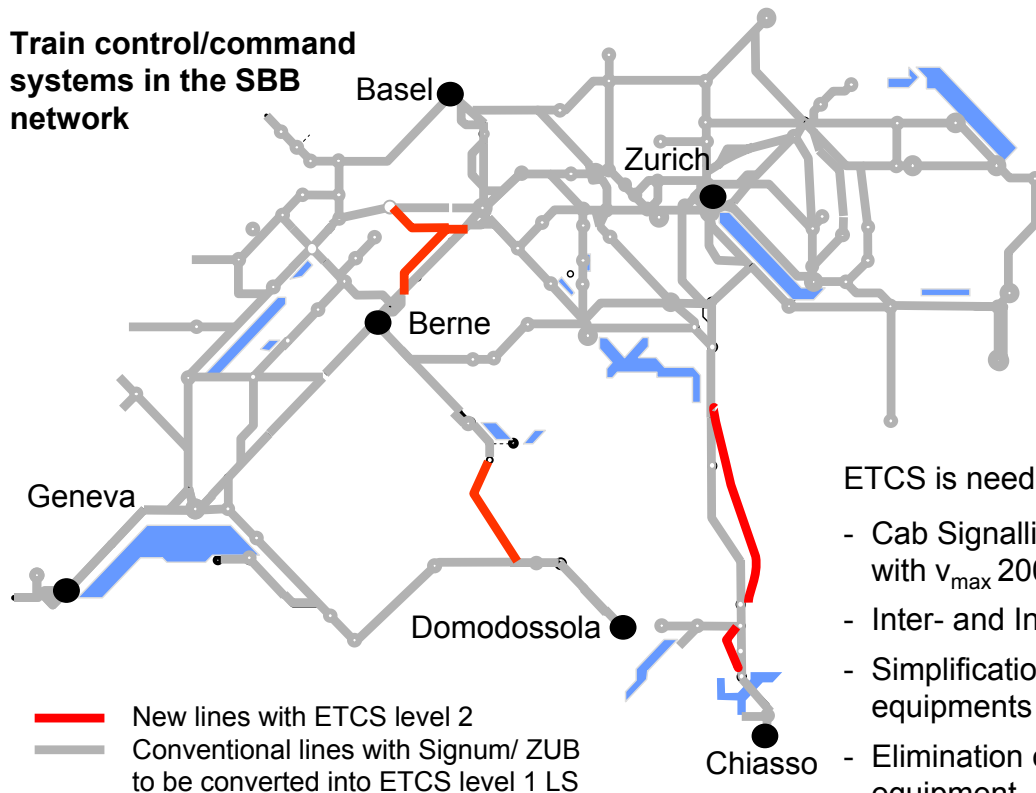
- *No line-side signals*
- *Use of GSM-R*
- *New interlocking or adaptation of existing interlocking*
- *No existing CC-system on track-side*

Level 2 is optimal for lines and stations with new signalling installations. Thereby, pure ETCS operation with cab signalling is recommended.

Migration to ETCS with mode Limited Supervision

Swiss ETCS migration strategy: target solution

Train control/command systems in the SBB network



ETCS is needed for:

- Cab Signalling on new lines with v_{max} 200-250 km/h
- Inter- and Intra-operability
- Simplification of onboard equipments
- Elimination of obsolete track equipment

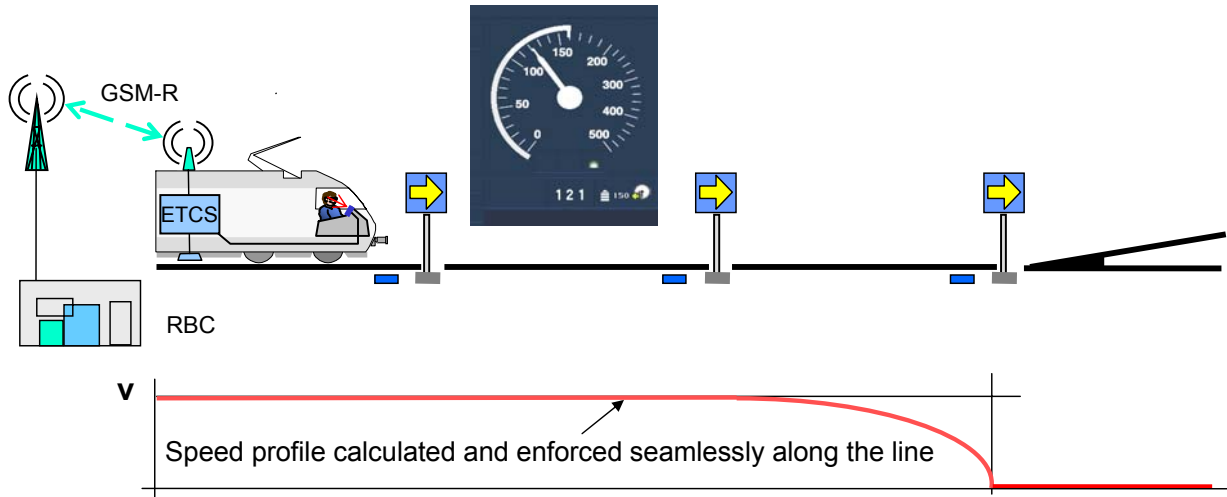
Migration to ETCS with mode Limited Supervision

Swiss ETCS migration strategy: ETCS on newly built lines

ETCS level 2 train operation in mode Full Supervision

More than 500 traction units are equipped with standard ETCS. When running on the ETCS level 2 lines, the legacy system is switched off. The driver gets all information from the DMI.

On trackside, fully safe (SIL4) ETCS-data are provided from the radio Block (via GSM-R) and fixed Eurobalises. No line-side signals or legacy fall-back control system exist.



Migration to ETCS with mode Limited Supervision

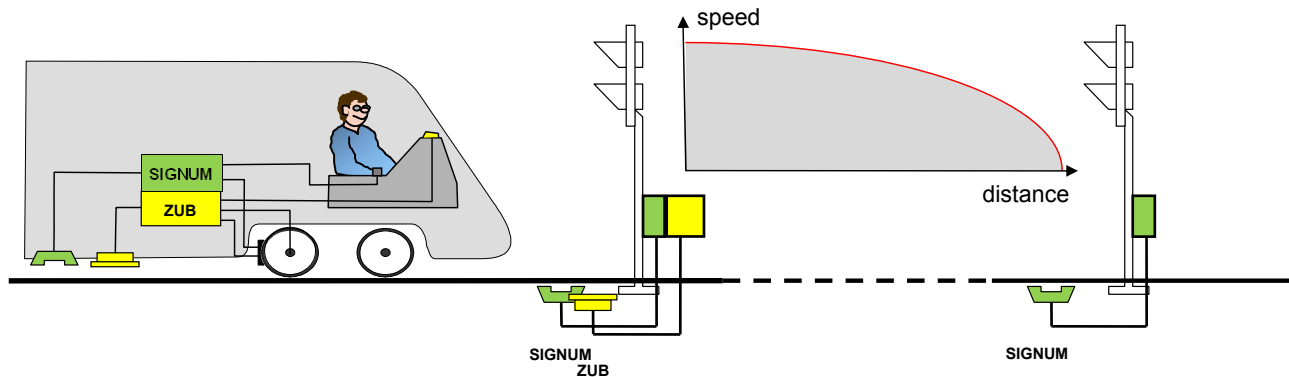
Swiss ETCS migration strategy: the Signum/ZUB legacy systems



All signals and traction units are equipped with the system Signum from the 1930ies which provides to the driver either a warning information or provokes an immediate stop.

Since 1990 the speed monitoring system ZUB 121 has been added on critical line sections and the major part of the traction unit fleet.

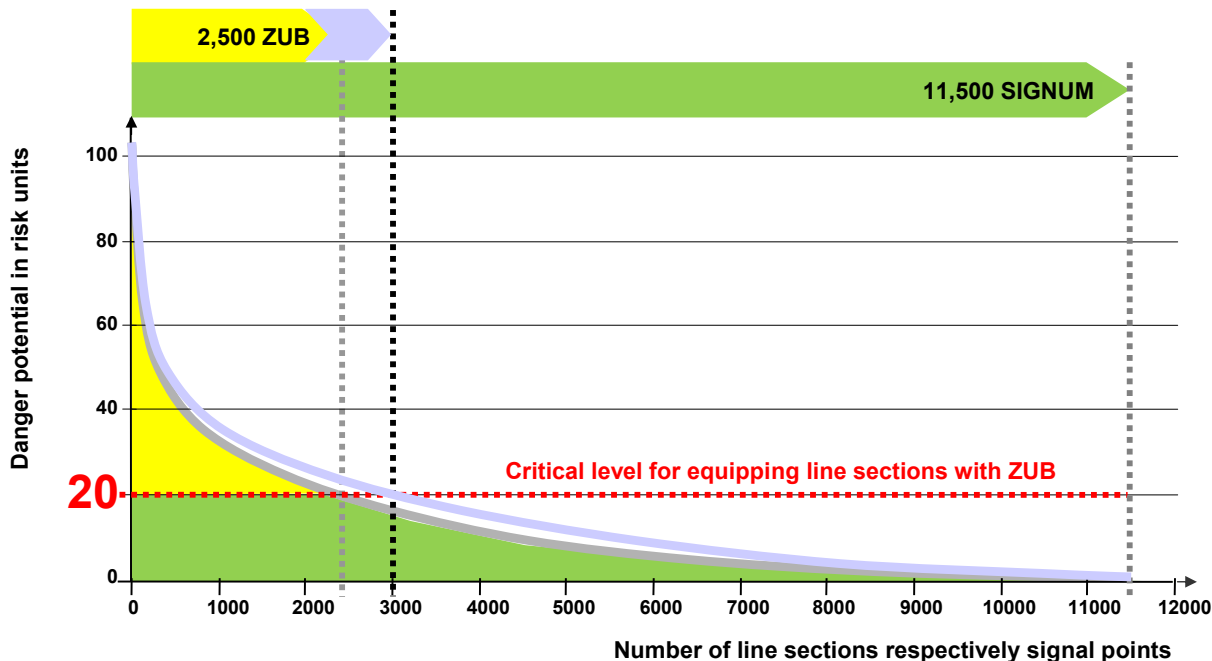
The track equipment of both systems is obsolete and needs to be replaced by state of the art technology.



Migration to ETCS with mode Limited Supervision

Swiss ETCS migration strategy: ZUB trackside deployment

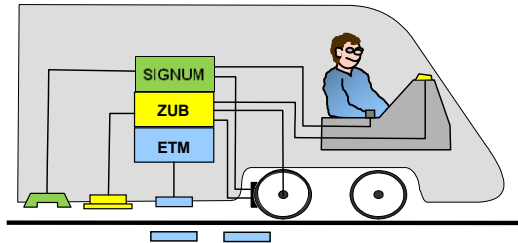
The Signals to be equipped with ZUB are determined by means of an analysis of the risk for passing the signal at danger and the probability of severe consequences . Currently an action for increasing the number of ZUB track devices from 2,500 to 3,000 is ongoing.



Migration to ETCS with mode Limited Supervision

Swiss ETCS migration strategy: Euro Signum/ZUB

In view of the equipment of all conventional lines and nodes with ETCS level 1, all traction units with ZUB and/or Signum (about 1'500) have been equipped with Eurobalise/Euroloop transmission units (ETM) including an interfacing device which extracts the national packet 44 from the standard ETCS telegram.



Eurobalise/Euroloop data transmission

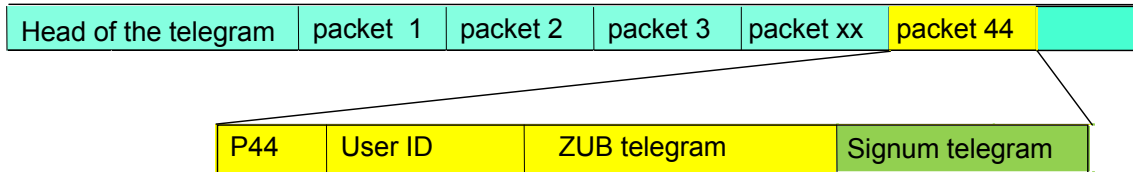


Eurobalise/Euroloop Transmission Module (ETM)



Antenna for Eurobalise/Euroloop and Eurobalise

Eurobalise telegram with packet 44 used for ZUB 121 and Signum

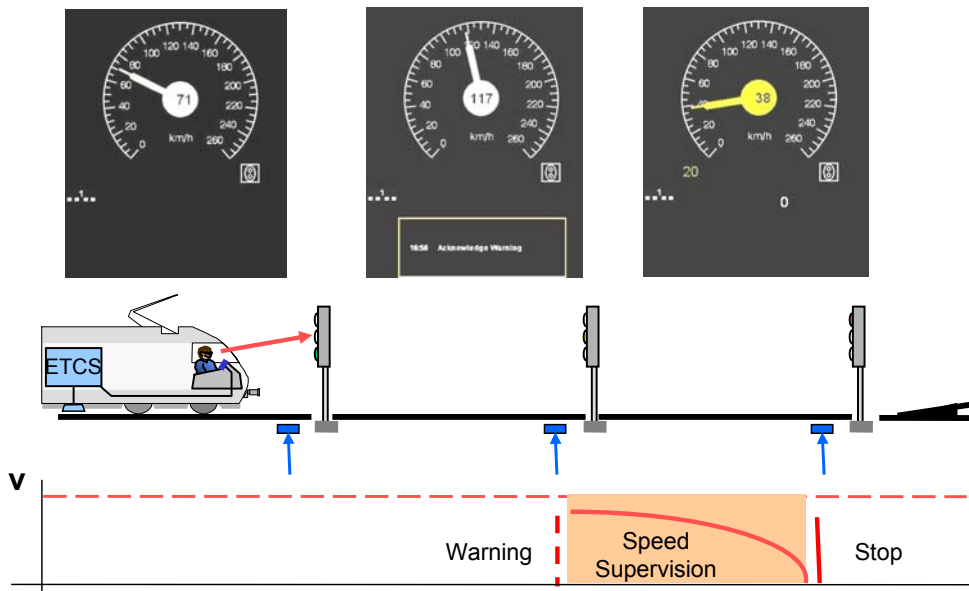


Migration to ETCS with mode Limited Supervision

Swiss ETCS migration strategy: Limited Supervision mode

ETCS level 1 train operation in mode Limited Supervision (LS)

The driver gets his target information from the line-side signals. Switchable Eurobalises at the line-side signals send ETCS telegrams for warning, stop and/or speed supervision to the ETCS on-board. The package 44 for Euro-Signum and ZUB is ignored.



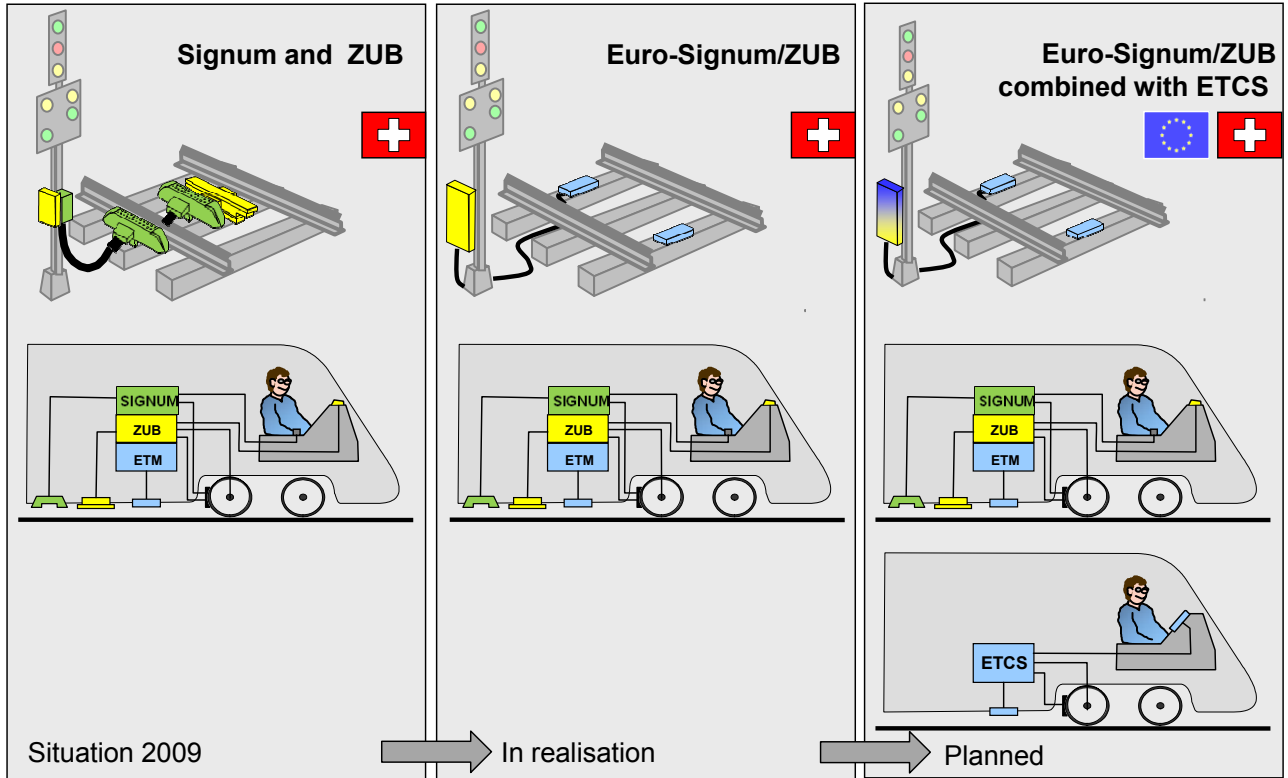
The DMI indicates basically only the real speed.

Warning messages are displayed on the ETCS DMI and must be acknowledged on the touch screen. Otherwise the train is tripped.

In case of speed supervision, the target value is indicated to the driver.

Migration to ETCS with mode Limited Supervision

Swiss ETCS migration strategy: phases for conventional lines



Migration to ETCS with mode Limited Supervision

Swiss ETCS migration strategy: Implementation programme

Implementation of ETCS on the complete Swiss normal gauge network

An important milestone for ETCS will be reached with the availability of ETCS Products according to the SRS baseline 3. Tests in Switzerland with pilot applications of Limited Supervision on-board and track-side show promising results.

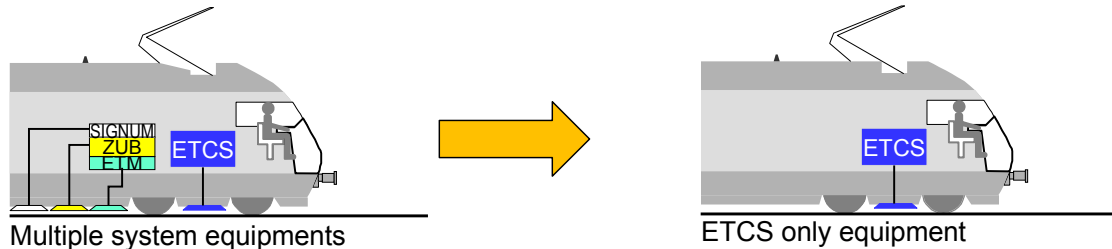
A programme has been established for introducing latest by 2017 ETCS level 1 on the complete conventional Swiss network. The new mode Limited supervision will allow to achieve this at reasonable cost by maintaining the high levels of safety and line capacity.



Migration to ETCS with mode Limited Supervision

Perspectives for ETCS with Limited Supervision mode

For **Switzerland** the adoption of the Limited Supervision (LS) mode allows to equip the whole normal gauge network by end 2017 with ETCS. Once this target is reached, pure ETCS equipment without parallel legacy systems will be sufficient for the trains and the legacy equipments will gradually disappear.



The lines which are part of **Corridor A** will even be ready for ETCS only train operation latest by 2015. It is remarkable that also the German and Italian railways envisage the adoption of Limited Supervision on parts of their corridor lines and nodes.

The LS approach is **basically applicable for all networks** using legacy systems with intermittent or semi continuous transmission devices. From a strategic point of view, LS is a medium term solution. It allows to build up the necessary fleet of ETCS equipped traction units what is a pre-condition for ETCS level 2 or level 3 train operation in the longer term.