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Energie und Kommunikation UVEK

Bundesamt für Verkehr BAV
Federal Office of Transport FOT

Swiss ERTMS Strategy

Edition 2023

Disclaimer:

This is an informal, partially automated translation of the Swiss ERTMS Strategy Edition 2023, created for the purpose of sharing the concept for ERTMS migration being pursued in Switzerland with international audiences. The target audience of this strategy is all stakeholders related to signalling systems in Switzerland.

For the binding text, refer to the ERTMS Strategy Edition 2023 in German on bav.admin.ch.

1 Introduction

The Swiss standard-gauge network is interoperable with Europe on the base of ETCS and GSM-R since 2018. With this, the most important goal defined by the FOT more than twenty years ago has been achieved.

In contrast to initial versions, developed by FOT and SBB in the early years of ERTMS, this ERTMS strategy for the train control system ETCS also takes into account the other command and control systems, such as interlocking and control technology, as well as the relevant peripheral systems, such as TMS and ATO. This also includes the system relevant digital data and voice communication technology: today GSM-R and FRMCS in future. All these elements do directly influence the performance of the railway system. Only a coordinated introduction of cab signalling, FRMCS, TMS or ATO will achieve the desired effects like reduction in complexity, improvement in performance and cost-effectiveness on both the trackside and on-board side.

The ERTMS strategy aims to address the greatest challenges in the implementation of ERTMS. Further fields of action, such as increasing the efficiency of railway operations through process automation (e. g. ATO), are therefore not explicitly addressed by the measures formulated in the strategy.

The ERTMS strategy applies to the interoperable Swiss standard gauge railway network. However, it cannot be ruled out that the implementation of the associated measures will have an impact on other areas of public transport. The FOT will keep an eye on the resulting consequences. The information from the implementation of the measures should be available for all areas of public transport.

The original ERTMS strategy was created in 2021 (see chapter 2). This document deals with its update in 2023 (see chapter 3).

2 ERTMS Strategy ed. 2021

The 2021 ERTMS strategy published by the FOT established that the operational suitability of ETCS has been proven for both line side and cab signalling. In addition, it defined how and where ERTMS/ETCS should develop in the interoperable Swiss standard gauge network by means of a long-term objective and a catalogue of measures. At that point of time, relevant optimisation potential was identified in the following areas:

- Rollout capability/scalability of cab signalling (economic efficiency through industrialisation),
- Modelling of the braking characteristics of trains, in particular freight trains,
- Cost of software and hardware upgrades for ETCS rolling stock equipment,
- Increase of capacity in nodes,
- Elimination of Class B systems on the cross-border lines,
- Simple control and better protection of shunting movements and construction sites,
- Retention of expertise among railway companies and industry.

Since then, the sector did institutionalise the so-called ERTMS forum for joint cooperation and coordination in the implementation of the ERTMS strategy.

3 ERTMS Strategy ed. 2023

The FOT assessed the implementation status of the ERTMS strategy at the beginning of 2023 (see Figure 1), involving the sector including the industry, and among other things taking into account the fact that the EU focuses on the implementation of cab signalling based on ETCS L2. This assessment confirmed the correctness of the path set in 2021. Nevertheless, a need for further action did emerge, particularly in the following areas:

- Forcefully implement cab signalling on the base of a deployment plan (see Figure 2),
- Create the prerequisites for the use of cab signalling in large nodes,
- Standardise the system landscape in coordination with expansion steps,

- Digitise and industrialise project planning and execution, and testing processes, particularly on the part of the IM,
- Focus on interoperable solutions and foreseeable innovation steps not too far in the future.

For this reason, the long-term objective (see Chapter 4) and some of the measures (see Appendix A) were tightened, supplemented or deleted. Appendix B shows the list the adjustments in more detail.

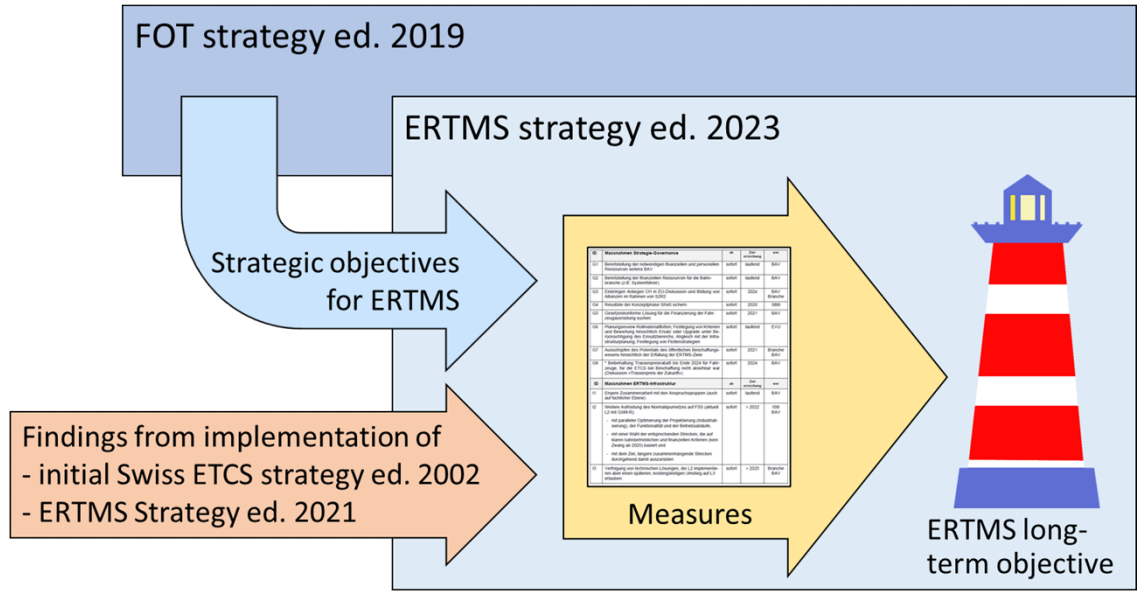

Figure 1: The ERTMS strategy works towards the optimisation of ERTMS / ETCS. Strategic ERTMS objectives[1] were derived from the FOT strategy[2] and apply unchanged in the ERTMS strategy ed. 2023.

[1] The strategic ERTMS objectives refer to topics on capacity, compatibility with Europe, costs, RAM, safety and innovations. See next footnote.

[2] Available in German, French and Italian. See http://www.bav.admin.ch → «Das BAV» → «Strategie»

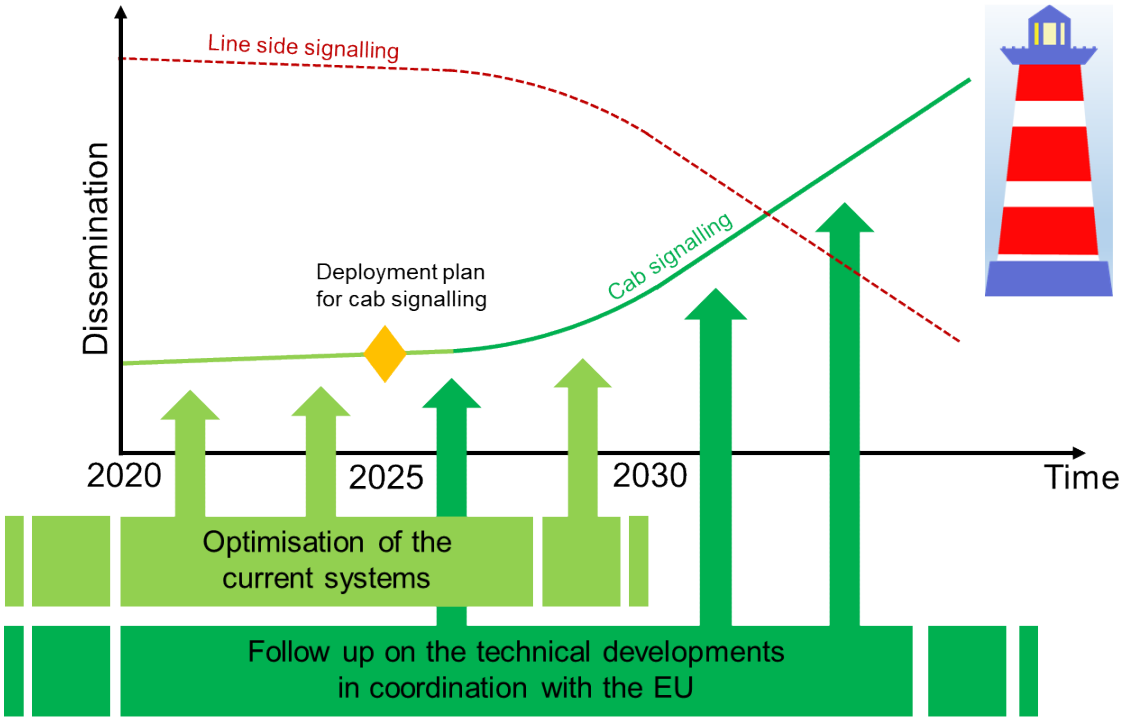

Figure 2: The ERTMS strategy ed. 2023 now calls for a deployment plan for cab signalling by 2025 and continued close coordination and alignment with European developments (DG MOVE, ERA, EU Rail).

4 ERTMS long-term objective ed. 2023

ERTMS will have contributed to the implementation of the FOT strategy and meets the needs of the stakeholders, essentially in terms of safety, high or improved capacity particularly in nodes, high availability, controllability of the overall system, lower costs per kilometre and interoperability.

ERTMS cab signalling will have been deployed network-wide on the base of a deployment plan with clear criteria for the infrastructure and vehicles, coordinated with the stakeholders. Optimisation opportunities will have been implemented through the cooperation of all stakeholders (in particular the railways, the industry and the relevant EU bodies) and taking into account the national boundary conditions and requirements.

The deployment will have been coordinated with the peripheral systems of cab signalling (e. g. TMS, ATO). It will also have included FRMCS succeeding GSM-R, forming the future base for mobile and operationally relevant data and voice communication (train radio).

During implementation, procurement and financing modalities of the infrastructure as well as of vehicles are taken into account with a specific focus on the use of mature products.

The implemented cab signalling based on ERTMS will provide the potential for further long-term continuous developments. Switzerland will actively cooperate with the EU and contribute in order to shape a uniform railway system.

5 Implementation and organisation

The FOT directs and coordinates the achievement of the ERTMS long-term objective through the catalogue of measures (see Annex A).

With their deployment plan and the resulting projects, the railways and industry ensure that the ERTMS long-term objective is achieved. The ETCS and train communication system management organisations support this work within the framework of the mandates received from the FOT.

All key leaders will report periodically to the FOT on the current status of the implementation of their measures.

Appendix A: Catalogue of measures to achieve the ERTMS long-term objective

The following table presents the measures to be implemented to achieve the ERTMS long-term objective. They are summarised in the following categories: governance (G), ERTMS infrastructure (I), ERTMS vehicle equipment (F) and technology (T).

ID	Measure	Deadline	Key leader	Contributors	Comment / Change since ERTMS strategy edition 2021
G1	The FOT's internal financial and human resources need to be allocated.	continuous	FOT	-	This measure remains unchanged.
G2	The funding for the digitalisation in the domain of ERTMS, the rollout of cab signalling and the vehicle equipment has to be developed.	continuous	FOT	-	Funding and deployment plan for cab signalling (see measure I2) must be aligned. An high-level programme monitoring has to be set up. The FOT finances the necessary investments in railway infrastructure and vehicles within the framework of the following existing instruments: – for the renewal of trackside and vehicles of the IM: service agreement for funding[3] for the operation and maintenance of the railway infrastructure; – for infrastructure expansion projects: funds for the expansion projects; – for vehicles related to regional passenger traffic: usual funds based on passenger traffic agreements with the regions. The equipment of long-distance and freight vehicles is financed by the RU as part of their modernisation. By 2026, the FOT will examine whether additional ERTMS-specific, pro rata additional financing is possible for the vehicles as part of a temporary system authority from 2029 on. This measure was specified for the reasons mentioned above.
G3	Participation in EU programmes and dedicated bodies. In doing so, alliances must be formed to support Switzerland's requests. The resulting European regulation shall take into account in a balanced manner the interoperability on the one hand, and the needs of the Swiss railway system on the other. Switzerland's specific requests focus on maintaining and increasing the efficiency and feasibility of cab signalling.	continuous	FOT with SA ETCS and SA Traincom	IM, RU, industry	The FOT and the sector represent Switzerland's interests in the various dedicated committees and programmes of the EU (in particular SBB within the framework of EU Rail) with the objective of an efficient Swiss rail system that can be further developed. As part of its support for these projects, the FOT exerts influence to ensure that priority is given to urgent, implementable harmonisation issues rather than visionary projects. Without Europe-wide harmonisation of operating processes, no relevant progress can be expected in terms of reducing system diversity, economies of scale for the migration to cab signalling and costs.

[3] the service agreements are four-year contracts between the FOT and the IM (in German called Dienstleistungsvereinbarung)

ID	Measure	Deadline	Key leader	Contributors	Comment / Change since ERTMS strategy edition 2021
	In addition, special attention must be paid to the harmonisation of operating processes at European level. Within the sector, it must be ensured that the harmonisation represented in the EU will be accepted and implemented in Switzerland.				To ensure sufficient time for the migration to cab signalling, Switzerland promotes in the European committees that the conditions for operation of ETCS L1 LS stay in place for long time enough (validity of the specifications, acceptance of the relevant NNTV). This measure was extended for the reasons mentioned above.
G4	*deleted*				The measure to secure the results of the Smartrail 4.0 programme's concept phase was implemented and thus deleted. Findings from this concept phase will flow into EU Rail.
G5	*deleted*				The measure on financing vehicle equipment has been deleted. Its content was merged into measure G2.
G6	The criteria for the replacement or upgrade of vehicle equipment must be defined taking into account the area of use and the infrastructure planning, in alignment with the ERTMS strategy. They must be taken into account in the design of the fleet strategy.	until 2024	RU and vhc owners	IM	The retrofit of the ZUB (Class B system) vehicles has to be aligned with the deployment plan for cab signalling (see measure I2). The deadline for implementing this measure has been extended to 2024.
G7	The potential of the revised public procurement law has to be exploited.	from 2021	IM and RU	-	The revised procurement law provides for example improvements in handling framework agreements. This measure remains unchanged.
G8	The track access charge discount for vehicles for which ETCS was not foreseeable at the time of procurement is to be maintained until the end of 2024.	until 2024	FOT	-	This measure was shortened because part of it was fulfilled.
I1	All stakeholders must work closely together, also on a technical level, and must be actively involved in the exchange of information.	continuous	all	-	The broadest possible involvement of the stakeholders (e. g. cargo RU and train drivers) should be encouraged so that developments are widely supported. This is the responsibility of everyone involved. This measure including key leader has been extended.
I2	New lines and renewals are realised with cab signalling. Line side signalling will only be implemented in justified exceptional cases. A binding deployment plan of cab signalling for the interoperable main and supplementary network must be developed by 2025.	from 2023	IM	FOT RU, industry, SA ETCS, SA Traincom	The following topics are to be addressed in the deployment plan for cab signalling: – Equipping larger perimeters (entire lines or sub-networks) enables synergies, economies of scale and finally optimisations of financial, operational and technical nature. – The deployment plan is to be based on criteria first to be defined, such as the type of line (corridor, interoperable main network, interoperable supplementary network). These criteria also regulate the handling of exceptions.

ID	Measure	Deadline	Key leader	Contributors	Comment / Change since ERTMS strategy edition 2021
					– The interaction with the equipment status of the vehicles and the replacement of GSM-R by FRMCS are relevant. – The allocation of tasks between industry and the railways and the depth of processing by the railways is to be challenged. – ETCS L1 LS is not being further developed at European level and will therefore not continue to exist in the long term as it is not actively supported by any EU country. ZUB and SIGNUM also have no long-term existence. For linesstill being implemented with line side signalling instead of ERTMS, measures must be taken before the end of the lifespan so that a subsequent conversion to cab signalling can be realised with minimum effort. This measure has been tightened up and supplemented with the deployment plan.
I3	Technical solutions that implement cab signalling with fixed signal sections and train detection systems, but allow a later, cost-effective switch to moving block sections without train detection system, should be pursued. This also includes hybrid solutions.	continuous	industry	IM, RU	Future-proof solutions are to be planned and realised that enable investment protection, evolutionary, interoperable further developments and realistically implementable rollout concepts in Switzerland. This measure was reformulated because in the new TSI 2023, the designation L2 includes the former designations L2 and L3.
I4	The development of FRMCS must be monitored for the purpose of timely planning for the replacement of GSM-R.	continuous	SA TrainCom	IM, RU, industry, vhc owners, SA ETCS	It is assumed that GSM-R will be decommissioned network-wide around 2035. This measure is related to measure F3. It was shortened because it has been clarified that GPRS is not an appropriate solution as an intermediate step until the implementation of FRMCS in Switzerland.
I5	The development of technology that allows moving block sections and the elimination of train detection systems in cab signalling areas are to be monitored.	continuous	IM with SA ETCS	alle	L2 with fixed signalling sections and train detection systems is currently being implemented throughout Europe. The potential of moving block sections and the elimination of train detection systems should be exploited when the technology is mature and can be used profitably in Switzerland. This measure was reformulated because with in new TSI 2023, the designation L2 includes the former designations L2 and L3.
I6	Also, cross-border lines on Swiss territory and in neighbouring countries shall aim at using ERTMS. It must be ensured that there are no undesirable repercussions for Switzerland.	continuous	SBB I with FOT	RU	The technical and operational complexity on the cross-border lines is high. There are still trackside Class B systems from neighbouring countries installed at many places. There are dependencies with the rolling stock strategies of the foreign railway undertakings, which operate the cross-border lines with vehicles that are only equipped with Class B systems. This measure is related to measure F10. It has been reformulated for better understanding.

ID	Measure	Deadline	Key leader	Contributors	Comment / Change since ERTMS strategy edition 2021
I7	*deleted*				The ERTMS strategy aims to equip and further develop the interoperable main and supplementary network in accordance with the TSI. The requirement that TSI-compliant vehicles must be able to travel over the lines of the supplementary network (Art. 15a Para. 2 EBV and Annex 6 EBV) continues to apply without restriction. This measure was deleted for the reasons mentioned above.
I8	Cab signalling and FRMCS must be implemented network-wide.	continuous	IM	RU, SA ETCS, SA Traincom	This measure was formulated solution agnostic and is linked to the deployment plan for cab signalling in terms of deadline (see measure I2).
I9	The potential of the existing systems for high-quality railway production is to be exploited. High priority must be given to standardisation and reduction of the overall systems complexity. Optimisations at product and system level must support standardisation and reduction of the overall systems complexity.	continuous	IM with SA ETCS	RU, industry	Selective, product-specific optimisations often lead to undesirable and further complication of the overall system. This measure was tightened up for the reason mentioned above and the deadline for its implementation was adjusted to "continuous".
I10	Optimisations in the areas of vehicle odometry and braking curves must be investigated and implemented.	end’ 2024	SBB I with SA ETCS	IM, industry	Significant optimisations in the areas of vehicle odometry and braking curves are key elements for a powerful, robust and further developable ERTMS. This measure is related to measure F1 and remains unchanged.
I11	The design engineering, planning and testing processes for signalling systems (related to cab signalling and including vehicle equipment) must be streamlined and accelerated. In particular, industrialisation and digitalisation is to be implemented on the part of the IM.	continuous	IM, RU	industry, FOT	The design engineering, project planning and testing processes for signalling systems must be industrialised and digitalised. Focus must be at comprehensiveness end-to-end (e. g. prevention of media gaps) so that projects can be carried out much more efficiently. It should be taken into account that most of the trackside costs are currently occurring at the level of the IM. This measure has been newly created for the reasons mentioned above.
F1	Optimisations in the areas of vehicle odometry, braking curves and upgradeability are to be investigated and implemented.	until 2024	SBB P with SA ETCS	RU, vhc owners, industry	This measure is related to measure I10 and applies unchanged.
F2	Technical solutions for optimising the vehicle architecture (e. g. OCORA, TOBA) must be pursued, taking into account the actual availability of the FRMCS.	continuous	RU, vhc owner	industry, IM	For this measure, the previously open key leader and the contributors involved have been adjusted.
F3	The development of the FRMCS and the coordination with its trackside use must be actively monitored.	continuous	SA Traincom	IM, RU	This measure is related to measure I4 and applies unchanged.

ID	Measure	Deadline	Key leader	Contributors	Comment / Change since ERTMS strategy edition 2021
F4	New vehicles must be equipped with the TSI-compliant ETCS Baseline 3 or higher and must be equipped with GSM-R or FRMCS as soon as available.	from 2014	vhc owners	IM, RU	The planned development activities in this area were included in this measure.
F5	*deleted*				This measure on vehicles equipped with ZUB (Class B) was deleted because it does not promote the implementation of the ERTMS strategy. Its initial content is covered by measure G6.
F6	Any necessary replacement of vehicle equipment must be carried out with ETCS Baseline 3 or higher and with GSM-R or, as soon as available, with FRMCS. Exceptions are possible in justified cases.	from 2014	vhc owners	IM, RU	The planned developments were included in this measure.
F7	*deleted*				This measure on NNTVs was deleted because its content does not have to persist in a measure and is mentioned in the explanations for measure G3.
F8	Vehicle equipment compatible with FRMCS and GSM-R is to be used as soon as it is available.	continuous	vhc owners	RU	To enable migration, bi-standard radio equipment has to be used as soon as available. The deadline has been specified.
F9	Developments in the field of freight train braking technology and automatic coupling must be pushed forward.	continuous	FOT	RU, vhc owners, industry	This measure complements the optimisations targeted in measures I10 and F1. TSI-compatible solutions are required for the automatic coupling. The deadline and the key leader were specified.
F10	A binding plan must be developed to enforce the decommissioning of foreign Class B train control systems on cross-border lines from 2025 onwards.	until 2024	FOT	IM, RU, vhc owners	This measure is related to measure I6 and applies unchanged.
F11	*deleted*				The 2G roaming measure has been deleted because it has been implemented. The upcoming migration from 3G to 4G is not relevant to the strategy.
F12	The causes of the high costs for equipping vehicles with ERTMS and, in particular, for software and hardware upgrades of the ETCS must be analysed thoroughly. The cost drivers must be identified and the relevant cost reduction measures implemented.	until 2024	FOT	SA ETCS, RU, industry	This measure has been newly created because the high cost of vehicle equipment is assessed as a major obstacle to the introduction of ERTMS.
T1	*deleted*				The TSIs only allow ATO in conjunction with cab signalling. Sufficient expansion of cab signalling is therefore a prerequisite so that ATO can realise its benefits.

ID	Measure	Deadline	Key leader	Contributors	Comment / Change since ERTMS strategy edition 2021
					This measure is therefore not a priority for the strategy and has been deleted for the reasons mentioned above.
T2	New developments for construction site safety and shunting operations must be introduced, at a good cost/benefit ratio and without disrupting interoperability. Activities to improve the organisational aspects must be continued.	continuous	IM	RU	Construction sites must be managed safely, must not restrict interoperability and should minimise their impact on the capacity of the network. TSI-compliant vehicles must be able to shunt on the interoperable network where necessary. The deadline for the implementation of measures has been adjusted to "continuous".
T3	The TMS is part of ERTMS. The potential and characteristics of cab signalling must be taken into account in the TMS. Mutual requirements must therefore be determined and harmonised.	continuous	SBB I	IM, RU	In coordination with the deployment plan for cab signalling (see measure I2), the TMS must be able to realise the potential of cab signalling. The development of the necessary functionalities must therefore be initiated in a timely manner. Attention must be paid to data consistency (including open interfaces) for other public transport providers and to congruence with developments in EU Rail. This measure has been tightened for the reasons mentioned above. Deadline and key leader have been specified.
T4	The technical and operational requirements for the use of cab signalling in large nodes must be analysed comprehensively and in the near term. The optimisations required must then be implemented.	until 2024	SA ETCS with SA Traincom	IM, RU	The potential for simplifying railway production must be examined in detail. This measure has been newly created to eliminate the existing uncertainties with respect to node capacity.
T5	By applying sub-network and line concepts, the renewal of the signalling systems and the expansion steps must be coordinated in such a way that a homogeneous use of technologies and products for the signalling system is achieved and the number of interfaces is reduced.	continuous	IM	industry, FOT	In order to eliminate the current "patchwork" of signalling system technologies, the priority must be on renewing larger areas. This will enable economies of scale. During implementation, consideration must be given to protection of investment for trackside and vehicles. This measure has been newly created and is linked to the deployment plan for cab signalling (see measure I2).

Supplementary explanation for the table

The following conventions apply to identify the measures:

- Measures that continue to exist in the ERMTS strategy ed. 2023 keep the ID issued in the ERTMS strategy ed. 2021, regardless of whether they have been revised or not.
- The IDs of deleted measures are no longer used, but are still visible.
- New measures receive a new ID.

The catalogue of measures in the ERTMS strategy ed. 2023 has been supplemented with explanatory notes. These explain the content of the measures and/or the changes compared to the ERTMS strategy ed. 2021.

Appendix B: List of changes

Edition 2021: First edition

Edition 2023: A status review in 2023 led to a revision of the long-term objectives and the catalogue of measures. Among other things, the following changes were made:

- New or renewed trackside systems must be realised with cab signalling. Line side signalling may only be used in justified exceptional cases. A binding deployment plan of cab signalling must be developed by 2025.
- The ERTMS strategy allows only TSI-compliant solutions. TSI-compliant vehicles must continue to be able to travel on the interoperable supplementary network without restriction.
- Renewals of the signalling systems and upcoming new lines must be coordinated in order to purge the signalling system landscape in the future.
- The optimisations to exploit the potential of the existing systems must not lead to an increase in the complexity of the overall system.
- Design engineering, project planning and testing processes for the signalling systems (especially cab signalling) must be simplified and accelerated, particularly on the part of the IM.
- The requirements for the use of cab signalling in large nodes must be analysed comprehensively and promptly.
- Participation in EU programmes and specialist bodies must focus on specific issues relating to maintaining and increasing the capacity of the line and the feasibility of cab signalling.
- All stakeholders must be actively involved in the exchange of information (including cargo RU and train drivers).
- Supplementary explanations for each measure help all stakeholders to better understand and categorise them in the overall context of the ERTMS strategy.

Appendix C: List of abbreviations/glossary

Abbreviation	Description
2G	2nd generation digital mobile communications standard (GSM and GSM-R)
3G	3rd generation digital mobile communications standard (UMTS)
4G	4th generation digital mobile communications standard (LTE)
5G	5th generation digital mobile communications standard
ATO	Automatic Train Operation
BAV	Bundesamt für Verkehr – Federal Office of Transportation (FOT) The FOT is the supervisory authority responsible for public transport in Switzerland (railways, cableways, ships, trams and buses). Large areas of freight transport also fall within the FOT's remit. The FOT is responsible for safety, finance and infrastructure, as well as the legal and political frameworks of public and freight transport.
Class B	Country-specific, non-interoperable train control systems. In Switzerland, these are SIGNUM and ZUB.
DG MOVE	Directorate-General for Mobility and Transport
ERA	European Union Agency for Railways
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
EU	European Union
EU-Rail	Joint undertaking for Europe's railways / Europe's Rail, ERJU
FOT	Swiss Federal Office of Transport (Bundesamt für Verkehr BAV, Office fédéral des tranports OFT, Uffizio federale dei trasporti UFT)
FRMCS	Future Railway Mobile Communication System – new digital mobile communication system, currently under development. The first version will integrate the 5G standard.
Cab signalling	Driver's cab signalling without active optical signals (with exceptions such as the shunting signals for L2 in Switzerland). Can be realised with ETCS L1 full supervision (not with L1 LS), L2 or proprietary systems (LZB, TVM, CBTC, etc.). In Switzerland, cab signalling on standard-gauge railways is implemented exclusively using ETCS L2.
GSM	Global System for Mobile Communications (2G)
GSM-R	Global System for Mobile Communications for Railways
IM	Infrastructure Manager
L1 LS	ETCS Level 1 Limited Supervision. Interoperable replacement for Class B systems (in Switzerland SIGNUM and ZUB).
L2	ETCS Level 2 Full Supervision. Driver's cab signalling. Can consist of systems with fixed signalling sections and train detection systems (formerly known as L2), as well as systems with moving block and without train detection systems (formerly known as L3), as well as hybrid systems. From TSI 2023 on, L2 includes both the former L2 and L3.
NNTR NNTV	Notified National Technical Rule Notifizierte Nationale Technische Vorschrift
OCORA	Open CCS On-board Reference Architecture
RAM/S	Reliability, Availability, Maintainability, Safety (Zuverlässigkeit, Verfügbarkeit, Instandhaltbarkeit, Sicherheit)

Abbreviation	Description
RU	Railway undertaking
SBB	Schweizerische Bundesbahnen / Swiss Federal Railways
SA	System Authority conducting technical engineering works on a particular topical area on behalf of FOT
SA ETCS	System Authority for ETCS conducting technical engineering works on behalf of FOT
SA TrainCom	System Authority on train communication (FRMCS and GSM-R) conducting technical engineering works on behalf of FOT
SIGNUM	National Train control system (local train protection system without braking curve monitoring)
SR40	Smartrail 4.0
TMS	Traffic Management System.
TSI	Technical Specification for Interoperability
TOBA	Telecom on-board architecture
vhc owner	Vehicle owner
ZUB	National train control system (local train protection system with braking curve monitoring)