HUNGARY

NATIONAL IMPLEMENTATION PLAN

TRAIN CONTROL / CCS TSI

INNOVÁCIÓS ÉS TECHNOLÓGIAI
MINISZTÉRIUM

MINISTRY OF INNOVATION AND TECHNOLOGY
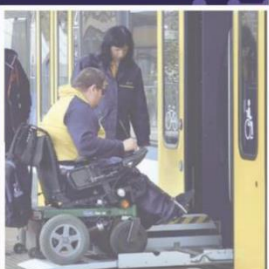
2020

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TO ACHIEVE COMPLIANCE WITH THE TECHNICAL SPECIFICATIONS FOR INTEROPERABILITY RELATING TO THE 'CONTROL-COMMAND AND SIGNALLING' SUBSYSTEM OF THE RAIL SYSTEM IN THE EUROPEAN UNION

1. Introduction

The European Implementation Plan for the European Rail Traffic Management System (ERTMS) aims to ensure the interoperability of the European rail network so that railway vehicles equipped with ERTMS gradually have access to more and more lines, terminals and marshalling yards. The implementation plan for the Hungarian core network corridors (see Chapter 1.1) also covers stations, junctions, airports and railway/road terminals, as well as their connections and infrastructure components.

European Member States have not yet achieved technical interoperability compliance. The reason is that they had already introduced national or other project-specific solutions.

On cross-border sections, infrastructure managers cooperate with each other simultaneously and in a technically consistent manner to install and place into service ERTMS. After consulting the railway undertakings concerned, infrastructure managers sign an agreement on the technical and operational details of the implementation of each cross-border section. The infrastructure managers conclude this agreement for each cross-border section at the latest one year before the previous implementation deadline. This agreement must include transitional provisions, taking into account the cross-border operations of railway undertakings.

The TSI for control-command and signalling subsystems sets out only the requirements that are essential to ensure the interoperability of the EU rail system and compliance with the essential requirements. The control-command and signalling subsystems consist of the following parts:

- voice radio communication;
- data radio communication;
- train detection;
- train protection.

2. Legal background

Article 11 of Regulation (EU) No 1315/2013 of the European Parliament and of the Council on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU ('Regulation (EU) No 1315/2013') lists the infrastructure components that are essential to achieve the interoperability of the European rail network.

A key precondition for the implementation of ERTMS is full compliance with Commission Regulation (EU) 2016/919 on the technical specification for interoperability relating to the 'control-command and signalling' subsystems of the rail system in the European Union ('Regulation 2016/919'). For the trackside implementation of ERTMS, the requirements referred to in Annex A to Regulation (EU) 2016/919 must be applied by Member States jointly, which will ensure compatibility with the ERTMS on-board units.

According to Commission Implementing Regulation (EU) 2017/6 on the European Rail Traffic

Management System European deployment plan ('Implementing Regulation 2017/6'), the trackside implementing rules are complementary to the on-board implementation rules set out in Regulation (EU) 2016/919, it is therefore necessary to adapt the ERTMS European Implementation Plan to the technical specifications for interoperability relating to the 'control-command and signalling' subsystems contained in the Regulation concerned. The rail freight corridors within the meaning of Regulation (EU) No 913/2010 of the European Parliament and of the Council1 can also play a crucial role in the implementation of ERTMS on cross-border sections. Coordinating cross-border implementation is an important element of business plans of railway undertakings. According to this Regulation, the infrastructure managers concerned (in Hungary, MÁV Magyar Államvasutak Zrt., 'MÁV', and GYSEV - Győr-Sopron-Ebenfurti Vasút Zrt., 'GYSEV', are involved in the sections of the European railway corridors) must sign an agreement setting out the implementation dates and technical solutions.

Regulation (EU) No 913/2010 requires that, in accordance with the specific implementing rules of the European Train Control System (ETCS) related to trackside equipment, infrastructure managers must equip the core network corridors with ERTMS and, no later than the date specified in the Annex to the above Regulation, ERTMS – including railway stations and junctions – must be placed into service on these corridors. Railway connections in the core network corridor for the elements listed in Annex II to Regulation (EU) No 1315/2013 and related to the infrastructure components referred to in Article 11 of that Regulation must be installed and put into service by the deadline set for each core network corridor section. A core network corridor can be considered to be equipped with ERTMS if, in accordance with Article 15 of Directive 2008/57/EC of the European Parliament and of the Council on the interoperability of the rail system within the Community ('Directive 2008/57/EC') and Article 18 of Directive (EU) 2016/797 of the European Parliament and of the Council of on the interoperability of the rail system within the European Union,2 the deployment of ERTMS is authorized at national level in accordance with the Directive, allowing passenger and freight traffic in both directions and on sidings.

On cross-border sections, the infrastructure managers may choose to maintain Class B systems as set out in paragraph 2.2 of the Annex to Commission Regulation (EU) 2016/919 on the technical specification for interoperability relating to the 'control-command and signalling' subsystems of the rail system in the European Union ('Commission Regulation (EU) 2016/919'). At the same time, for vehicles equipped with an ERTMS version compatible with trackside equipment according to paragraph 1.1 of the Annex to Regulation 2016/919,

by the end of the deadlines set out in Annex I, access to those lines and to infrastructure components in accordance with Article 11 of Regulation (EU) No 1315/2013 must be provided without the need to be equipped with Class B systems.

3. Overview of components and characteristics of ERTMS

ERTMS consists of three parts. ETML covers management and traffic management level tasks, GSM-R provides mobile radio communication network coverage for railway communication (voice and data communication) and ETCS covers safety-oriented areas (train detection, train protection). The GSM-R and ETCS systems are two important elements of the integrated European rail traffic management system.

The Class A train protection system is ETCS, and the Class A radio system is GSM-R. For Class A

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[1] REGULATION (EU) No 913/2010 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 September 2010 concerning a European rail network for competitive freight
[2] DIRECTIVE (EU) 2016/797 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 May 2016 on the interoperability of the rail system within the European Union (recast)

train detection, the TSI contains only the requirements for the interface with other subsystems. In the case of the trans-European rail system, Class B systems are the limited number of legacy train protection systems that were in use on the trans-European rail system before 20 April 2001. In the case of other parts of the European Union rail system, Class B systems are the limited number of legacy train protection systems that were in use before 1 July 2015.

The GSM-R network basically consists of two parts: the core network and the radio network. The core network provides control over network resources, establishment and disconnection of calls, provision of services necessary for operation, user databases and gateways to certain network elements and external networks. The core network, in particular with regard to operational safety and availability, for railway applications is designed in a georedundant way. Two such networks had been implemented in Hungary by the end of 2018. One in Budapest on Horog Street, the other in Székesfehérvár in the building of the railway station.
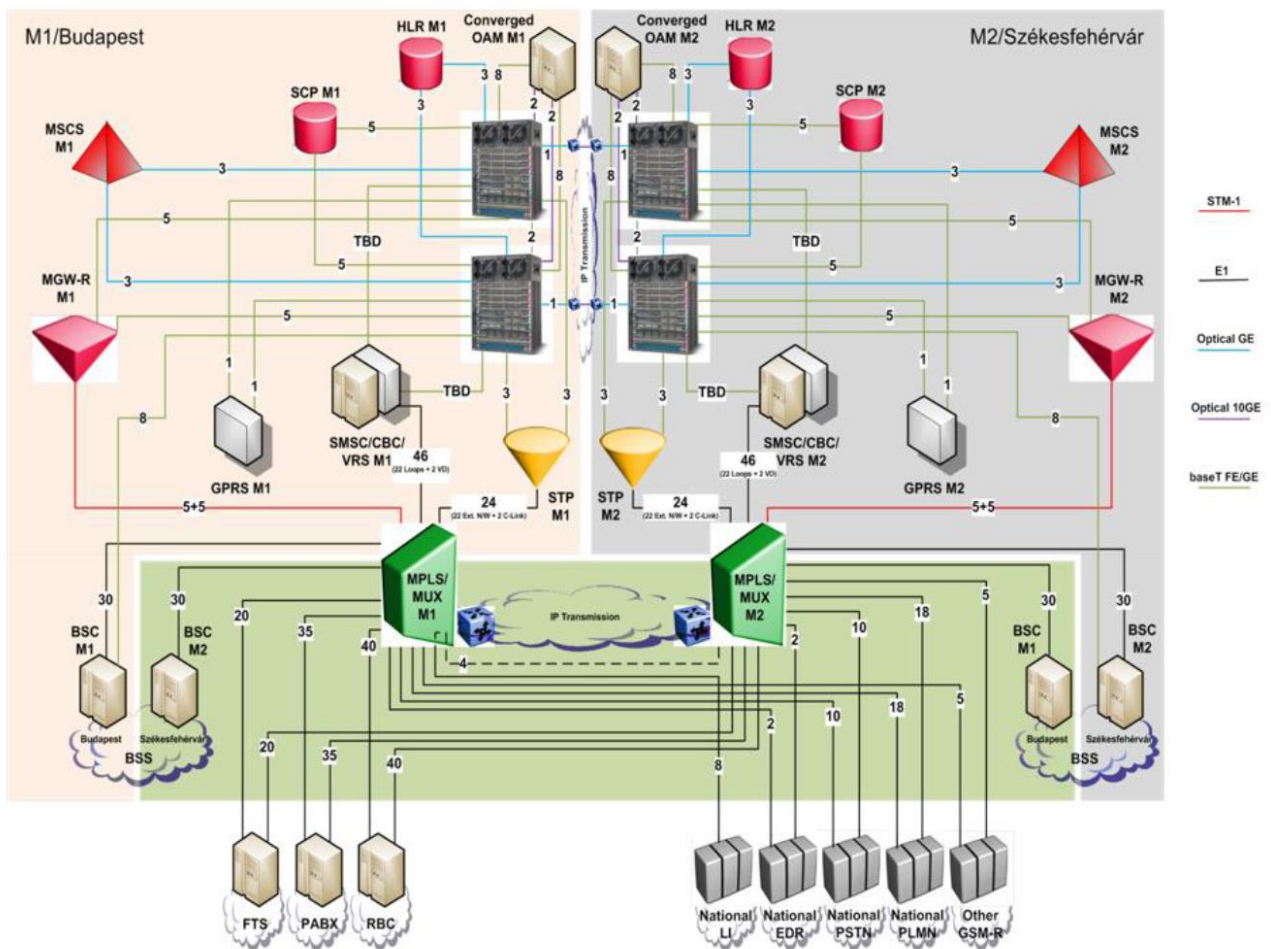
Figure 1. System diagram of geo-redundant design of the GSM-R core network (source: Kapsch)

The GSM-R radio network has two levels: level R1 provides single radio coverage (there is no redundant coverage if a cell fails), while R2 also has a backup network coverage which in case of failure of the primary (type A layer) cell immediately takes over the radio communication (type B layer).
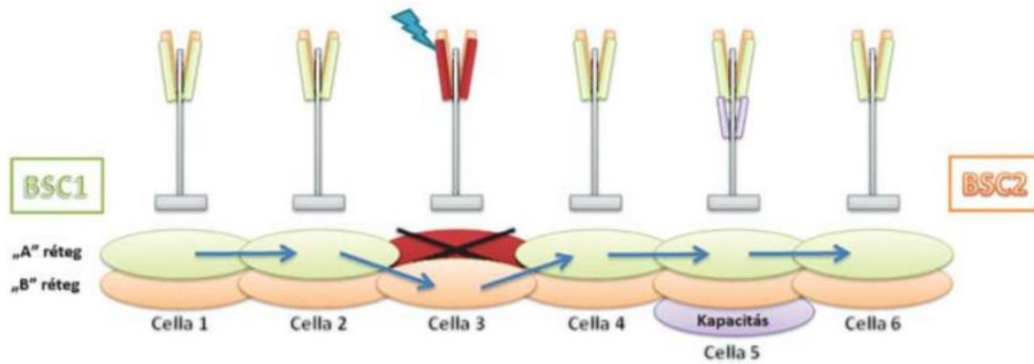
Figure 2. Redundant design of the cellular coverage (source: Railway Wiring World, September 2018)

	Layer 'A'
	Layer 'B'
	Cell
	Capacity
	BSC

4. Implementation of the Hungarian sections of the TEN-T corridors

Hungarian sections of the trans-European transport network ('TEN-T') railway corridors as set out in Annex I to Commission Implementing Regulation (EU) 2017/6:
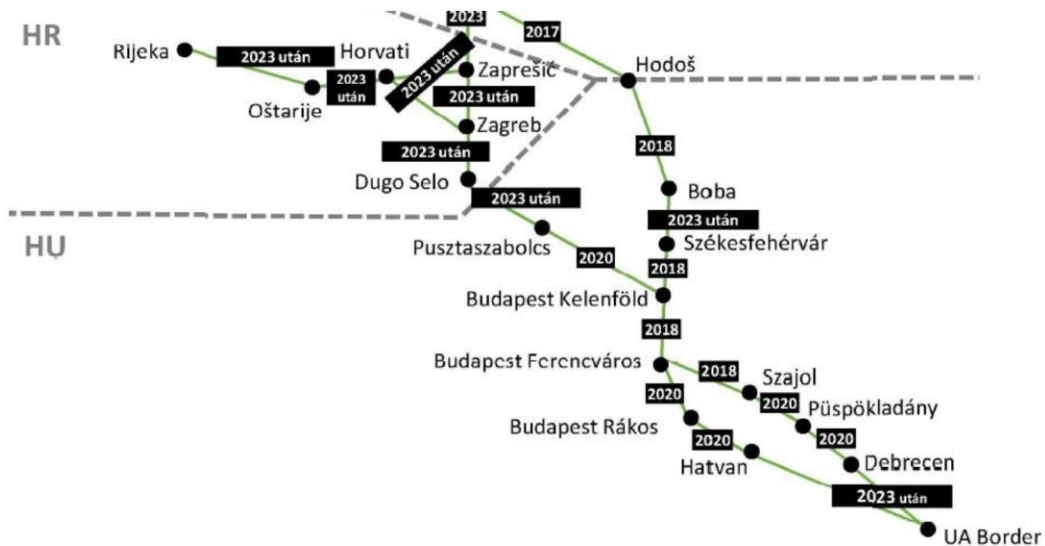
Figure 3. Hungarian section of the Mediterranean Corridor 2/2
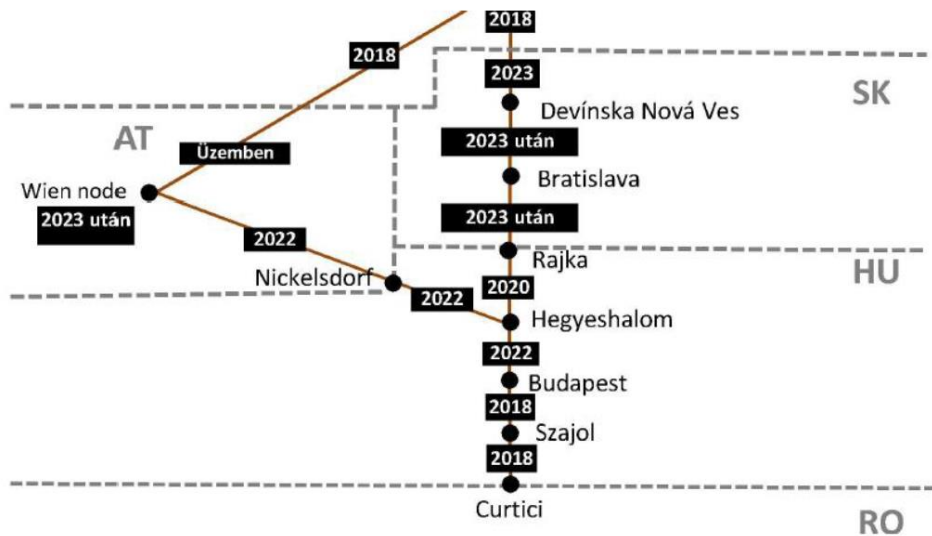
Figure 4. 1/2 Hungarian section of the Eastern/Eastern Mediterranean Corridor
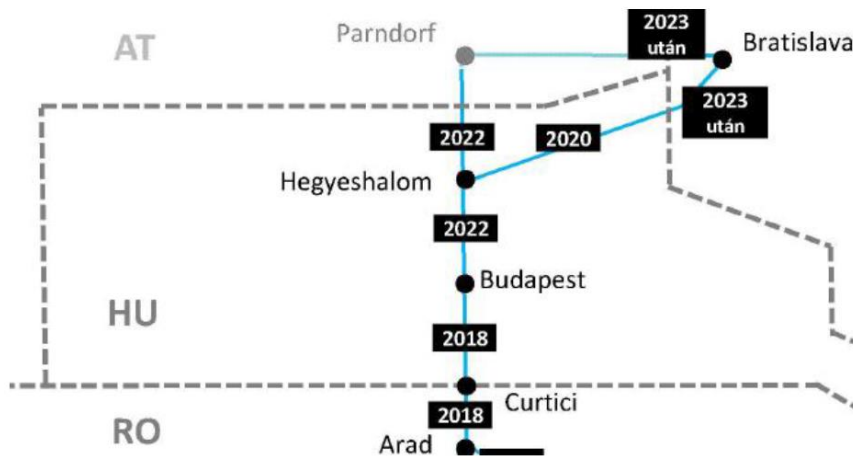
Figure 5. 1/2 Hungarian section of the Rhine-Danube Corridor

5.   Implementation of GSM-R in Hungary

The Hungarian project aims to replace the Hungarian analogue railway radio system and to lay the foundations for the deployment of EIRENE (European Integrated Railway Radio Enhanced Network) and ETCS, which are necessary to ensure international railway interoperability, primarily on the TEN-T marked sections of the Hungarian railway network. Modernisation and improvement of the compatibility of railway communication systems will make rail passenger and freight traffic safer, faster and free of congestion, both at the level of international, regional and suburban transport. The multi-year investment will enable the development of value-added services, and the modernisation will provide a more favourable environment for local and regional development of public and private investments that support economic growth. The project contributes to Hungary's fulfilment of its commitment made to the EU in 2007 to deploy the ERTMS system in Hungary.

In its first phase, by the end of 2018 the GSM-R project was implemented on a railway section of a

total of 905 km, which includes both R1 and R2 level sections. As part of the second phase, the GSM-R network is expected to be built on additional 2255 km, and some existing lines will be covered by R2, which is also shown in Figures 6 and 7.
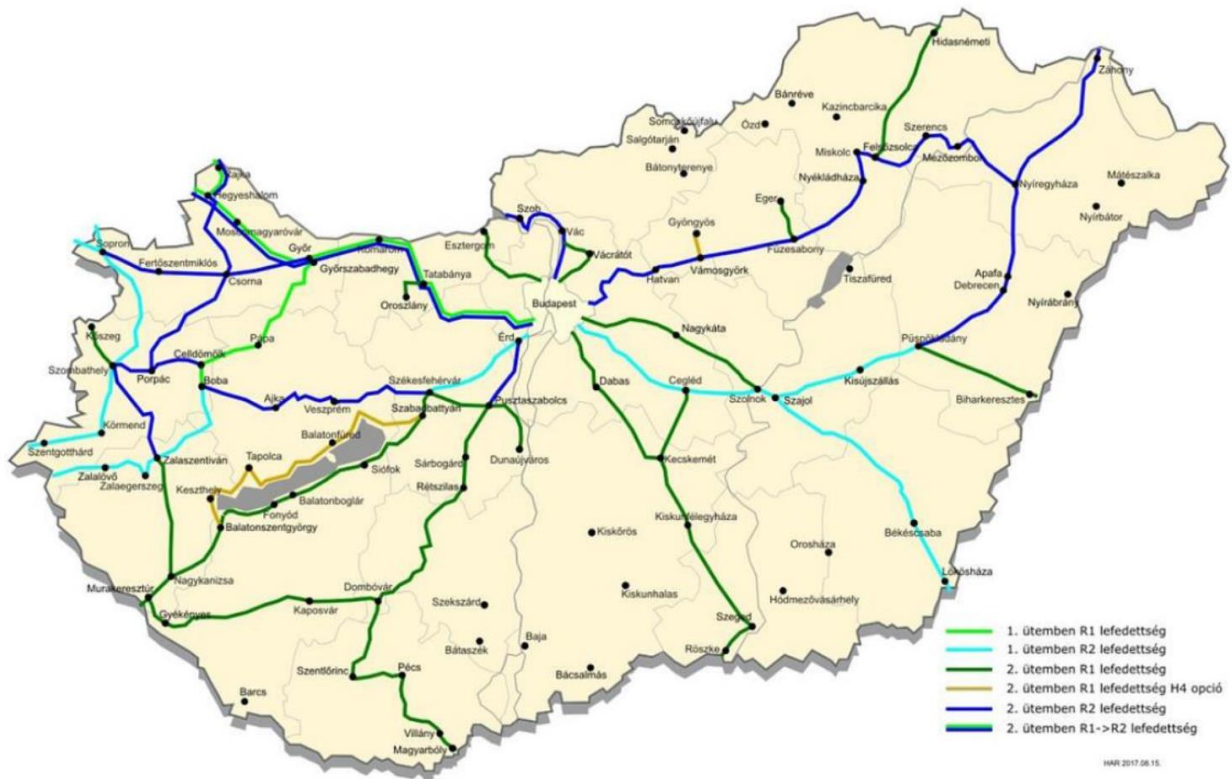
Figure 6. National lines of GSM-R level 1 and 2 (source: MÁV Zrt.)

	R1 coverage in Level 1
	R2 coverage in Level 1
	R1 coverage in Level 2
	R1 coverage in Level 2 option M4
	R2 coverage in Level 2
	Rl->R2 coverage in Level 2
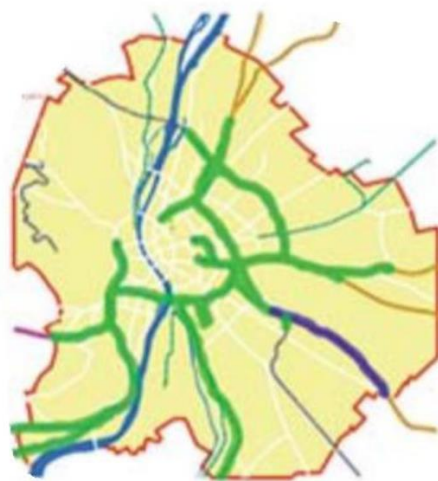
Figure 7. Budapest lines of GSM-R Phase 1 and 2 (source: MÁV Zrt.)

5.1. Completed projects for the GSM-R radio network and the core network (GSM-R Phase 1)

The quality requirements for the operation of the GSM-R network are contained in Commission Decision 2010/713/EU on modules for the procedures for assessment of conformity, suitability for use and EC verification to be used in the technical specifications for interoperability adopted under Directive 2008/57/EC of the European Parliament and of the Council.

The following subsystem elements which are related to the implementation phases were completed in GSM-R Phase 1:

Core network part of the MÁV GSM-R CCT subsystem:
• 1+3 phases: M2 Székesfehérvár and M1 Budapest core network in a geo-redundant configuration

Radio communication part of the MÁV GSM-R CCT subsystem, provision of coverage (BTS):

• Phase 2, 1/2 Hungarian section of the Eastern/Eastern Mediterranean Corridor:

  o M100.1 (177 km): Budapest-Cegléd-Szajol-Püspökladány
  o M120.1 (115 km): Szajol-Békéscsaba-Lökösháza-national border ('NB')
  o
• Phase 4, Hungarian section of the Mediterranean Corridor 2/2:

  o M001.1 (127 km): Budapest-Győr-Komárom NB
  o M001.2 (60 km): Győr-Hegyeshalom-Rajka-NB
  o M010.1 (82 km): Győr-Boba
  o M000.1 (50 km): Budapest ring road and stations
  o
• Phase 5:

  o M015.1 (62 km): Sopron national border-Szombathely
  o M021.2 (55 km): Szombathely-Szentgotthárd NB
  o M504.1 (8 km): Sopron-Ágfalva-NB
  o M025.1 (102 km): Boba-Bajánsenye-NB
  o M030.1 (67 km): Budapest-Székesfehérvár.

The new TSI 2016/919/EU entered into force on 27 May 2016, replacing the Control-Command and Signalling (CCS) TSI in force at the beginning of the GSM-R project. According to the new regulations, the following sections have been completed:

Table 1. Details of the completed line sections:

Line section	Date of placing in service	Service provider
Budapest-Keleti - Ferencváros	30.06.2020	MÁV
Ferencváros - Kelenföld	30.06.2020	MÁV
Kelenföld - Budaörs	30.06.2020	MÁV
Budaörs - Biatorbágy	30.06.2020	MÁV
Biatorbágy - Tatabánya	30.06.2020	MÁV
Tatabánya	30.06.2020	MÁV
Tatabánya - Tata	30.06.2020	MÁV
Budaörs - Tata	30.06.2020	MÁV
Tata - Hegyeshalom	30.06.2020	MÁV
Budapest - Hegyeshalom NB	30.06.2020	MÁV
Hegyeshalom - **Rajka NB**	2020 2nd quarter	GYSEV
Győr-Marshalling yard - Győrszemere	30.06.2020	MÁV
Győrszemere - Vaszar	30.06.2020	MÁV
Vaszar - Celldömölk	30.06.2020	MÁV
Boba – Zalaszentiván branching	30.06.2020	MÁV
Zalaszentiván branching - Zalaegerszeg	30.06.2020	MÁV
Zalaegerszeg - Andráshida branching	30.06.2020	MÁV
Andráshida branching - Zalacséb-Salomvár	30.06.2020	MÁV
Zalacséb-Salomvár - **Őriszentpéter NB**	30.06.2020	MÁV
Budapest-Déli - Kelenföld	30.06.2020	MÁV
Kelenföld	30.06.2020	MÁV
Kelenföld - **Székesfehérvár**	30.06.2020	MÁV
Ágfalva border - Sopron	2020 2nd quarter	GYSEV
Sopron - Harka	2020 2nd quarter	GYSEV
Harka - Harka NB	2020 2nd quarter	GYSEV
Harka - **Szombathely**	2020 2nd quarter	GYSEV
Szombathely Szentgotthárd	2020 2nd quarter	GYSEV
Szentgotthárd - **Szentgotthárd NB**	2020 2nd quarter	GYSEV
Budapest-Keleti - Rákos	30.06.2020	GYSEV
Budapest-Nyugati - Kőbánya-Kispest	30.06.2020	MÁV
Kőbánya-Kispest - Vecsés	30.06.2020	MÁV
Vecsés - Albertirsa	30.06.2020	MÁV
Albertirsa - Szolnok A branching	30.06.2020	MÁV
Szolnok A branching - Szolnok E branching	30.06.2020	MÁV
Szolnok E branching - **Püspökladány**	30.06.2020	MÁV

Szajol - Békéscsaba	30.06.2020	MÁV
Békéscsaba - **Lőkösháza NB**	30.06.2020	MÁV
Kőbánya felső - Angyalföld branching	30.06.2020	MÁV
Angyalföld branching - **Rákosrendező**	30.06.2020	MÁV
Budapest-Nyugati - Rákosrendező	30.06.2020	MÁV
Rákosrendező-**Istvántelek main workshop**	30.06.2020	MÁV

5.2. Planned projects for the deployment of the GSM-R network (GSM-R Phase 2)

In Government Decision No 1575/2016 of October 19 approving the complex implementation of the project entitled 'Level 2 of the deployment of the GSM-R system along the Hungarian railway lines' with the mobilization of the largest available EU support, the Government decided to implement Level 2 of the deployment of the GSM-R system from CEF/IKOP sources. The total length of the railway network covered by the project is ~2255 km. Some of the project proposals contained in the Government decision are as follows:

- Level 2 of the deployment of the GSM-R system on the core railway network of the Hungarian TEN-T: The project proposal will be implemented on those Hungarian line sections of the TEN-T railway core network that were not covered in Level 1 of the entire GSM-R development. The total length of the railway network planned to be covered by the GSM-R system within the project part is ~956 km.

- Level 2 of the deployment of the GSM-R system on the comprehensive railway network of the Hungarian TEN-T: The project proposal will be implemented on those Hungarian line sections of the TEN-T comprehensive railway network that were not covered in Level 1 of the entire GSM-R development. The total length of the railway network planned to be covered by the GSM-R system within the project part is ~1044 km.

- Level 2 of the deployment of the GSM-R system on suburban line sections connected to the railway network of the Hungarian TEN-T: The project proposal will be implemented on those Hungarian suburban line sections that were not covered in Level 1 of the entire GSM-R development. The total length of the railway network planned to be covered by the GSM-R system within the project part is ~255 km.

Technical tasks related to the deployment of the GSM-R system (Level 2) on a total of ~ 2 255 km of normal gauge national public railway line section (design, implementation, placing in service):

o GSM-R radio network (BTSs, BSSs, repeaters, antennas, towers, antenna supports, outdoor cabinets, power supply, air conditioning, security technology, property protection);
o At least 2 BSCs with completely identical hardware configuration and software version;
o IP/MPLS and DWDM based transmission technology network;
o Design and implementation of a dispatcher system related to the GSM-R system at ~212 locations;
o Optical cable network for line sections and optical loop closures specified in the technical description:
  ■ New fibre optic cables and substructure: ~1 868 km,
  ■ Installation of new fibre optic cables into an existing substructure: ~444 km,
  ■ New fibre optic cables on a new pole row: ~129 km,

- New optical cables on the railway overhead line: ~117 km.
  - o Design and implementation of operation and maintenance support systems (OSS),
  - o Adaptation of RBCs implemented in related ETCS 2 projects (~ 135 km) to the GSM-R system, performance of interoperability tests for the affected GSM-R sections

Table 2. GSM-R Phase 2 planned railway sections, with special emphasis on R2 level lines:

GSM-R section ID	Name	Length (km)	Level of coverage	Source
M001	Budapest - Hegyeshalom NB - Rajka NB	192	R1-->R2	CEF
M100-1a	Püspökladány - Debrecen	46	R2	CEF
M100-1b	Debrecen - Záhony NB	111	R2	CEF
M040-1a	Érd branching - Százhalombatta (excl.)	5	R2	CEF
M040-1b	Százhalombatta (incl.) - Pusztaszabolcs	25	R2	CEF
M080a	Budapest (Rákos) - Hatvan	59	R2	CEF
M080b	Hatvan - Miskolc - Mezőzombor	151	R2	CEF
M100-2	Mezőzombor - Nyíregyháza	45	R2	CEF
M020-1	Székesfehérvár - Boba	110	R2	CEF
M040-2	Pusztaszabolcs - Dombóvár	111	R1	CEF
M041	Dombóvár - Gyékényes	101	R1	CEF
M030-1	Székesfehérvár - Nagykanizsa	150	R1	IKOP 2
M101	Püspökladány - Biharkeresztes NB	53	R1	IKOP 2
M070	Budapest - Vác - Szob NB	51	R2	IKOP 2
Gy008	Győr - Sopron	80	R2	IKOP 2
M030-2	Nagykanizsa - Murakeresztúr NB	16	R1	IKOP 2
Gy017-1	Szombathely - Zalaszentiván	49	R2	IKOP 2
M017-2	Zalaszentiván - Nagykanizsa	53	R1	IKOP 2
M040-3	Dombóvár - Pécs	64	R1	IKOP 2
M020-2	Celldömölk - Porpác	28	R2	IKOP 2
Gy020-3	Porpác - Szombathely	12	R2	IKOP 2
M136	Szeged - Röszke NB	14	R1	IKOP 2

Gy016	Hegyeshalom - Porpác	94	R2	IKOP 2
M140	Cegléd - Szeged	118	R1	IKOP 2
M065	Pécs - Villány	36	R1	IKOP 2
M066	Villány - Magyarbóly NB	7	R1	IKOP 2
M120	Budapest - Ujszász - Szolnok	80	R1	IKOP 2
M044	Székesfehérvár - Pusztaszabolcs	30	R1	IKOP 2
M030-3	Murakeresztúr - Gyékényes	15	R1	IKOP 2
M090	Felsőzsolca - Hidasnémeti NB	60	R1	IKOP 2
M400-217	Eperjeske marshalling yard branching (wide) - Eperjeske marshalling yard railway station (wide) Eperjeske marshalling yard branching (wide) - Záhony marshalling yard (wide) Eperjeske marshalling yard railway station (wide) - Tornyospálca reload railway station (wide) Eperjeske marshalling yard railway station (wide) - Eperjeske border (wide) Wood storage siding branch (wide) - Tuzsér (wide) Komoró (wide) - Wood storage siding branch (wide) Tuzsér (wide) - Eperjeske marshalling yard branching (wide) Tuzsér (wide) - Záhony branching (wide) Záhony branching (wide) - Záhony (wide) Záhony (wide) - Záhony border (wide) Eperjeske marshalling yard railway station (wide) - Mándok reload railway station (wide) Eperjeske-reload (wide)- Eperjeske marshalling yard railway station (wide)	25	R1	IKOP 2

M042-1	Pusztaszabolcs - Adony	9	R1	IKOP 2
M071	Budapest - Vácrátót - Vác	41	R1	IKOP 3.1
M142	Kőbánya-Kispest - Lajosmizse - Kecskemét	98	R1	'IKOP 3 .1: Bp-Pest and Bács-Kiskun county border IKOP 3.2: Pest and Bács-Kiskun county border-Kecskemét'
M002	Budapest - Esztergom	48	R1	'IKOP 3.1: Bp-Pest and Komárom-Esztergom county border IKOP 3.2: Pest and Komárom-Esztergom county border-Esztergom'
M042-2	Adony - Dunaújváros	18	R1	IKOP 3.2
Gy018	Szombathely - Kőszeg	18	R1	IKOP 3.2
M087	Füzesabony - Eger	17	R1	IKOP 3.2
M012	Tatabánya - Oroszlány	15	R1	IKOP 3.2
Total:		2255		

Table 3. MÁV draft - schedule for the implementation of the GSM-R Phase 2 (divided into line sections):

Starting point of the line	End point of the line	Dividing the line into sections	Planned or ongoing renovation of existing lines - GSM-R 2 and FRMCS (GSM-R)
			Scheduled completion date
Budapest-Keleti	**Hegyeshalom NB**	Budapest-Keleti - Ferencváros	GSM-R 2: 2023.
Rákosrendező	**Esztergom**	Rákosrendező - Angyalföld	GSM-R 2 project until 2025
		Angyalföld - Óbuda	GSM-R 2 project until 2025
		Óbuda	GSM-R 2 project until 2025
		Óbuda - Solymár	GSM-R 2 project until 2025

		Solymár	GSM-R 2 project until 2025
		Solymár - Pilisvörösvár	GSM-R 2 project until 2025
		Pilisvörösvár - Őrhegy 'A' branching	GSM-R 2 project until 2025
		Őrhegy 'A' branching - Őrhegy 'B' branching	GSM-R 2 project until 2025
		Őrhegy 'B' branching - Piliscsaba	GSM-R 2 project until 2025
		Piliscsaba - Esztergom	GSM-R 2 project until 2025
Székesfehérvár	**Komárom**		FRMCS (GSM-R), until 2030
Bodajk	**Balinka**		FRMCS (GSM-R), until 2030
Mór	**Pusztavám**		FRMCS (GSM-R), until 2030
Moha-Rakodó	**Moha felső**		FRMCS (GSM-R), until 2030
Tatabánya	**Oroszlány**	Tatabánya - Környe	GSM-R 2 until 2025
		Környe - Oroszlány	GSM-R 2 until 2025
		Zalaszentiván (excl.) - Gelse	GSM-R 2 until 2025
		Gelse - Nagykanizsa	GSM-R 2 until 2025
Székesfehérvár	**Celldömölk**	Székesfehérvár - Várpalota	GSM-R 2 until 2025
		Várpalota - Hajmáskér	GSM-R 2 until 2025
		Hajmáskér - Veszprém	GSM-R 2 until 2025
		Veszprém - Herend	GSM-R 2 until 2025
		Herend - Ajka	GSM-R 2 until 2025
		Ajka	GSM-R 2 until 2025
		Ajka - Boba	GSM-R 2 until 2025
		Boba - Celldömölk	GSM-R 2 until 2025
Celldömölk	**Porpác**	Celldömölk - Porpác	GSM-R 2 2025-ig
Zalaegerszeg	**Rédics**	Zalaegerszeg - Lenti	FRMCS (GSM-R), until 2030
		Lenti - Rédics	FRMCS (GSM-R), until 2030
Székesfehérvár	**Murakeresztúr NB**	Székesfehérvár - Szabadbattyán	GSM-R 2 until 2025
		Szabadbattyán - Lepsény	GSM-R 2 until 2025
		Lepsény - Siófok	GSM-R 2 until 2025
		Siófok - Zamárdi felső	GSM-R 2 until 2025
		Zamárdi felső - Balatonszemes branching	GSM-R 2 until 2025
		Balatonszemes branching - Balatonlelle felső	GSM-R 2 until 2025
		Balatonlelle felső - Balatonszentgyörgy	GSM-R 2 until 2025
		Balatonszentgyörgy - Zalakomár	GSM-R 2 until 2025
		Zalakomár - Murakeresztúr	GSM-R 2 until 2025

		Murakeresztúr - Murakeresztúr NB	GSM-R 2 until 2025
Kaposvár	**Fonyód**		FRMCS (GSM-R), until 2030
Kelenföld	**Pécs**	Kelenföld - Százhalombatta	GSM-R 2 until 2023
		Százhalombatta - Pusztaszabolcs	GSM-R 2 until 2023
		Pusztaszabolcs - Dombóvár	GSM-R 2 until 2023
		Dombóvár - Vásárosdombó	GSM-R 2 until 2023
		Vásárosdombó - Sásd	GSM-R 2 until 2023
		Sásd - Szentlőrinc	GSM-R 2 until 2023
		Szentlőrinc - Pécs	GSM-R 2 until 2023
Dombóvár	**Gyékényes NB**	Dombóvár - Kaposvár	GSM-R 2 until 2023
		Kaposvár - Gyékényes	GSM-R 2 until 2023
		Gyékényes - Gyékényes NB	GSM-R 2 until 2023
Pusztaszabolcs	**Paks**	Pusztaszabolcs - Adony	GSM-R 2 until 2023
		Adony - Dunaújváros	GSM-R 2 until 2023
		Dunaújváros - Mezőfalva branching	GSM-R 2 until 2023
		Mezőfalva branching - Paks	FRMCS (GSM-R), until 2030
Mezőfalva branching	**Rétszilas**		GSM-R 2 until 2023
Székesfehérvár	**Pusztaszabolcs**	Székesfehérvár - Börgönd	GSM-R 2 until 2023
		Börgönd - Pusztaszabolcs	GSM-R 2 until 2023
Sárbogárd	**Börgönd**		FRMCS (GSM-R), until 2030
Rétszilas	**Bátaszék**	Rétszilas - Szekszárd	FRMCS (GSM-R), until 2030
		Szekszárd - Bátaszék	FRMCS (GSM-R), until 2030
Dombóvár	**Bátaszék**		FRMCS (GSM-R), until 2030
Murakeresztúr	**Szentlőrinc**	Murakeresztúr - Ortilos	GSM-R 2 until 2025
		Ortilos - Gyékényes	GSM-R 2 until 2025
		Gyékényes - Középrigóc	GSM-R 2 until 2025
		Középrigóc - Szentlőrinc	GSM-R 2 until 2025
Pécs	**Mohács**	Pécs - Pécsbánya-Marshalling yard	GSM-R 2 until 2025
		Pécsbánya-Marshalling yard- Villány	GSM-R 2 until 2025
		Villány - Mohács	FRMCS (GSM-R), until 2030
Villány	**Magyarbóly NB**	Villány - Villány branching	GSM-R 2 until 2025
		Villány branching - Magyarbóly NB	GSM-R 2 until 2025
Rákospalota-Újpest	**Szob NB**	Rákospalota-Újpest - Vác	GSM-R 2 until 2025
		Vác	GSM-R 2 until 2025
		Vác - Szob NB	GSM-R 2 until 2025

Rákospalota-Újpest	Vác	Rákospalota-Újpest - Vácrátót	GSM-R 2 until 2025
		Vácrátót - Vác	GSM-R 2 until 2025
Rákos	Sátoraljaújhely NB	Rákos - Szerencs	GSM-R 2 until 2025
		Szerencs - Mezőzombor	GSM-R 2 until 2025
		Mezőzombor-Sárospatak	GSM-R 2 until 2025
		Sárospatak-Sátoraljaújhely	GSM-R 2 until 2025
-	-	Sátoraljaújhely - Sátoraljaújhely NB	GSM-R 2 until 2025
Hatvan	**Somoskőújfalu NB**	Hatvan - Selyp	FRMCS (GSM-R), until 2030
		Selyp - Salgótarján külső	FRMCS (GSM-R), until 2030
		Salgótarján külső - Somoskőújfalu	FRMCS (GSM-R), until 2030
		Somoskőújfalu - Somoskőújfalu NB	FRMCS (GSM-R), until 2030
Hatvan	**Újszász**		FRMCS (GSM-R), until 2030
Füzesabony	**Putnok**	Füzesabony - Eger-Marshalling yard branching	GSM-R 2 until 2025
		Eger-Marshalling yard branching - Eger	GSM-R 2 until 2025
Felsőzsolca	**Hidasnémeti NB**	Felsőzsolca - Hidasnémeti	GSM-R 2 until 2025
		Hidasnémeti - Hidasnémeti NB	GSM-R 2 until 2025
Miskolc-Tiszai railway station	**Bánréve NB**	Miskolc-Tiszai - Miskolc Gömöri	FRMCS (GSM-R), until 2030
		Miskolc-Gömöri - Sajószentpéter	FRMCS (GSM-R), until 2030
		Sajószentpéter - Kazincbarcika	FRMCS (GSM-R), until 2030
		Kazincbarcika - Bánréve	FRMCS (GSM-R), until 2030
		Bánréve - Bánréve NB	FRMCS (GSM-R), until 2030
Bánréve	**Ózd**		FRMCS (GSM-R), until 2030
Nyíregyháza	**Záhony NB**	Nyíregyháza - Kisvárda	GSM-R 2 until 2023
		Kisvárda - Tuzsér	GSM-R 2 until 2023
		Tuzsér - Záhony	GSM-R 2 until 2023
		Záhony - Záhony NB	GSM-R 2 until 2023
Mezőzombor	**Nyíregyháza**		GSM-R 2 until 2023
Püspökladány	**Biharkeresztes NB**		GSM-R 2 until 2025
Debrecen	**Nyírábrány NB**	Debrecen - Nyírábrány	GSM-R 2 until 2025
		Nyírábrány - national border	GSM-R 2 until 2025
Debrecen	**Nagykereki**	Debrecen - Sáránd	FRMCS (GSM-R), until 2030
		Sáránd - Pocsaj-Esztár	FRMCS (GSM-R), until 2030
		Pocsaj-Esztár - Nagykereki	FRMCS (GSM-R), until 2030

Debrecen	**Füzesabony**	Debrecen - Tóvóvölgy	FRMCS (GSM-R), until 2030
		Tócóvölgy - Füzesabony	FRMCS (GSM-R), until 2030
Apafa	**Mátészalka**	Apafa - Nyírbátor	FRMCS (GSM-R), until 2030
		Nyírbátor - Mátészalka	FRMCS (GSM-R), until 2030
Mátészalka	**Záhony**		FRMCS (GSM-R), until 2030
Rákos	**Szolnok**	Rákos - Tápiószele	GSM-R 2 until 2025
		Tápiószele - Szolnok	GSM-R 2 until 2025
Kötegyán	**Püspökladány**	Kötegyán - Vésztő	FRMCS (GSM-R), until 2030
		Vésztő - Szeghalom	FRMCS (GSM-R), until 2030
		Szeghalom - Püspökladány	FRMCS (GSM-R), until 2030
Tiszatenyő	**Hódmezővásárhelyi Népkert**	Tiszatenyő - Kunszentmárton	FRMCS (GSM-R), until 2030
		Kunszentmárton - Szentes	FRMCS (GSM-R), until 2030
		Szentes - Hódmezővásárhelyi Népkert	FRMCS (GSM-R), until 2030
Hódmezővásárhely	**Makó branching**	Hódmezővásárhely - Hódmezővásárhely-Újváros	FRMCS (GSM-R), until 2030
		Hódmezővásárhely-Újváros - Makó branching	FRMCS (GSM-R), until 2030
Szeged	**Kötegyán NB**	Szeged - Szeged-Marshalling yard	FRMCS (GSM-R), until 2030
		Szeged-Marshalling yard - Hódmezővásárhely	FRMCS (GSM-R), until 2030
		Hódmezővásárhely - Békéscsaba	FRMCS (GSM-R), until 2030
		Békéscsaba - Gyula	FRMCS (GSM-R), until 2030
		Gyula - Sarkad	FRMCS (GSM-R), until 2030
		Sarkad - Kötegyán	FRMCS (GSM-R), until 2030
		Kötegyán - Kötegyán NB	FRMCS (GSM-R), until 2030
Szeged railway station	**Röszke NB**		GSM-R 2 until 2025
Cegléd	**Szeged**	Cegléd - Városföld	GSM-R 2 until 2025
		Városföld - Kiskunfélegyháza	GSM-R 2 until 2025
		Kiskunfélegyháza - Kiskundorozsma	GSM-R 2 until 2025
		Kiskundorozsma - Szeged-	GSM-R 2 until 2025

		marshalling yard	
		Szeged-marshalling yard - Szeged	GSM-R 2 until 2025
Kőbánya-Kispest	**Kecskemét**	Kőbánya-Kispest - Kispest	GSM-R 2 until 2025
		Kispest - Örkény	GSM-R 2 until 2025
		Örkény - Lajosmizse	GSM-R 2 until 2025
		Lajosmizse - Kecskemét alsó	GSM-R 2 until 2025
		Kecskemét alsó - Kecskemét	GSM-R 2 until 2025
Ferencváros	**Kelebia NB**	Ferencváros - Soroksári Road	under planning, 2023
		Soroksári Road - Soroksár	under planning, 2023
		Soroksár- Kunszentmiklós-Tass	under planning, 2023
		Kunszentmiklós-Tass - Kelebia NB	under planning, 2023
Bátaszék	**Kiskunhalas**		FRMCS (GSM-R), until 2030
Kiskunhalas	**Kiskunfélegyháza**		FRMCS (GSM-R), until 2030
Eperjeske - Átrakó (wide)	**Eperjeske - Marshalling yard (wide)**		GSM-R 2 until 2025
Eperjeske - Marshalling yard branching (wide)	**Eperjeske - Marshalling yard (wide)**		GSM-R 2 until 2025
Eperjeske - Marshalling yard branching (wide)	**Záhony branching (wide)**		GSM-R 2 until 2025
Eperjeske - Marshalling yard (wide)	**Tornyospálca - transfer loading bay (wide)**		GSM-R 2 until 2025
Eperjeske - Marshalling yard (wide)	**Eperjeske NB (wide)**		GSM-R 2 until 2025
Komoró (wide)	**Komoró - Fatároló siding junction (wide)**		GSM-R 2 until 2025
Komoró - Fatároló siding junction (wide)	**Tuzsér (wide)**		GSM-R 2 until 2025
Tuzsér (wide)	**Eperjeske - Marshalling yard branching (wide)**		GSM-R 2 until 2025
Tuzsér (wide)	**Záhony branching (wide)**		GSM-R 2 until 2025
Záhony branching (wide)	**Záhony (wide)**		GSM-R 2 until 2025
Záhony (wide)	**Záhony NB (wide)**		GSM-R 2 until 2025

6. Establishment of the ETCS system on Hungarian TEN-T lines

6.1. *Functions and levels of the ETCS system*

Through the uniform EU requirements for track-to-vehicle connectivity, the ETCS is suitable for ensuring that traction units equipped with the appropriate on-board equipment can cross national borders without stopping. Using this system, it is no longer necessary for locomotives to be equipped with several types of national standard on-board control-command equipment.

The ETCS has three different levels: Level 1 (L1), Level 2 (L2) and Level 3 (L3). When using L1, the GSM-R network is not required for operation of the signal transmission, as it provides point signal transmission to the on-board equipment when passing over the installed balises. In the case of ETCS L2, balises essentially transmit only position data to the on-board equipment, while train control instructions are received from the Radio Block Centre (RBC) of the ETCS L2 already via the GSM-R system. For continuity of communication, ETCS L2 train control is only possible for the R2-level GSM-R system, as in case of failure of the core network the backup network is immediately available. Level 3 (ETCS L3) has so far been developed only for high-speed rail passenger transport; no standards have been developed for locomotive traction, and are therefore not applied as yet. At this level, the functions allow the omission of open-line lock-and-block systems as, based on the vehicle's GPS position, the control panel can calculate, among other things, the braking distance. This solution will make it possible in the future to further increase the number and speed of trains running on the line, thus ensuring a better use of rolling stock and equipment.

6.2. Implementation of ETCS L2 on the TEN-T lines in Hungary

The precondition for the deployment of the ETCS L2 system is a stable operation of the GSM-R network. On line sections certified and commissioned in GSM-R Phase 1, testing of ETCS L2 and, if successful, commissioning may start. According to the data provided by MÁV, deployment of the ETCS L2 system will be completed first on the Kelenföld-Székesfehérvár line. The NoBo conformity assessment procedure can only start after successful tests.

Table 4. Hungarian ETCS railway line sections:

Starting point of the line	End point of the line	Dividing the line into sections	Planned or ongoing renovation of existing lines - ETCS	Note 2.
Budapest-Keleti	Hegyeshalom NB	Budapest-Keleti - Ferencváros		GSM-R 2 also affects
		Ferencváros - Kelenföld	under deployment, comp. end of 2020	ETCS L2 2.3.0d
		Kelenföld - Budaörs	In preparation, planned completion in 2023	ETCS L1 2.2.2 ->2.3.0d
		Budaörs - Biatorbágy	In preparation, planned completion in 2023	ETCS L1 2.2.2 ->2.3.0d
		Biatorbágy - Tatabánya	In preparation, planned	ETCS L1 2.2.2 ->2.3.0d

			completion in 2023	
		Tatabánya	In preparation, planned completion in 2023	ETCS L1 2.2.2 ->2.3.0d
		Tatabánya - Tata	In preparation, planned completion in 2023	ETCS L1 2.2.2 ->2.3.0d
		Budaörs - Tata	In preparation, planned completion in 2023	ETCS L1 2.2.2 ->2.3.0d
		Tata - Hegyeshalom	In preparation, planned completion in 2023	ETCS L1 2.2.2 ->2.3.0d
		Budapest - Hegyeshalom national border	In preparation, planned completion in 2023	ETCS L1 2.2.2 ->2.3.0d
Boba	**Őriszentpéter NB**	Boba - Zalaszentiván branching	end of 2020	ETCS L2 2.3.0d
		Zalaszentiván branching - Zalaegerszeg	end of 2020	ETCS L2 2.3.0d
		Zalaegerszeg - Andráshida branching	end of 2020	ETCS L2 2.3.0d
		Andráshida branching - Zalacséb-Salomvár	end of 2020	ETCS L2 2.3.0d
		Zalacséb-Salomvár - Őriszentpéter national border	end of 2020	ETCS L2 2.3.0d
	Kelenföld		mid 2020	ETCS L2 2.3.0.d
Kelenföld	**Székesfehér-vár**		mid 2020	ETCS L2 2.3.0.d
Kelenföld	**Pusztaszabolcs**	Kelenföld - Százhalombatta	under planning, comp.: end of 2021	ETCS L2 3.4.0.
		Százhalombatta - Pusztaszabolcs	under planning, completion: end of 2021	ETCS L2 3.4.0.
Albertirsa	**Kisvárda**	Albertirsa - Szolnok A branching	Under deployment, comp.: end of 2022	ETCS L2 2.3.0d
		Szolnok A branching - Szolnok E branching	Under deployment, comp.: end of 2022	ETCS L2 2.3.0d

		Szolnok E branching - Püspökladány	Under deployment, comp.: end of 2022	ETCS L1 2.3.0d
		Püspökladány - Nyíregyháza	Püspökladány - Ebes Under deployment, Ebes - Nyíregyháza expectedly completed until 2030: end of 2022	ETCS L2 2.3.0d
		Nyíregyháza - Kisvárda	until 2030	ETCS L2 2.3.0d
Szajol	**Lőkösháza NB**	Szajol - Békéscsaba	under deployment, comp. end of 2021	ETCS L2 2.3.0d
		Békéscsaba - Lőkösháza NB	Trial operation, comp. mid 2020	ETCS L1 2.3.0d
Ferencváros	**Kelebia NB**	Ferencváros - Soroksári Road	2026	ETCS L2 2.3.0d GSM-R
		Soroksári Road - Soroksár	2026	ETCS L2 2.3.0d GSM-R
		Soroksár-Kunszentmiklós-Tass	2026	ETCS L2 2.3.0d GSM-R
		Kunszentmiklós-Tass - Kelebia NB	2026	ETCS L2 2.3.0d GSM-R
Ferencváros	**Kőbánya-Kispest**		n.a.	ETCS L2 2.3.0d

In the major railway developments phase implemented between 2018 and 2023 the aim is to build a modern railway signalling and control system that provides interoperability in the European Union, building on the already established GSM-R railway telecommunications system within Phase 2 on a total of 2 255 km of affected railway lines. The plans include:

- Deployment of the ETCS L2 railway signalling and control system on railway line No 25 between Boba and Bajánsenye.
- Deployment of the ETCS L2 railway signalling and control system on railway line No 30 between Ferencváros and Székesfehérvár.
- Deployment of the ETCS L2 and L1 level railway signalling and control system on the Ferencváros-Monor-Szajol railway line No 100 and on the Gyoma-Békéscsaba-Lökösháza railway line No 120.
- Deployment of the ETCS L2 railway signalling and control system on the Sopron-Szombathely railway line No 15 and the Szombathely-Szentgotthárd railway line No 21 of GYSEV Zrt. Expected preparatory projects in 2020–2021: Kelenföld-Hegyeshalom, Székesfehérvár-Balatonszetgyörgy and Hatvan-Füzesabony.
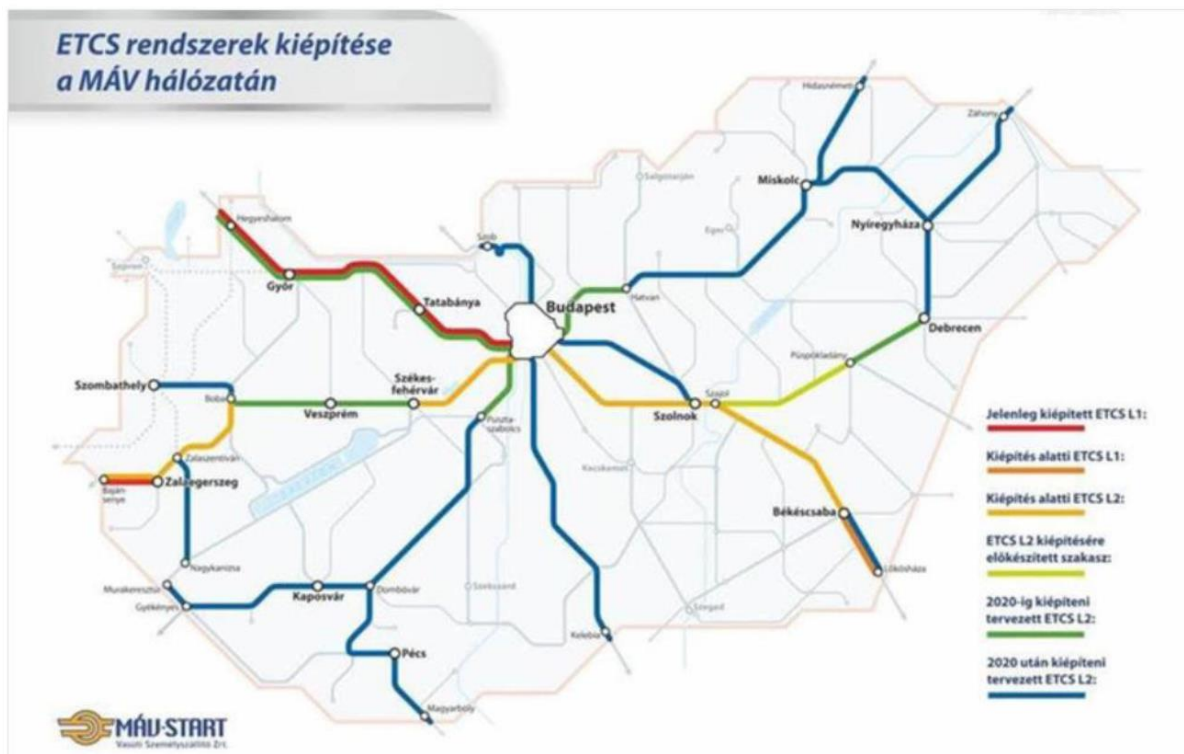
Figure 8. Deployment of the ETCS on the Hungarian TEN-T railway lines (source: MÁVStart)

	Deployment of ETCS systems on the MÁV network
	Currently deployed ETCS L1:
	ETCS L1 under deployment:
	ETCS L2 under deployment:
	Phase prepared for ETCS L2 deployment:
	ETCS L2 planned to be deployed by 2020:
	ETCS L2 planned to be deployed after 2020:

7. Summary

In view of the above, it can be seen that Hungary is committed to the deployment of ERTMS/ETCS. In addition to the development of a unified system and promotion of interoperability, this will improve the operation and maintenance of railway lines and the training of drivers and increase the safety level of railway lines.

We have presented the projects implemented for the core network corridors in Hungary, which also covers stations, junctions, airports and rail/road terminals, as well as their associated connections and infrastructure components.

In Hungary it has already been implemented on 905 km of standard-gauge national public railway line sections, and by deploying the planned additional 2 255 km of GSM-R railway communication system, it will continuously replace the difficult-to-operate analogue railway radio systems. By developing modern control-command and signalling equipment, Hungary intends to promote the integration of the domestic railway network into the international network, thereby promoting interoperability and increasing railway safety.

8. Binding standards taken into account in the CCS TSI (ERTMS) NOBO compliance procedures

EU regulations

- Commission Directive 2011/18/EU amending Annexes II, V and VI to Directive

2008/57/EC of the European Parliament and of the Council on the interoperability of the rail system within the Community

- Directive 2011/65/EU of the European Parliament and of the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment
- Directive 2008/57/EC of the European Parliament and of the Council on the interoperability of the rail system within the Community
- Commission Directive 2009/131/EC amending Annex VII to Directive 2008/57/EC of the European Parliament and of the Council on the interoperability of the rail system within the Community
- Directive 2004/108/EC of the European Parliament and of the Council on the approximation of the laws of the Member States relating to electromagnetic compatibility
- Commission Decision 2010/713/EU on modules for the procedures for assessment of conformity, suitability for use and EC verification to be used in the technical specifications for interoperability adopted under Directive 2008/57/EC of the European Parliament and of the Council
- Commission Regulation (EU) 2016/919 on the technical specification for interoperability relating to the 'control-command and signalling' subsystems of the rail system in the European Union
- Directive 2006/95/EC of the European Parliament and of the Council on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits

European and Hungarian Standards

- EIRENE FRS, GSM - R Functional requirements specification, Version 8.0.0, 21/12/2015
- EIRENE SRS GSM - R System requirements specification, Version 16.0.0, 21/12/2015
- ETSI EN 301 515 Global System for Mobile Communication (GSM); Requirements for GSM operation on railways, Version 2.3.0
- ETSI TS 102 281, Detailed requirements for GSM operation in railways, Version 3.0.0
- ETSI TS 102 610 Railway Telecommunication; GSM; Usage of the UUIE for GSM operation on railways, Version 1.3.0
- MORANE / A11T6001, Radio Transmission FFFIS for Euroradio, Version 13.0.0
- TS 103169 ASCI Options for Interoperability V 1.1.1
- MORANE / P 38 T 9001, FFFIS for GSM - R SIM Cards, Version 5.0
- MORANE / F 10 T 6002, FFFS for Confirmation of High Priority Calls, Version 5.0
- MORANE / F 12 T 6002, FIS for Confirmation of High Priority Calls, Version 5.0
- MORANE / E 10 T 6001, FFFS for Functional Addressing, Version 4.1
- MORANE / E 12 T 6001, FIS for Functional Addressing, Version 5.1
- MORANE / F 10 T 6001 FFFS for Location Dependent Addressing, Version 4
- MORANE / F 12 T 6001 FIS for Location Dependent Addressing, Version 3
- MORANE / F 10 T 6003, FFFS for Presentation of Functional Numbers to Called and Calling Parties, Version 4
- MORANE / F 12 T 6003, FIS for Presentation of Functional Numbers to Called and Calling Parties, Version 4
- EN 50126 Railway applications – Specification and demonstration of reliability, availability, maintainability and safety (RAMS), 1999
- EN 50128 Railway applications – Telecommunications, signalling and control systems, data processing systems - Software for railway control and monitoring systems, 2001
- EN 50129 Railway applications – Telecommunications, signalling and control systems, data processing systems, safety electronic systems for signalling and control equipment, 2003
- EN 50159_1 Railway applications – Telecommunications, signalling and data processing

systems.

Part 1: Security telecommunications in closed transmission systems, 2010
- EN 50159_2 Railway applications – Telecommunications, signalling and data processing systems.

Part 2: Security telecommunications in closed transmission systems, 2001, 2010
- UNISIG SUBSET-037 EuroRadio FIS V2.3.0
- UNISIG SUBSET- 092-1 ERTMS EuroRadio Conformance Requirements V2.3.0
- UNISIG SUBSET- 092-2 ERTMS EuroRadio test cases safety layer V2.3.0

9. Literature and bibliography

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