REPLies to the questionnaire in 5/LCCE/60

Usage of railway radiocommunications systems

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# Armenia

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| 1 Please provide the name(s) of Railway Radiocommunication Systems providing railway traffic control, passenger safety and security for train operations in your country. | 2 What are the technical and operational characteristics of each system? |  | | | 3 Are you planning to migrate your system? If possible please answer the above questions for the future system(s), and indicate which existing system(s) would be replaced? |
| 2.1 What are the Frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 Short wave radio communication system | РВС-1-2130 kHz | 2,13 MHz | [www.psrc.am](http://www.psrc.am)  Resolutions No.457 of 5 August 2009, No.69 of 3 March 2010, No.70 of 3 March 2010 | Power of radio stations- 12Wt  class in Radiation –3K00J3E  antenna height above the ground –5.0M  degree in Radiation - 360° |  |
| 2 Station and repair service of radio communication | 151,825 MHz;  151,875 MHz;  153 MHz;  154 MHz | Power of radio stations – 5Wt  class in Radiation – 16K0F3E  antenna type – spikes  antenna height above the ground – 5.5M; degree in Radiation - 360° |  |

# Australia

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| 2.1 What are the Frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? | |
| 1 Private Mobile Radio | 408.6375-409.04375 MHz  418.0875-418.49375 MHz  410.625 MHz  411.375 MHz  411.625 MHz  412.375 MHz  450.050 MHz  450.4125 MHz. | Conventional analogue and digital radio | Conventional 400 MHz analogue and digital radio  • The frequency ranges 408.6375-409.04375 MHz and 418.0875-  418.49375 MHz are for two-frequency use.  • The frequency ranges 410.61875-410.63125 MHz, 411.36875-  411.38125 MHz, 411.61875 411.63125 MHz, 412.36875 412.38125 MHz, 450.04375 450.05625 MHz and 450.40625 450.41875 MHz are for simplex (single frequency) use. | Note: The technical parameters of the RF interface could include channel separation, antenna type, antenna gain, polarization, e.i.r.p., receiving noise figure, transmission data rate, transmission distance (km), modulation, multiplexing method, protection criteria, etc. | Current systems will be retained. Metropolitan systems will be supplemented by GSM-R. The 800 MHz UMTS system is operated by an Australian carrier for an interstate rail network. It is possible this may migrate to LTE. |
| 2 Wi-Fi | 2.4 GHz and 5.8 GHz | 802.11 | As per 802.11 |
| 3 UMTS | 800 MHz |  | As per 3GPP UMTS in 800 MHz. |
| 4 GSM-R | 1 800 MHz | GSM-R 1800 | As per GSM-R in 1 800 MHz. |

# Australia (Queensland Rail)

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| 2.1 What are the Frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 Train Control Radio | 403-420 MHz PMR, 25 KHz channel bandwidth, 403-420 MHz DMR tier 3. | Standard 1: Wide Area analog PMR, being replaced by Tier 3 DMR, see <http://dmrassociation.org/> |  | Train control radio and maintenance radio in South east Queensland currently migrating to Tier 3 DMR. |
| 2 Maintenance Radio | 403-420 MHz PMR, 25 KHz channel bandwidth, 403-420 MHz DMR tier 3. | Standard 1: Wide Area analog PMR, being replaced by Tier 3 DMR, see <http://dmrassociation.org/> |  |
| 3 ETCS Level 2 (proposed) | 1770 MHZ – 1785 MHZ and 1865 MHZ to 1880 MHz | Not determined, but likely to be LTE. |  |
| 4 Linking Radios | 403-420 MHz, 900 MHz, 6 GHz, 8 GHz, 10 GHz | Standard PDH, SDH, Ethernet radios |  |
| 5 Automatic Train Protection (ATP) Radio | 403-420 MHz, 25 KHz channel bandwidth | Wide area PMR, 403-420 MHz, 25 kHz bandwidth. |  |
| 6 Shunting Radio | 403-420 MHz PMR, 25 KHz channel bandwidth, 403-420 MHz DMR tier 3. | Wide area PMR, 403-420 MHz, 25 kHz bandwidth |  |
| 7 Wayside Radio | 403-420 MHZ, 25 KHz and 12.5 KHz simplex. | Local area PMR, 403-420 MHz, 25 kHz and 12.5 bandwidth, also 450.05 MHz |  |

# Bosnia-Herzegovina

No such systems in use

# Canada

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| 2.1 What are the Frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 Centralized Train Control (CTC), using voice dispatch. | 160.1700-161.5800 MHz | The applicable Canadian Radio Standard Specification (RSS) and Standard Radio System Plans (SRSP) available at <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/h_sf01375.html> | Conform to applicable SRSP | No. Some Train control technology might be implemented in the future, in addition to the existing systems. |
| 2 Wayside sensors (detecting defective breaks, wheels or bearing) | 160.1700-161.5800 MHz | The applicable Canadian Radio Standard Specification (RSS) and Standard Radio System Plans (SRSP) available at <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/h_sf01375.html> | Conform to applicable SRSP |
| 3 Remote Control Locomotives in yards | 450 MHz, 900 MHz | The applicable Canadian Radio Standard Specification (RSS) and Standard Radio System Plans (SRSP) available at <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/h_sf01375.html> | Conform to applicable SRSP |
| 4 Proximity Detectors | 160.1700-161.5800 MHz | The applicable Canadian Radio Standard Specification (RSS) and Standard Radio System Plans (SRSP) available at <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/h_sf01375.html>, GPS. | Conform to applicable SRSP |

# China

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| 2.1 What are the Frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 900 MHz Band GSM-R System | 885-889 MHz (uplink)  930-934 MHz (downlink) | 3GPP TS 45 series  <http://www.3gpp.org/ftp/Specs/archive/45_series/>  UIC gsmr2875-1.0  <http://www.uic.org/IMG/pdf/gsmr2875-1.0.pdf> | |  |  | | --- | --- | | Frequency Range (MHz) | 885~889 (uplink)  930~934 (downlink) | | Channel separation (kHz) | 200 | | Antenna gain (dBi) | Mobile station: ≥0  Base station : 65°(Half-power Beam width):17  Or 33°(Half-power Beam width):21 | | Polarization | Dual-polarized | | Transmitting radiation power (dBm) | Mobile station (Handset: 33, Locomotive station: 39)  Base station: 46 | | Modulation | GMSK | | Multiplexing method | TDMA | | Receiver sensitivity (dBm) | Mobile station: ≤-104  Base station: ≤ -110 | | Yes. China is planning to migrate the system. A field test related to LTE-based next generation railway radiocommunication system is planned to be carried out in 2018 on some high speed railway line to verify system capacity and technical characteristics for RSTT in different typical scenarios. |
| 2 450 MHz Band Wireless Train Dispatching System | 457.200-458.650 MHz  467.200-468.650 MHz | GB/T 28792-2012  <http://www.csres.com/detail/227622.html> | |  |  | | --- | --- | | Frequency Range (MHz) | 457.200-458.650  467.200-468.650 | | Channel Spacing | 25kHz | | Frequency Tolerance | ≤5×10-6 | | Antenna Gain (dBi) | Fixed radio station: 9(Omni-directional), 12(Directional)  Locomotive station: 0 | | Carrier Power (dBm) | Fixed Radio Station: 34.7-37(simplex), 37-40 (duplex)  Locomotive Station: 37(simplex), 40 (duplex)  Handset: 34.7 | | Modulation type | FM | | Adjacent-channel Selectivity (receiver) (dB) | ≥65 | | Co-channel Rejection (dB) | ≥-8 | |

# Czech Republic

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| 2.1 What are the Frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 GSM-R | 876-880,1 MHz;  921-925,1 MHz | *Standard 1:*  Name: CEPT ECC Decision (02)05  (URL): <http://www.erodocdb.dk/docs/doc98/official/pdf/ECCDEC0205.pdf>  *Standard 2:*  Name : CEPT Recommendation T/R 25-09 | <http://www.ctu.eu/sites/default/files/obsah/o-ctu/rsup-p_10_08-2012-11_en.pdf> | No |
| 2 PMR/PAMR | 148,2-149,05 MHz;  152,8-153,65 MHz | *Standard 1:*  Name: CEPT Recommendation T/R 25-08  URL: <http://www.erodocdb.dk/docs/doc98/official/pdf/Tr2508.pdf> | <http://www.ctu.eu/sites/default/files/obsah/o-ctu/rsup-p_01_09-2015-06_en.pdf> |

# Finland

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| 2.1 What are the frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 Intermittent Automatic Train Running Control (Finland ATP-RHK/VR) | 27,1 MHz | Standard 1:  Name:\_\_\_\_\_\_\_\_\_\_\_\_  (URL):\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |
| 2 Axle Counter | SkxSA, 30,6 kHz and 28,0 kHz (Thales)  2N59-1R-200-40 SBB, 37,5 - 42,5 kHz (Tiefenbach)  Zp43: 43kHz (Siemens)  MR (ja eMR): 125Hz (Siemens)  FTG S 46: 4.75 kHz; 5.25 kHz; 5.75 kHz; 6.25 kHz (Siemens)  FTG S 917: 9.5 kHz; 10.5 kHz; 11.5 kHz; 12.5 kHz; 13.5 kHz; 14.5 kHz; 15.5 kHz; 16.5 kHz (Siemens)  2N59-1R-400RE-40, 37,5 kHz- 42,5 kHz (Tiefenbach) | Standard 1:  Name:\_EN50126-1/EN50128/EN50129, SSAS4/EN 61000-6-2/EN50121-4  (URL):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  | Not at the moment |
| 3 RFID | Speedway R420 ETSI, 865-868MHz | Standard 1: ETSI 302 208  Name:  (URL):\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  | Not at the moment |
| 4 Eurobalise | 27,1 MHz | Standard 1:  Name:\_\_\_\_\_\_\_\_\_\_\_\_  (URL):\_\_\_\_\_\_\_\_\_\_\_\_\_ |  | Not at the moment |
| 5 Hot box detector | Measuring frequency RSR 180: 250 kHz or 307 kHz  Oscillating mirror: 2,4 kHz  Oscillator on Scanner: 32,786 kHz  Measuring frequency RSR 123: 1 MHz  Oscillator on Scanner MM2: 60 MHz  Oscillator on Scanner MM3: 533 MHz | Standard 1:  Name:\_\_\_\_\_\_\_\_\_\_\_\_  (URL):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  | No at the moment but about in five years some 50 hot box detector will be replaced. |
| 6 GSM-R: – Dispatcher 🡨🡪 Train Driver, Shunting Leader, Track Construction Responsible; voice communication, SMS communication | 876-880 MHz and 921-925 MHz | Radio System : R-GSM  Standard 1: 3GPP: TS45.005 Radio transmission and reception)  <http://www.3gpp.org/DynaReport/45005.htm>  Standard 2: European Union Agency for Railways: GSM-R System Requirements Specification  <http://www.era.europa.eu/Document-Register/Pages/Set-1-and-2-and-3-EIRENESRS.aspx> | channel separation: 200 kHz  antenna type: Omni- and directional antenna systems  antenna gain: 2dBi - 21 dBi  polarization: Vpol und Xpol  e.i.r.p.: min. -14 dBW, max. 37 dBW  receiving noise figure: app. 8 dB  transmission data rate: Up to 8 x 22,8 kbit/s (brutto)  transmission distance (km): typically: ca.8 km, max. 35 km  modulation: GMSK  multiplexing method: TDMA  protection criteria: n/a | Yes, we are planning to migrate GSM-R voice communication to PPDR's existing TETRA system and partly to public mobile network. |
| 7 TETRA – Shunting team communication 2017 🡪 Dispatcher 🡨🡪 Train Driver, Shunting Leader, Track Construction Responsible; voice communication | 380-385 MHz and 390 and 395 MHz, + direct mode channels | ETSI EN 300 392-2 Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 2: Air Interface (AI)  <http://www.etsi.org/deliver/etsi_en/300300_300399/30039202/03.08.01_60/en_30039202v030801p.pdf> |  | Not at the moment |

# France

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| 1 GSM-R:  – Dispatcher 🡨🡪 Train Driver, voice communication  – Trackside 🡨🡪 Train, data communication for ETCS Level 2&3 | 876-880 MHz and  921-925 MHz | Radio System : R-GSM  Standard 1: 3GPP: TS45.005 Radio transmission and reception)  <http://www.3gpp.org/DynaReport/45005.htm>  Standard 2: European Union Agency for Railways: GSM-R System Requirements Specification  <http://www.era.europa.eu/Document-Register/Pages/Set-1-and-2-and-3-EIRENESRS.aspx> |  | ITEM 1: GSM-R to a new technology to be defined by 2022 at EU level  ITEM 2: Analog radio to be suppressed in 2018  ITEM 4: Digital RLE to possibly LTE in 202x  ITEM 5: Analog RLE to be suppressed in 2018 and beyond  ITEM 9 : CCTV 50MHz to be gradually replaced by TVSE-EAS-NG (10 GHz)  ITEM 15 : radio band for CBTC to be defined |
| 2 Analog Radio:  – Dispatcher 🡨🡪 Train Driver & Shunting Staff, voice communication | 457-468 MHz | Radio System: analog railway radio  Standard 1: UIC Code 751-3 “Technical regulations for international analogue ground-train radio systems”  <http://www.uic.org/cdrom/2006/fiches_uic2006/1999_2006/fiches%20%E9lectroniques/anglais/e751x3.pdf> |  |
| 3 KVB – Contrôle Voie Balise: (French Automatic Train Protection System on conventional lines) | 4,5 MHz (DL) & 27 MHz (UL) | <http://www.securite-ferroviaire.fr/reglementations/systeme-de-signalisation-de-classe-b-controle-de-vitesse-par-balises-kvb-equipemen-0> |  |
| 4 Analog RLE - Local Entreprise Radio:  – Train Driver, maintenance staff 🡨🡪 Shunting Staff & Maintenance staff, voice communication | 160-164 MHz  444-445 MHz  457-468 MHz  160 MHz  153 MHz | TETRA – normes [ETSI](https://fr.wikipedia.org/wiki/ETSI) EN 300 392-1 and EN 300 392-2 |  |
| 5 Digital RLE – Local Entreprise Radio:  – Train Driver, maintenance staff, operational staff 🡨🡪 Shunting Staff & Maintenance staff, operational staff, voice communication | 465.1625 MHz /  455.1625 MHz (UL/DL) (TBC) | Analog radio |  |
| 6 Eurobalise Transmit Spectrum | 0,984‑7,484 MHz (part of ETCS, Balise sends to train) | Standard 1: ERTMS Subset 36 FIS for Eurobalise  (URL): [http://www.era.europa.eu/ Document-Register/Pages/Set-3-FIS-for-Eurobalise.aspx](http://www.era.europa.eu/Document-Register/Pages/Set-3-FIS-for-Eurobalise.aspx) |  |
| 7 Telepower to Eurobalise | 27.090 – 27.100 MHz (part of ETCS, train triggers balise) | Standard 1: ERTMS Subset 36 FIS for Eurobalise  (URL): [http://www.era.europa.eu/ Document-Register/Pages/Set-3-FIS-for-Eurobalise.aspx](http://www.era.europa.eu/Document-Register/Pages/Set-3-FIS-for-Eurobalise.aspx) |  |
| 8 Level Crossings remote control | 465.1625 MHz / 455.1625 MHz (UL/DL) (TBC) | TETRA – normes [ETSI](https://fr.wikipedia.org/wiki/ETSI) EN 300 392-1 and EN 300 392-2 |  |
| 9 Closed Circuit Television Systems (CCTV) | 50 MHz | to be completed |  |
| 10 INPT – Acropol Railway Safety Radio with shared resources with ANTARES and TETRAPOL | 380-410 MHz | Tetrapol – [www.tetrapol.com](http://www.tetrapol.com) |  |
| 11 IRIS Railway Safety Radio (TETRA) | 410-414.50 MHz | TETRA – normes [ETSI](https://fr.wikipedia.org/wiki/ETSI) EN 300 392-1 and EN 300 392-2 |  |
| 12 DPAR – Dispositif Portatif d’Annonce automatique par Radio Trackside maintenance warning system communication |  |  |  |
| 13 FH – Faisceau Hertzien  Microwave link | 12 GHz with a 7 MHz bandwidth  13 GHz with a 3.5 MHz bandwidth  22 GHz with a 3.5 MHz bandwidth  23 GHz with a 3.5 MHz bandwidth  26 GHz with a 14 MHz bandwidth  38 GHz with a 7 MHz bandwidth | Analog radio |  |
| 14 Axle Counter |  |  |  |
| 15 CBTC: Communication Based Train Control  Urban-area control command signalling system (project name: NeXTEO) | To be defined | IEEE 802.11a CSMA |  |

# Germany

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| 2.1 What are the Frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 GSM-R:  Dispatcher ↔ Train Driver & Shunting Staff, voice communication  Trackside ↔ Train, data communication | 873-876 / 876-880 MHz and 918-921 / 921-925 MHz | Radio System: R-GSM  Standard 1: 3GPP: TS45.005 Radio transmission and reception)  <http://www.3gpp.org/DynaReport/45005.htm>  Standard 2: European Union Agency for Railways: GSM-R System Requirements Specification  <http://www.era.europa.eu/Document-Register/Pages/Set-1-and-2-and-3-EIRENESRS.aspx> | channel separation: 200 kHz  antenna type: Omni- and directional antenna systems  antenna gain: 2 dBi - 21 dBi  polarization: vertical and cross  e.i.r.p.: min. -14 dBW, max. 37 dBW  receiving noise figure: app. 8 dB  transmission data rate: Up to 8 x 22,8 kbit/s (brutto)  transmission distance: typically: ca.8 km, max. 35 km  modulation: GMSK  multiplexing method: TDMA  protection criteria: n/a | ITEM 3: Continuous Automatic Train Running Control to ETCS (ITEM 6/7) until 31.12.2030.  ITEM 5: Eurobalises until 31.12.2021 (with the same frequency utilisation) |
| 2 Analog Radio:  Dispatcher ↔ Train Driver & Shunting Staff, voice communication | 68‑87,5 MHz (4 m Band)  146‑174 MHz (2 m Band)  443‑470 MHz (70 cm Band) | Radio System : analog railway radio  Standard 1: UIC Code 751-3 “Technical regulations for international analogue ground-train radio systems”  <http://www.uic.org/cdrom/2006/fiches_uic2006/1999_2006/fiches%20%E9lectroniques/anglais/e751x3.pdf>  Standard 2: “Radio equipment with an internal or external RF connector intended primarily for analogue speech;  Part 1: Technical characteristics and methods of measurement”  <http://www.etsi.org/deliver/etsi_en/300001_300099/30008601/01.04.01_60>  Standard 3: “Radio equipment with an internal or external RF connector intended primarily for analogue speech;  Part 2: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive”  <http://www.etsi.org/deliver/etsi_en/300001_300099/30008602/01.03.01_60>  Standard 4: VOEV 04.05.3:1982, Technical Requirements For Data And Speech Mobile Radios  <http://infostore.saiglobal.com/EMEA/Details.aspx?ProductID=773026> | channel separation: 25 kHz  antenna type: omni- and directional antenna systems  antenna gain: 1,8-17 dBi  polarization: Vpol  e.i.r.p.: min -3,1 dBW, max 24,5 dBW  receiving noise figure: app. 4-5 dB  transmission data rate: -/-  transmission distance: 10-20 km  modulation: FM  multiplexing method: -/-  protection criteria: n/a |
| 3 Continuous Automatic Train Running Control | 36 kHz +/- 0,4 kHz and 56 kHz +/- 0,2 kHz | Standard: ORE, Report DT 123 (A 46/S 1005), Utrecht, April 1981 | antenna type: ferrite rod antenna  transmission data rate: 1200 Baud / 600 Baud  transmission distance: 1 m  modulation: FSK +/- 0,4 kHz or +/- 0,2 kHz |
| 4 Intermittent Automatic Train Running Control | 500 Hz / 1000 Hz / 2000 Hz | Standard 1: Proprietary, no standard available  English Wiki:  <https://en.wikipedia.org/wiki/Punktf%C3%B6rmige_Zugbeeinflussung> | - no information - |
| 5 Intermittent Automatic Train Speed Control  ZUB122 | 850 kHz transmission train to trackside  50 Hz transmitter circuit  100 Hz energy supply during communication | Proprietary, no standard available  DB internal product solution according DB internal regulation 418.3250 (version from 13.12.2015) | antenna type: loop antenna  loop length: up to 500 m  transmission data rate: 50 kBaud  modulation: FSK  transmission distance: 1 m |
| 6 Eurobalise Transmit Spectrum | 0,984‑7,484 MHz (part of ETCS, Balise sends to train) | Standard 1: ERTMS Subset 36 FIS for Eurobalise  (URL): <http://www.era.europa.eu/Document-Register/Pages/Set-3-FIS-for-Eurobalise.aspx> | antenna type: loop antenna  transmission data rate: 564 kBaud  modulation: FSK  transmission distance: 1 m |
| 7 Telepower to Eurobalise | 27.090‑27.100 MHz (part of ETCS, train triggers balise) | Standard 1: ERTMS Subset 36 FIS for Eurobalise  (URL): <http://www.era.europa.eu/Document-Register/Pages/Set-3-FIS-for-Eurobalise.aspx> | antenna type: loop antenna  transmission data rate: 564 kBaud  modulation: FSK  transmission distance: 1 m |
| 8 Radio Remote Control System of Traction Vehicle for Freight Vehicles  <http://www.cattron-theimeg.de/product-portfolio/th-ecloII.html> | 419,730 MHz (DB)  419,770 MHz (DB)  419,790 MHz (DB)  429,730 MHz (further Railways)  429,770 MHz (further Railways)  429,790 MHz (further Railways) | Standard 1: EN 50239:1999  <http://shop.bsigroup.com/ProductDetail/?pid=000000000030268844>  Standard 2: ETSI EN 300 113  <http://www.etsi.org/deliver/etsi_en%5C300100_300199%5C300113%5C02.01.00_20%5Cen_300113v020100a.pdf>  Standard 3: ETSI EN 300 220  <http://www.etsi.org/deliver/etsi_en/300200_300299/30022001/02.04.01_40/en_30022001v020401o.pdf> | channel separation: 12,5/20/25 kHz  antenna type: omni- and directional antenna systems  antenna gain: due to operational needs  polarization: vertical  transmitted RF power: 500 mW (standard), optional up to 2 W  transmission data rate: 3 100 bit/sec / RF transmission (12,5 kHz)  4 800 bit/sec / RF transmission (20/25 kHz)  transmission distance: < 1 km  modulation: F3D  multiplexing method: TDMA |
| 9 Radar Scanner for Level Crossings  <https://aerospace.honeywell.com/en/products/navigation-and-sensors/honeywell-radar-scanner> | 76-77 GHz | Standard 1: to be completed | channel separation: -/-  antenna type: -/-  antenna gain: -/-  polarization: -/-  e.i.r.p.: -/-  receiving noise figure: -/-  transmission data rate: -/-  transmission distance: -/-  modulation: -/-  multiplexing method: -/-  protection criteria: -/- |
| 10 Radio-operated Approach Annunciator  <https://www.mobility.siemens.com/mobility/global/SiteCollectionDocuments/en/rail-solutions/rail-automation/level-crossing-protection-systems/simis-lc_en.pdf> | Data Application in GSM-R: 876-880 MHz and 921-925 MHz | No standard available, business solution from Siemens | channel separation: -/-  antenna type: -/-  antenna gain: -/-  polarization: -/-  e.i.r.p.: -/-  receiving noise figure: -/-  transmission data rate: -/-  transmission distance: -/-  modulation: -/-  multiplexing method: -/-  protection criteria: -/- |
| 11 Axle Counter | Sk11 (Thales) 5060 Hz  ZP 70 (Siemens) 9,8 kHz ± 1,0 kHz  Zp 30 Family (Thales) 27,0 kHz bis 32,0 kHz  DSS 200-45 (Pintsch Tiefenbach) 38-42 kHz  ZP 43 E (Siemens) 43,0 kHz ± 1,0 kHz  ZP D 43 (Siemens) 43,0 kHz ± 2,0 kHz  ZP D 43 I (Siemens) 43,0 kHz ± 2,0 kHz  RSE45 (Siemens) 74,5 kHz ± 5,5 kHz  Axle sensor(AS) 325 kHz ± 20 kHz (Scheidt&Bachmann)  WSD (Siemens) 830 kHz ± 40 kHz (System 1)  960 kHz ± 40 kHz  (System 2)  WSS (Siemens) 830 kHz ± 40 kHz  RSR122 (Frauscher) 1130 kHz ±15 kHz (System 1) 1035 kHz ±15 kHz (System 2)  RSR123 (Frauscher) 1000 kHz ±1 kHz (System 1)  1228,8 kHz ±1 kHz (System 2) | Standards:  EN 50121-1 / EN 50121-4  <http://www.beuth.de/en/standards> | channel separation: -/-  antenna type: -/-  antenna gain: -/-  polarization: -/-  e.i.r.p.: -/-  receiving noise figure: -/-  transmission data rate: -/-  transmission distance: -/-  modulation: -/-  multiplexing method: -/-  protection criteria: -/- |
| 12 CBTC (Communication-Based Train Control)  Airlink operates in line with WLAN standards using either worldwide available free (ISM bands) or licensed frequency bands. | 2.400-2.500 MHz ISM band  (1.785-1.805 MHz LTE-M)  (5.725-5.875 MHz ISM band)  5.905‑5.925 MHz  5.935‑5.965 MHz | Standards:  IEEE 802.11 a/b/g/p  http://www.ieee802.org/11/ | antenna type: Planar or Yagi Antenna  e.i.r.p.: Up to 10 dBm  Transmission distance: up to 1 km |
| 13 SOFIS balises | transmission frequency: 2,45 GHz ISM-Band (2.4000 to 2.4835 GHz; 75 MHz bandwidth) | Standards:  2004/108/EG (EN 61000-6-2, EN 61000-6-4, EN 50121-3-2, EN 50121-4)  2006/95/EG (EN 60215/A2)  1999/5/EG (EN 300 440-2 V.1.1.2) EN 50392  <http://eur-lex.europa.eu/homepage.html>  <http://www.beuth.de/en/standards> | channel separation: -/-  antenna type: -/-  antenna gain: -/-  polarization: 13dBi < Gain < 14dBi  e.i.r.p.: linear, horizontal  receiving noise figure: -/-  transmission data rate: 1200 Baud – SOFIS LG S52830-B210-A6  1200 Baud – SOFIS MILG S52830-B210-A10  9600 Baud – SOFIS FZLG S52830-B210-A7  transmission distance: -/-  modulation: -/-  multiplexing method: -/-  protection criteria: -/- |
| 14 Radio-operated Strike-in and Radio Monitoring Signal for Simis LC  <https://www.mobility.siemens.com/mobility/global/SiteCollectionDocuments/en/rail-solutions/rail-automation/level-crossing-protection-systems/simis-lc_en.pdf> | 467.425 MHz to 468.300 MHz, channel spacing 25 kHz | No standard available, business solution from Siemens | channel separation: -/-  antenna type: -/-  antenna gain: -/-  polarization: -/-  e.i.r.p.: -/-  receiving noise figure: -/-  transmission data rate: -/-  transmission distance: -/-  modulation: -/-  multiplexing method: -/-  protection criteria: -/- |
| 15 Closed Circuit Television Systems (CCTV) & Public Address Systems (PA) | 5.470‑5.725 MHz Wi-Fi band  5.725‑5.875 MHz ISM band | Standard:  Proprietary and IEEE 802.11 n  <http://www.ieee802.org/11/> | antenna type: Planar or Yagi Antenna  e.i.r.p.: Up to 10 dBm  transmission distance: up to 1 km |
| 16 Digital mobile radio (DMR) | DMR 68‑87,5 MHz (4 m Band)  146‑174 MHz (2 m band)  TETRAPOL / TETRA 410‑430 MHz  440‑443 MHz  445‑448 MHz | Standard 1: ETSI Overview  <http://www.etsi.org/website/document/technologies/leaflets/digitalmobilradio.pdf> | see chapter 2.2 |
| 17 Data service for automatic train composition | 167.475 MHz  167.600 MHz  467.900 MHz  468.100 MHz  468.225 MHz  468.250 MHz  458.275 MHz | Standard 1: EN 50239:1999  <http://shop.bsigroup.com/ProductDetail/?pid=000000000030268844>  Standard 2: ETSI EN 300 113  <http://www.etsi.org/deliver/etsi_en%5C300100_300199%5C300113%5C02.01.00_20%5Cen_300113v020100a.pdf>  Standard 3: ETSI EN 300 220  <http://www.etsi.org/deliver/etsi_en/300200_300299/30022001/02.04.01_40/en_30022001v020401o.pdf> | channel separation: 25 kHz  antenna type: Omni and  antenna gain: 0dB  polarization: vertical  transmitted RF power: 500 mW (standard), optional up to 2 W  transmission data rate: 4800 bit/sec  transmission distance: < 1 km  modulation: F3D  multiplexing method: TDMA |

# Hungary

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| 1 Please provide the name(s) of Railway Radiocommunication Systems providing railway traffic control, passenger safety and security for train operations in your country. | 2 What are the technical and operational characteristics of each system? | | |
| 2.1 What are the frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 Analog Radio  Dispatcher ↔ Train drivers and/or shunting staff, voice communication | 148,800-163,900 MHz for local technology communication systems (simplex)  158,100-158,375 MHz (mobile) and 163,100-163,375 MHz (fix) for train radio system  457,400-468,450 MHz for local technology communication systems (simplex)  457,38-458,48 MHz and 467,38-468,48 MHz for UIC 751-3 train radio system | *Standard 1:*  UIC 751-3  <http://www.uic.org/cdrom/2006/fiches_uic2006/1999_2006/fiches%20%E9lectroniques/anglais/e751x3.pdf>  *Standard 2:*  ETSI EN 300 086-2  <http://www.etsi.org/deliver/etsi_en/300001_300099/30008602/01.03.01_60/en_30008602v010301p.pdf> | According to the standard referenced above |
| 2 GSM-R  Dispatcher ↔ Train drivers and/or shunting staff, voice communication  Trackside ↔ Train, data communication  Trackside ↔ Fixed part (data collection, remote control applications) | 876-880 MHz and 921-925 MHz (the installed GSM-R system also capable to support ER-GSM band in the range of 873,2-876 MHz and 918,2-921 MHz, but we do not use this frequency range) | *Standard 1:* 3GPP: TS45.005 Radio transmission and reception <http://www.3gpp.org/DynaReport/45005.htm>  *Standard 2:* ETSI EN 301 502 <http://www.etsi.org/deliver/etsi_en/301500_301599/301502/12.05.01_60/en_301502v120501p.pdf>  *Standard 3:* ETSI EN 301 511 <http://www.etsi.org/deliver/etsi_en/301500_301599/301511/12.01.01_60/en_301511v120101p.pdf> | According to the standard referenced above |
| 3 Eurobalise Transmit Spectrum | 0,984‑7,484 MHz (part of ETCS, Balise sends to train) | Standard 1: ERTMS Subset 36 FIS for Eurobalise  (URL): <http://www.era.europa.eu/Document-Register/Pages/Set-3-FIS-for-Eurobalise.aspx> | According to the standard referenced above |
| 4 Telepower to Eurobalise | 27.090‑27.100 MHz (part of ETCS, train triggers balise) | Standard 1: ERTMS Subset 36 FIS for Eurobalise  (URL): <http://www.era.europa.eu/Document-Register/Pages/Set-3-FIS-for-Eurobalise.aspx> | According to the standard referenced above |

**3 Are you planning to migrate your system? If possible please answer the above questions for the future system(s), and indicate which existing system(s) would be replaced?**

Currently in Hungary the coverage of the different train radio systems is the following:

|  |  |
| --- | --- |
| **Train radio systems** | **Number of km of lines covered by** |
| 160 MHz | 2 000 km |
| 450 MHz | 1 178 km |
| GSM-R I. phase | 935 km |

As it can be seen from the table, the first phase of the GSM-R does not fully cover the currently existing analog radio systems.

Preparation of an additional GSM-R project called the GSM-R II. phase is started in 2016.

The proposed coverage of the second phase will be approx. 2 410 km.

**Migration plans**

| **Railway radio network migration strategy targets** | |
| --- | --- |
| **Old system** | **New system after the migration** |
| 160 MHz and 450 MHz corridor lines which are covered with GSM-R I. phase | GSM-R I. phase |
| 160 MHz main lines | GSM-R I. and II. phase4 |
| 160 MHz regional lines | UIC 751-3 450 MHz system3 |
| 160 MHz local technology comm.1 | 450 MHz local technology comm.2 |
| 450 MHz main lines | GSM-R I. and II. phase4 |
| 450 MHz regional lines | no planned migration3 |
| 450 MHz local technology comm.1 | no planned migration |

**1** According to the first trial tests made with GSM-R it’s likely that the local technology communications (shunting) cannot not be migrated to GSM-R, due to the high reaction times ( between channel request and uplink grant or reject messages) and very limited handheld equipment support for this technology.

**2** The channel raster of the cab radios (locomotive radios) is limited to 25 kHz in the 450 MHz range due to the fact that every cab radio is developed according to the UIC 751-3 standard. Cab radios used in the railway sector will not going to support 12,5 KHz channel raster. In the public sector this raster is denser (12,5KHz), which could limit the migration plans from 160 MHz local technology systems and also might limit the usage of the 450 MHz local technology communication systems (no other system which is supported by cab radios is available for this purpose).

**3** On regional lines where the installation of GSM-R is not financially feasible, probably we will use cost effective 450 MHz UIC 751-3 train radio systems.

**4** On main lines after the completition of the GSM-R I. and II. phase we will be able to migrate from the existing 160 MHz and 450 MHz analog train radio systems to GSM-R.

In Hungary we will migrate the rolling stock to dual mode 450MHz / GSM-R cab radios to be able to handle the above mentioned requirements.

# Iraq

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| 1 Please provide the name(s) of Railway Radiocommunication Systems providing railway traffic control, passenger safety and security for train operations in your country. | 2 What are the technical and operational characteristics of each system? | | | 3 Are you planning to migrate your system? If possible please answer the above questions for the future system(s), and indicate which existing system(s) would be replaced? |
| 2.1 What are the Frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 VHF system (Handheld – Base station- repeater). | 150-160 MHz | N/A | 1. B.W. = 12.5 kHz 2. Output Power = 20-40W 3. Antenna type = OMNI 4. Antenna Gain = 3 -9 dB 5. Polarization = /. 6. Transmission distance = 20 – 50 km 7. Modulation = FM | Yes. |
| 2 GSM-R Systems | N/A | N/A | N/A |

# Italy

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| 1 Please provide the name(s) of Railway Radiocommunication Systems providing railway traffic control, passenger safety and security for train operations in your country. | 2 What are the technical and operational characteristics of each system? | | | 3 Are you planning to migrate your system? If possible please answer the above questions for the future system(s), and indicate which existing system(s) would be replaced? |
| 2.1 What are the frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 GSM-R:  - Traffic controllers ↔ Train Driver, voice communication;  - ETCS Radio block centre ↔ ETCS on board EVC, data communication;  - All operational communication between railway maintainers, on board crew, station crew, office staff, security staff, fire brigade when operating in railway tunnels.  - Data communication for diagnostic and supervision of:  - Wind transversal detection systems;  - Tunnel repeater systems. | 876-880 MHz and 921-925 MHz | Radio System : R-GSM  Standard 1: 3GPP: TS45.005 Radio transmission and reception)  <http://www.3gpp.org/DynaReport/45005.htm>  Standard 2: European Union Agency for Railways: GSM-R System Requirements Specification  <http://www.era.europa.eu/Document-Register/Pages/Set-1-and-2-and-3-EIRENESRS.aspx> | channel separation: 200 kHz  antenna type: Omni- and directional antenna systems  antenna gain: 2dBi - 21 dBi  polarization: Vpol und Xpol  e.i.r.p.: min. -14 dBW, max. 37 dBW  receiving noise figure: app. 8 dB  transmission data rate: Up to 8 x 22,8 kbit/s  transmission distance (km): typically: ca.8 km, max. 35 km  modulation: GMSK  multiplexing method: TDMA  protection criteria: n/a | In the forthcoming years RFI (Italian railway infrastructure manager) has a plan to extend the implementation of ERTMS L2 not only to the new High Speed lines, but also to Conventional lines which will be part of European corridors and to the main Urban node lines. |
| 2 VHF Radio: direct mode used by Infrastructure Manager maintainers  UHF Radio: direct mode used by Train Operating Companies during Shunting operation | 164,700 MHz and 164,750 MHz  440 MHz – 443 MHz | - no available information - | channel separation: 12,5 kHz  antenna type: omnidirectional antenna  antenna gain: n/a  polarization: 360°  e.i.r.p.: 1 – 5 W  receiving noise figure: n/a  transmission data rate: -/-  transmission distance (km): 1 - 2 km  modulation: FM  multiplexing method: -/-  protection criteria: n/a |
| 3 Continuous Automatic Train Running Control (Italian: BACC) | 50 Hz  178 Hz | - no available information - | - no available information - |
| 4 National Automatic Train Control System (Italian: SSC) | 5,75 GHz  5,81 GHz | - no available information - | - no available information - |
| 5 Eurobalise Transmit Spectrum used by National & European Automatic Train Control System (Italian: SCMT/ETCS) | 0,984‑7,484 MHz (part of SCMT&ETCS, Balise sends to train) | Standard 1: ERTMS Subset 36 FIS for Eurobalise  (URL): <http://www.era.europa.eu/Document-Register/Pages/Set-3-FIS-for-Eurobalise.aspx> | Antenna type: loop antenna  Loop length: up to 500m  Transmission data rate: 50 kBaud  Modulation: FSK  Transmission distance: 1 m |
| 6 Telepower to Eurobalise used by National/European Automatic Train Control System (Italian: SCMT/ETCS) | 27.090‑27.100 MHz (part of SCMT&ETCS, train triggers balise) | Standard 1: ERTMS Subset 36 FIS for Eurobalise  (URL): <http://www.era.europa.eu/Document-Register/Pages/Set-3-FIS-for-Eurobalise.aspx> | Antenna type: loop antenna  Transmission data rate: 564 kBaud  Modulation: FSK  Transmission distance: 1 m |
| 7 Radar Scanner for Level Crossings (Italian: PAI-PL) | 9.2‑9.7 GHz in 14 channels | Italian D.M. 28/02/2000 – “National Frequency Band Plan” supplement n.45 at Italian G.U. n.65 of 18/03/2000. | channel separation: see Frequency Bands  antenna types: parabolic and horn  antenna gain: 19 dB and 8.5 dB  polarization: horizontal  e.i.r.p.: 405 mW and 35 mW  receiving noise figure: 15 dB  transmission data rate: 5KHz  transmission distance (km): 0,008 (80m)  modulation: phase  multiplexing method: N.A.  protection criteria: |
| 8 Level Crossings command (Pedal) | (Tekfer) 92 kHz Detector 1  98 kHz Detector 2 | - no available information - | - no available information - |
| 9 Axle Counter (Pedal component system) | (Alstom) 39 kHz Detector 1  50 kHz Detector 2  (Ducati) 47 kHz Detector 1  53/73 kHz Detector 2  (Thales) 29 kHz Detector 1  31 kHz Detector 2 | EN 50121-1  EN 50121-4  FS Railway Standards | - no available information - |
| 10 Hot Box Detector  (Pedal) | (Ducati) 39 kHz Detector 1  50 kHz Detector 2  (Borbardier) 38 kHz Detector 1  42 kHz Detector 2 | EN 50121-1  EN 50121-4  FS Railway Standards | - no available information - |
| 11 Automated Track Workers Systems (ATWS)  (Italian: Sistemi per la Protezione Cantieri) | (Zollner) ZFS model  (transceiver )  Italy licenced frequency: 460,40000 MHz 460,45000 MHz 460,38750 MHz 440,02500 MHz | ETSI EN 300 113-2 | channel separation:12,5 khz  antenna type: ½ Lambda Dipolantenna  antenna gain:0dB  polarization:vertical  e.i.r.p.:1 Watt  receiving noise figure:  transmission data rate:9600 baut  transmission distance (km):3-4 km  modulation:4FSK  multiplexing method: halfplex/time plex  protection criteria: CRC32/XTEA |
| 12 Public Address Systems (PA) WI-FI (WiLife Station) | 2,4 GHz  5 GHz | Standards  IEEE 802.11ac – IEEE 802.11 n – | ( 2x2 MIMO Cisco Meraki MR72)  channel separation: 20MHz  antenna type: omni directional antenna systems  antenna gain: N/A  polarization: dual band double polarizzation  e.i.r.p.: 19 dBm / 20 dBm  receiving noise figure: N/A  transmission data rate: N/A  transmission distance (km): N/A  modulation: OFDM  multiplexing method: -/-  protection criteria: -/- |
| 13 On train Public Address Systems (PA) (Italian: OBOE) | Data services offered by MNO 3G & 4G networks | - no available information - | - no available information - |
| 14 Driving Information System data collection at train depot  (Italian: D.I.S.) | 2,4 GHz | IEEE 802.11 WIFI - IEEE 802.11 b/g | - no available information - |
| 15 Trains diagnostics data communication | Data services offered by MNO 3G networks | - no available information - | - no available information - |

# Japan

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| 1 Please provide the name(s) of Railway Radiocommunication Systems providing railway traffic control, passenger safety and security for train operations in your country. | 2 What are the technical and operational characteristics of each system? | | | 3 Are you planning to migrate your system? If possible please answer the above questions for the future system(s), and indicate which existing system(s) would be replaced? |
| 2.1 What are the frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
|  |  | Specifications of these all railway radiocommunication systems used in Japan are defined by railway companies in conformity with the ministerial ordinance “Technical Regulatory Standards on Japanese Railways” which is enacted by Ministry of Land, Infrastructure, Transport and Tourism. Some existing railway radiocommunication systems have been deployed in accordance with JRS-23400 series that is the part of the Japan Railway Standards defined by former Japan National Railways. Of course, the radio equipment used in these systems are designed and implemented in conformity with the technical characteristics and requirements defined in the Radio Law and the related ministerial ordinances. |  |  |
| 1 Train Radio System (TRS) | 150 MHz band  300 MHz band  400 MHz band | JRS-23400 series\* (in Japanese) | Detail parameters of the all systems are provided in the attached Japanese contribution Documents [5A/253](http://www.itu.int/md/R15-WP5A-C-0253/en) and [5A/254](http://www.itu.int/md/R15-WP5A-C-0254/en). | Japan has been facilitating the digitalization of train radio system. And Japan is interested in the RSTT to provide the high-speed data to the train crews and passengers from the train communication networks. So, Japan has begun to study millimetre-wave band radiocommunication systems for railway systems to provide high-speed data to the train crews and passengers to realize more secure and comfortable railway transport services. |
| 2 Radiocommunication system for High Speed Train (RHST) | 400 MHz band | JRS-23400 series\* (in Japanese) |
| 3 Emergency Alarm Radio System (EARS) | 300 MHz band | JRS-23400 series\* (in Japanese) |
| 4 Radiocommunication system for EMergency Cut Off System (REMCOS) | 150 MHz band |  |
| 5 Radiocommunication system for Electronic Blocking System (REBS) | 300 MHz band | JRS-23400 series\* (in Japanese) |
| 6 Radiocommunication system for Japan Radio Train Control system (JRTC Radio) | 300 MHz band | JRS-23400 series\* (in Japanese), JIS E 3801 (in Japanese),  IEC 62280, IEC/TS 62773 |
| 7 Yard Radio (YR) | 150 MHz band  300 MHz band  400 MHz band | JRS-23400 series\* (in Japanese) |
| 8 Millimetre wave Video Transmission system (MVT) | 43 GHz |  |

# Republic of Korea

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| 1 Please provide the name(s) of Railway Radiocommunication Systems providing railway traffic control, passenger safety and security for train operations in your country. | 2 What are the technical and operational characteristics of each system? | | | 3 Are you planning to migrate your system? If possible please answer the above questions for the future system(s), and indicate which existing system(s) would be replaced? |
| 2.1 What are the frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 LTE-R | 718-728 MHz (uplink)  773-783 MHz (downlink) | Name: LTE-R system requirements  URL: <http://www.tta.or.kr/data/ttas_view.jsp?rn=1&pk_num=TTAI.KO-06.0407> | Frequency range: 718-728 MHz (uplink) 773-783 MHz (downlink)  No. of channels: 1  Channel separation: 10 MHz  Antenna gain: –  Polarization: –  Transmitting radiation power: Terminal: Max. 2 W, Base station: 80 W  e.i.r.p.: –  Receiving noise figure: –  Transmission data rate: Max. 75 Mbps (downlink), Max. 37 Mbps (uplink)  Transmission distance: –  Modulation: OFDMA (downlink), SC‑FDMA (uplink)  Multiplexing method: Full Duplex FDD | NONE |
| 2 VHF system | 153 MHz | Name: KRS CM 0005 – 15 (R), VHF Transceiver (Station)  URL: <http://www.kric.or.kr/jsp/handbook/tei/techdocDetail.jsp?objectId=0900271a8016ab9e&menuId=M01020301&docId=0203011>  Name: KRS CM 0007 – 15 (R), VHF Transceiver (Locomotive)  URL: <http://www.kric.or.kr/jsp/handbook/tei/techdocDetail.jsp?objectId=0900271a8016ab9e&menuId=M01020301&docId=0203011> | Frequency range: 153 MHz  No. of channels: 4  Channel separation: 25 kHz  Antenna gain: 3 dBi  Polarization: –  Transmitting radiation power: Base station: 25 W, Train: 25 W, Portable terminal: 3‑4.8 W  e.i.r.p.: –  Receiving noise figure: –  Transmission data rate: 9.6 kbps  Transmission distance: –  Modulation: FM  Multiplexing method: – |
| 3 TRS | 806-811 MHz (uplink)  851-856 MHz (downlink) | Name: TTA TTAS.KO-09.0037, Korea Digital TRS (TETRA) Basic Standard  URL: <http://www.tta.or.kr/data/ttas_view.jsp?rn=1&pk_num=TTAS.KO-09.0037> | Frequency range: *ASTRO*: 806-811 MHz (uplink); 851-856 MHz (downlink) *TETRA*: 806-811 MHz (uplink); 851-856 MHz (downlink)  Channel separation:  *ASTRO*: 12.5 kHz, 25 kHz *TETRA*: 25 kHz  Antenna gain:  *ASTRO*: 3 dBi *TETRA*: 3 dBi  Polarization: –  Transmitting radiation power: *ASTRO*: Base station: 70 W, Train: 30 W, Portable terminal: 3 W *TETRA*: Base station: 25 W, Train: 3 W, Portable terminal: 1 W  e.i.r.p.: –  Receiving noise figure: –  Transmission data rate: *ASTRO*: 9.6 kbps *TETRA*: 36 kbps  Transmission distance: –  Modulation:  *ASTRO*: C4FM (Continuous 4 level FM) *TETRA*: π/4 DQPSK  Multiplexing method: *ASTRO*: FDMA *TETRA*: TDMA |
| 4 TRPD (Train Radio Protection Device) | 443.3125 MHz | Name: KRS CM 0014 08(R) Train Radio Protection Device  URL: <http://www.kric.or.kr/jsp/handbook/tei/techdocDetail.jsp?objectId=0900271a80078483&menuId=M01020301&docId=0203011> | Frequency range: 443.3125 MHz  No. of channels: 1  Channel separation: 12.5 kHz  Antenna gain: 3 dBi  Polarization: Vertical  Transmitting radiation power: 36 dBm  e.i.r.p.: 39 dBm  Receiving noise figure: Under 2 dB  Transmission distance: 8 kbps  Modulation: GMSK (Gaussian Minimum Shift Keying)  Multiplexing method: Single |
| 5 Video for Platform | 18.86-18.92 GHz  19.20-19.26 GHz | Name: KR Code 2012 KR I-05070 Platform Video System  URL: <http://kr.or.kr/boardCnts/view.do?boardID=1000009&boardSeq=17818&lev=0&m=041101&searchType=null&statusYN=C&page=46&s=krhome> | Frequency range: 18.86-18.92 GHz, 19.20-19.26 GHz  No. of channels: 6  Channel separation: 10 MHz  Antenna gain: –  Polarization: –  Transmitting radiation power: 100 mW  e.i.r.p.: –  Receiving noise figure: –  Transmission distance: 1.5-2.5 km  Modulation: OFDM  Multiplexing method: – |

# Malta

There are no railways in Malta.

# Netherlands

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| 1 Please provide the name(s) of Railway Radiocommunication Systems providing railway traffic control, passenger safety and security for train operations in your country. | 2 What are the technical and operational characteristics of each system? | | | 3 Are you planning to migrate your system? If possible please answer the above questions for the future system(s), and indicate which existing system(s) would be replaced? |
| 2.1 What are the Frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 GSM-Rail (ETCS/ERTMS  level 2) | UL: 876-880 MHz;  DL: 921-925 MHz | Standard 1:  Name: 3GPP TS 45.005  URL: <https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=2709> | Channel separation: 200 kHz  Antenna beamwidth: 90° or 120° (az)  Antenna gain: 18 dB  e.i.r.p.: 61 dBm  Receiver noise figure: 8 dB  Intersite distance:  3-4 km (urban); 8 km (rural)  Modulation: GMSK  Minimum coverage level: -72 dBm  Minimum *C/I*: 12 dB (17 dB for ETCS/ERTMS level 2) | Future spectrum options for GSM-R to consider are:  – Extension of the UIC band with:  UL: 873-876 MHz; DL: 918-921 MHz  – 700 MHz band: UL: 698-703 MHz, DL: 753-758 MHz and/or UL: 733-736 MHz, DL: 788-791 MHz |

# Netherlands – ProRail

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| 1 Please provide the name(s) of Railway Radiocommunication Systems providing railway traffic control, passenger safety and security for train operations in your country. | 2 What are the technical and operational characteristics of each system? | | | 3 Are you planning to migrate your system? If possible please answer the above questions for the future system(s), and indicate which existing system(s) would be replaced? |
| 2.1 What are the frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| GSM-R | 876-880 MHz and 921-925 MHz | EIRENE 7.4.0/15.4.0 <http://www.uic.org/gsm-r> | Most of the technical parameters are imbedded in the standards (see 2.2) | ProRail is planning to replace the GSM-R system when it has reached “end of life” around 2030. The successor of GSM-R is unknown at the moment and is currently defined by the FRMCS (Future Radio Mobile Communications System) program under the UiC. |
| Microwave | 18/26/38 GHz | ETSI EN 302 217-2-2 <http://www.etsi.org> | Most of the technical parameters are imbedded in the standards (see 2.2) | ProRail wants to reduce the number of microwaves in the GSM-R network and replace them with fixed fiber connections. |
| EuroBalises | 27,095MHz and 4,515MHz |  | Most of the technical parameters are imbedded in the standards (see 2.2) | The number of Eurobalises will grow significantly the coming year when ERTMS is further deployed in the Netherlands. No replacement foreseen. |
| Marine VHF Radio | VHF channel 18, 20 and 22 |  | Most of the technical parameters are imbedded in the standards (see 2.2) | The Marine VHF Radio is used for a small number of bridges. No replacement foreseen. |

# Norway

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| 1 Please provide the name(s) of Railway Radiocommunication Systems providing railway traffic control, passenger safety and security for train operations in your country. | 2 What are the technical and operational characteristics of each system? | | |
| 2.1 What are the frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 GSM-R including GPRS  – Voice and data | 876-880 / 921-925 MHz | *Standard 1:* 3GPP: TS45.005 (Radio transmission and reception) <http://www.3gpp.org/DynaReport/45005.htm>  *Standard 2:* European Union Agency for Railways: GSM-R System Requirements Specification <http://www.era.europa.eu/Document-Register/Pages/Set-1-and-2-and-3-EIRENESRS.aspx> | Jernbaneverket who is the GSM-R operator in Norway have been issued a frequency license (a spectrum license) by the Norwegian Communications Authority. The license specify the technical conditions for use of the frequency band 876-880 / 921-925 MHz <http://frekvens.nkom.no/Frekvensportalen/tillatelser/1003386.pdf>  Norwegian Communications Authority have defined the usage right according to harmonized use of the frequencies in Europe (ECC/DEC(02)05 and standards EN 301 502 and EN 301 511). Jernbaneverket operates GSM-R in accordance with the specified terms and conditions of the license. |
| 2 Analogue UHF radio  – Shunting radio | 36 channels in the  450-470 MHz range |  | Jernbaneverket who operates shunting radio services in Norway have been issued a frequency license by the Norwegian Communications Authority for use of specified 25 kHz channels in the UHF band. The current use is by handheld terminals transmitting at maximum 5 W. |
| 3 European Rail Traffic Management System (ERTMS)  <https://ec.europa.eu/transport/modes/rail/ertms_en>  In Norway we are in the process of developing and implementing European Transport Control System (ETCS) / Automatic Train Protection (ATP) of the ERTMS where GSM-R currently are the carrier of signals between rolling stock (trains) and traffic control systems in the ERTMS system. Rolling out ERTMS is on a very early stage in Norway. Starting to implement and using signaling systems class A and B in larger scale will mean increased use of axel counters. |  |  |  |

**3 Are you planning to migrate your system? If possible please answer the above questions for the future system(s), and indicate which existing system(s) would be replaced?**

ITEM 1: To use GSM-R for shunting radio and phase out the UHF based shunting radio services are currently under consideration. The current license for use of UHF channels expire by 31. December 2016. Jernbaneverket have applied for a license for use of UHF channels for 2017. In the application it is indicated that Jernbaneverket are looking into ending their use of UHF band for analogue radio but they will not be able to draw any conclusions until 2017.

Jernbaneverket who operates the GSM-R network have not yet adopted a formal position on the future of GSM-R and what technology to deploy after GSM-R. Jernbaneverket have indicated that their preferences are likely to be following a harmonized European approach on use of frequencies for future rail radio systems (Future Railway Mobile Communication System – FRMCS). Jernbaneverket have indicated that they are most likely to adopt a position which is in line with views that has been expressed by other GSM-operators in Europe regarding the successor system for GSM‑R should consider the opportunity to enlarge the market size and product ecosystem by following the main mobile standards used by commercial operators and base themselves on commercially available carrier sizes. Jernbaneverket have indicated that they have a preference for maintaining their use of the 876-880 / 921-925 MHz band and add bandwith from the band below the current GSM-R band to be able to operate on a 5 MHz carrier basis. Jernbaneverket have also indicated that it will be necessary to find a migration solution that are most likely to implicate use of additional spectrum in a transposition period to be able to change technology and at the same time be able to operate trains in Norway.

# Qatar

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| 1 Please provide the name(s) of Railway Radiocommunication Systems providing railway traffic control, passenger safety and security for train operations in your country. | 2 What are the technical and operational characteristics of each system? | | | 3 Are you planning to migrate your system? If possible please answer the above questions for the future system(s), and indicate which existing system(s) would be replaced? |
| 2.1 What are the Frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| CBTC/TCS for Signalling / Traffic control | 2.4 GHz for Doha Metro and 5.9 GHz for Lusail LRT | EN 301893, IEEE 802.11 | TCS for Lusail LRT uses three non-adjacent channels in 5.9 GHz range; channel BW 5 MHz; Max e.i.r.p. 30 dBm; OFDM modulation; CBTC for Metro utilises the ISM band at 2.4 GHz with FHSS; 80 MHz bandwidth; 79 MHz for FHSS & 1 MHz for each | Not for the time being as we are green field project. However, migration to LTE will be assessed once technology is fully standardized and matured in rail environment |
| Tetra for critical communication | 410-430 MHz for both Doha Metro and Lusail LRT | ETSI 300 392-1 | 7 TMO and 1 DMO; e.i.r.p. for BTS 40 dBm and for handheld 30 dbm; omni and directional antennas 7 dBi to dBi. |
| Wi-Fi BBRS for train to ground data communication | 5.8 GHz for both Doha Metro and Lusail LRT | IEEE 802.11 | Channel 149 and 165; e.i.r.p. - 33 dB; Data rate 144.4; vertical and horizontal polarisation; Gain 9 to 18; 64 QPSK |

# Russian Federation

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| 1 Please provide the name(s) of Railway Radiocommunication Systems providing railway traffic control, passenger safety and security for train operations in your country. | 2 What are the technical and operational characteristics of each system? | | | | 3 Are you planning to migrate your system? If possible please answer the above questions for the future system(s), and indicate which existing system(s) would be replaced? |
| 2.1 What are the Frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? | |
| 1 Analogue radiocommunication system – MF range | 2,130 MHz  2,150 MHz | Standard 1: No corresponding standards | Antennas: omnidirectional, directional，waveguide  Polarization: horizontal; vertical  Transmitter output power: up to 10W  Type of modulation: FM  Typical range: up to 10 km | Note: The technical parameters of the RF interface could include channel separation, antenna type, antenna gain, polarization, e,i.r,p., receiving noise figure, transmission data rate, transmission distance (km), modulations multiplexing method, protection criteria, etc. | It is planned to migrate a number of VHF-band analogue radiocommunication networks to work with the DMR-standard radio interface |
| 2 Analogue radiocommunication system – VHF range | 151,7125 – 154,0125 MHz  154,9875 – 156,0125 MHz | Standard 1: No corresponding standards  Standard 2: <http://docs.cntd.ru/document/gost-12252-86> | Frequency grid: 25 kHz, 12.5kHz  Antennas: rod, co-linear, loop, Yagi  Polarization: vertical  Transmitter output power: 2 W (portable radios), up to 10 W for fixed radios  Type of modulation: FM  Typical range: up to 10 km |
| 3 TETRA | 457,40 – 458.45 MHz  467,40 – 468.45 MHz | [http://www.etsi.org/standards-search#page=1&search=TETRA&title=1&etsiNumber=1&content=1&version=0&onApproval=1&published=1&historical=](http://www.etsi.org/standards-search%23page=1&search=TETRA&title=1&etsiNumber=1&content=1&version=0&onApproval=1&published=1&historical=) | Frequency grid: 25 kHz  Antennas: panel, co-linear, rod  Polarization: vertical  Gain: up to 15 dB  Transmitter output power: up to 25 W  Type of modulation: DQPSK  Typical range: 12 km |
| 4 GSM-R | 876 - 880 MHz  921 – 925 MHz | Standard 1:3GPP:TS45.005 Radio transmission and reception  <http://www.3gpp.org/DynaReport/45005.htm>  Standard 2:European Union Agency for Railways:GSM-R System Requirements Specification  [http://www.era.europa.eu/Document-Register/Pages/Set-1-and -2-and-3-EIRENESRS.aspx](http://www.era.europa.eu/Document-Register/Pages/Set-1-and%20-2-and-3-EIRENESRS.aspx) | Frequency grid: 200 kHz  Types of Antenna: panel, rod, with circular antenna pattern, directional  Antenna gain: 2-20 dBi  Polarization: vertical  Transmitter output power: 2 W(hand-held radio), 8 W(locomotive-based radio), up to 50 W base station  Type of modulation: GMK  Channel-spacing method: TDMA |
| 5 DMR | 151,7125 – 154,0125 MHz  154,9875 – 156,0125 MHz | Standard 1.No corresponding standards  Standard 2.  <http://www.etsi.org/deliver/etsi_ts/102300_102399/10236101/02.04.01_60/ts_10236101v020401p.pdf> | Frequency grid: 12.5 kHz  Antennas: rod, co-linear, Yagi; with circular radiation pattern  Antenna gain: up to 17 dBi  Polarization: vertical  Transmitter output power: 2 W (hand-held radio), 10 W(locomotive-based radio), up to 40 W base station |
| 6 DECT | 1880,0 – 1900,0 MHz | Standard 1.  [http://www.etsi.org/standards-search#page=1&search=TETRA&title=1&etsiNumber=1&content=1&version=0&onApproval=1&published=1&historical=](http://www.etsi.org/standards-search%23page=1&search=TETRA&title=1&etsiNumber=1&content=1&version=0&onApproval=1&published=1&historical=) | Used bandwidth: 20 MHz  Mean emission power of base and user stations: up to 10 Mw  Types of antenna: panel, directional  Polarization: vertical; horizontal  Antenna gain: 15 Db  Typical range: 200-500 m |
| 7 SAI Palma | 865,0; 867,0; 869,0 MHz | Standard 1.  <http://www.iso.org/iso/home/store/catalogue_ics/caalogue_detail_ics.htm?csnumber=59644>  Standard 2.  <http://www.iso.org/iso/home/store/catalogue_ics/caalogue_detail.htm?csnumber=18435>  Standard 3.No international standards  <http://npogdps.com/asset/files/07-11/sai.pdf> | Transmitter power: up to 2 W  Types of antenna: panel, directional  Antenna gain: up to 5 dB Typical range: 5 m |
| 8 Prizama-K | 76.6 +/- 0.15 GHz | Business solution  <http://dokltd.ru/products/a20192> | Type of modulation: FMCW  Transmitter power: 100 gW  Types of antenna: parabolic, diameter 60 cm  Antenna gain: 48 dB  Beamwidth: 0,42 degrees  Typical range: 500 m  Velocity measurement range: 1-100 km/h  Distance measurement range: 1.5-500 m |
| 9 RUTP/SUTP | 155,0750 – 155,2750 MHz | Standard 1.<http://docs.cntd.ru/document/gost-12252-86>  Standard 2.Business solution  <http://www.findpatent.ru/patent/238/2385247.html> | Data transfer  Frequency grid: 25 kHz  Antennas: rod, co-linear, loop, Yagi;  Polarization: vertical  Transmitter output power: up to 10 W for fixed and locomotive-borne radios  Type of modulation: FM  Typical range: up to 10 km |
| 10 RRL | 394…410/434…450 MHz  3600 – 4200 MHz  4400 – 5000 MHz  7900 – 8400 MHz  14,5 – 15,35 GHz  25,25 – 27,5 GHz | 1.<http://www.micran.ru/productions/telecommunication/radio_rel/MIC-RL400R/tech/>  2.[http://www.network-service.ru/index.php?go=Content&id=19#3](http://www.network-service.ru/index.php?go=Content&id=19%233)  3.<https://telekom.org.ru/katalog-naimenovanii-res/near-interlink-nl-2005/>  4. <https://telekom.org.ru/katalog-naimenovanii-res/near-interlink-nl-292>  5.<http://www.nateks.ru/catalog/besprovodnye-resheniya/radioreleynye-sistemy-semeystva-nateks-microlink/nateks-microlink-6-fos-38-fos>  6.<http://microlink.ru/mlink-g/> | l . Type of modulation: QPSK  Types of antenna: log-periodic Polarization: vertical, horizontal  Gain: 14 dB  Transmitter power: 2 W  Type of modulation: QPSK  Types of antenna: parabolic Polarization: vertical, horizontal Gain: 35 dB  Transmitter power: 1 W  Type of modulation: QPSK  Types of antenna: parabolic Polarization: vertical, horizontal  Gain: 37 dB  Transmitter power: 0,9 W  of modulation: 128TCM  Types of antenna: parabolic Polarization: vertical, horizontal  Gain: 45 dB  Transmitter power: 0,5 W  Type of modulation: QPSK  Types of antenna: parabolic  Polarization: vertical, horizontal  Gain: 42,5 dB  Transmitter power: 0,04 W  Type of modulation: QPSK  Types of antenna: parabolic  Polarization: vertical, horizontal  Gain: 35,9 dB  Transmitter power: 0, I W |
| 11 Satellite communications | 11450 – 11700 MHz  13750 – 14500 MHz | Standard 1. | Antenna: Cassegrain, prime focus  Polarization: horizontal (transmission), vertical (reception),  Gain Antennas: transmission 55.1 dB, reception 53,1 dB |
| 12 MALS/GALS | 151,7125 – 154,0125 MHz  154,9875 – 156,0125 MHz  457,40 – 458.45 MHz  467,40 – 468.45 MHz  876 - 880 MHz  921 – 925 MHz | Standard 1. <http://docs.cntd.ru/document/gost-12252-86>  Standard 2. No corresponding standards | Data transfer  Frequency grid: 25 kHz  Antennas: rod, co-linear, loop, Yagi  Polarization: vertical  Transmitter output power: up to 10 W for fixed and locomotive-borne radios  Type of modulation: DRCMSK Typical range: up to 10 km  Frequency grid: 25 kHz:  Antennas: panel, co-linear, rod  Polarization: vertical  Gain: up to 15 dB  Transmitter output power: up to 25 W  Type of modulation: 71/4 DQPSK  Typical range: 12 km |
| 13 SIR | 151,7125 – 154,0125 MHz  154,9875 – 156,0125 MHz | Standard 1. <http://docs.cntd.ru/document/gost-12252-86>  Standard 2.No corresponding standards | Data transfer  Frequency grid: 25 kHz  Antennas: rod, co-linear, loop, Yagi  Polarization: vertical  Transmitter output power: up to 10 W for fixed and locomotive-borne radios  Type of modulation: GMSK  Typical range: up to 10 km |
| 14 MSR-32 | 400 – 470 MHz | Standard 1.No corresponding standards.Business solution(Siemens) | Data transfer  Frequency grid: 25 kHz  Antennas: rod, co-linear, loop, Yagi  Polarization: vertical  Transmitter output power: up to 10 W for fixed and locomotive-bome radios  Type of modulation: MSK  Typical range: up to 5 km |
| 15 SDU ML | 151,7125 – 154,0125 MHz  154,9875 – 156,0125 MHz | Standard 1.No corresponding standards | Data transfer  Frequency grid: 25 kHz  Antennas: rod, co-linear, loop, Yagi  Polarization: vertical    Transmitter output power: up to 10 W for  fixed  and locomotive-borne radios  Type of modulation: DRCMSK  Typical range: up to 10 km |
| 16 ASU-D | 876 - 880 MHz  921 – 925 MHz | Standard 1.3GPP:TS45.005 Radio transmission and reception  <http://www.3gpp.org/DynaReport/45005.htm>  Standard 2:European Union Agency for Railways: GSM-R System Requirements Specification  [http://www.era.europa.eu/Document-Register/Pages/Set- I-and-2-and-and-3-EIRENESRS.aspx](http://www.era.europa.eu/Document-Register/Pages/Set-%20I-and-2-and-and-3-EIRENESRS.aspx)  Standard 3. No corresponding standards | Frequency grid: 200 kHz  Types of antenna: locomotive-specific  Antenna gain: 0 dB  Polarization: vertical  Transmitter output power: 2 W (locomotive-borne radio)  Typical range: up to  10 km to base station  Type of modulation: GMSK  Channel-spacing method: TDMA |
| 17 ITARUS | 876 - 880 MHz  921 – 925 MHz | Standard 1.3GPP:TS45.005 Radio transmission and reception  <http://www.3gpp.org/DynaReport/45005.htm>  Standard 2:European Union Agency for Railways: GSM-R System Requirements Specification  [http://www.era.europa.eu/Document-Register/Pages/Set- I-and-2-and-and-3-EIRENESRS.aspx](http://www.era.europa.eu/Document-Register/Pages/Set-%20I-and-2-and-and-3-EIRENESRS.aspx)  Standard 3. No corresponding standards | Frequency grid: 200 kHz  Types of antenna: panel, rod, with circular antenna pattern, directional  Antenna gain: 2-20 dBi  Polarization: vertical  Transmitter output power: 8 W (locomotive-borne radio), up to 40 W base station  Typical range: 5 km  Type of modulation: GMSK  Channel-spacing method: TDMA |
| 18 ASU VOP-2 | 876 - 880 MHz  921 – 925 MHz | Standard l : 3GPP: TS45.005 Radio transmission and reception  <http://www.3gpp.org/DynaReport/45005.htm>  Standard 2: European Union Agency for Railways: GSM-R System Requirements Specification <http://www.era.europa.euDocument-Register/Pages/Set-1-and-2-and-3-EIRENESRS.aspx>  Standard 3. No corresponding standards | Frequency grid: 200 kHz  Types of antenna: panel, rod, with circular antenna pattern, directional  Antenna gain: 2-20 dBi  Polarization: vertical  Transmitter output power; 8 W (locomotive-borne radio), up to 40 W base station  Typical range: 5 km  Type of modulation: GMSK  Channel-spacing method: TDMÅ  Transmitter output power: 250 mW  Type of modulation: DQPSK |
| 19 KUPOL | 154,9875 - 156,0125MHz | Standard l . <http://docs.cntd.ru/document/gost-12252-86>  Standard 2. No corresponding standards | Data transfer  Frequency grid: 25 kHz  Antennas: rod, co-linear, loop, Yagi  Polarization: vertical  Transmitter output power: up to 10 W for fixed and locomotive-borne radios  Type of modulation: FM  Typical range: up to 10 km |

# Spain

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| 1 Please provide the name(s) of Railway Radiocommunication Systems providing railway traffic control, passenger safety and security for train operations in your country. | 2 What are the technical and operational characteristics of each system? | | | 3 Are you planning to migrate your system? If possible please answer the above questions for the future system(s), and indicate which existing system(s) would be replaced? |
| 2.1 What are the frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| GSM-R:  – Dispatcher ↔ Train Driver & Shunting Staff, voice communication  – Trackside ↔ Train, data communication | 876-880 MHz and 921‑925 MHz in use  873-876 MHz and 918‑921 MHz not in used, but foreseen to increase capacity or migration to new system in the future | Radio System: R-GSM  *Standard 1:* 3GPP: TS45.005 Radio transmission and reception)  <http://www.3gpp.org/DynaReport/45005.htm>  *Standard 2:* European Union Agency for Railways: GSM-R System Requirements Specification  <http://www.era.europa.eu/Document-Register/Pages/Set-1-and-2-and-3-EIRENESRS.aspx> | Channel separation: 200 kHz  Antenna type: Directional antenna systems  Antenna gain: 9 dBi – 21 dBi  Polarization: circular, Vpol and Xpol  e.i.r.p.: 53.3 dBm  Transmission data rate: 2 400 to 9 600 bps (data)  Transmission distance (km): typically 4 km  Modulation: GMSK  Multiplexing method: TDMA  Protection criteria: n/a | Analog radio (Tren-Tierra) will be migrated to GSM-R.  GSM-R will be migrated in the future to a new broadband radiocommunication system. This new system is under definition in this moment by UIC (Railways International Union) and ERA (European Railway Agency). |
| Analog Radio (Tren-Tierra):  – Dispatcher ↔ Train Driver & Shunting Staff, voice communication | 447‑460 MHz | *Standard 1:* Name: UIC 751-3  URL: <http://www.uic.org/cdrom/2006/fiches_uic2006/1999_2006/fiches%20%E9lectroniques/anglais/e751x3.pdf> | Frequency range:  447.550‑448.650 MHz (downlink) 457.600‑458.600 MHz (uplink)  FM Modulation duplex  S/N better than 20 dB along the 95% of space and time  Types of antenna: Yagui or Helical  Messages in FSK modulation  50 kHz separation between frequencies |
| LZB  Trackside ↔ Train, data communication | Track to train 36 kHz  Train to track 56 kHz |  | **Trackside** ↔ Train, data communication:  – Transmission track → Train:  Current cable via:> 170 mAeff  Modulation: frequency modulation (FSK): 36 kHz (±400 Hz)  1 → 35.6 kHz  0 → 36.4 kHz  Transmission Rate (emission): 1 200 Bit/sec  – Reception track → Train:  Level in antenna (reception via cable): min. 20 mVeff  Signal / noise for a width 4 kHz band: min. 15 dB  Permissible level difference between the two antennas: max. 6 dB  Necessary phase difference to recognize crossing points between the two reception antennas: 180° +30  **Train** ↔ Trackside, data communication  – Transmission vehicle – Track:  Emission in the vehicle: Emission level (emission via the cable): 32 Vrms about 50 W (20 Watts)  Modulation (receive direction): 56 kHz (±200 Hz)  1 → 55.8 kHz  0 → 56.2 kHz  Transmission speed (receive direction): 600 bit / sec  Phase difference between the two outputs issue: 90°  – Reception on the track: Level in the cable channel (receiving direction): min. 700 mVeff |
| ASFA  Trackside ↔ Train, data communication | 50-120 kHz | "Especificaciones técnicas y funcionales del sistema de Vía ASFA Digital" | |  |  |  |  | | --- | --- | --- | --- | | **Chan.** | **Min. freq.** | **Nomin. freq.** | **Max. freq** | | L-1 | 51 519 | 52 145 | 52 562 | | L0 | 55 027 | 55 695 | 56 141 | | L1 | 59 295 | 60 000 | 60 480 | | L2 | 63 230 | 64 020 | 64 580 | | L3 | 67 520 | 68 310 | 68 880 | | L4 | 72 010 | 72 887 | 73 580 | | L5 | 76 995 | 77 770 | 78 450 | | L6 | 81 980 | 82 980 | 83 730 | | L7 | 87 450 | 88 540 | 89 390 | | L8 | 94 290 | 95 500 | 96 620 | | L9 | 100 946 | 103 007 | 104 215 | |

# Sweden

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| 1 Please provide the name(s) of Railway Radiocommunication Systems providing railway traffic control, passenger safety and security for train operations in your country. | 2 What are the technical and operational characteristics of each system? | | | 3 Are you planning to migrate your system? If possible please answer the above questions for the future system(s), and indicate which existing system(s) would be replaced? |
| 2.1 What are the frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 ATC Balise and Euro Balise | 4.5 MHz | ETSI EN 302 608 | AFSK |  |
| 2 ATC On-board | 27 MHz | ETSI EN 302 608 | AFSK |  |
| 3 Working teams (Railway) | 160 MHz | n/a | Analogue NFM |  |
| 4 Tunnel Rescue | 378 MHz | [www.etsi.org/technologies-clusters/technologies/tetra](http://www.etsi.org/technologies-clusters/technologies/tetra) | Tetra, Radiating Cable |  |
| 5 Radio link for Radio Block | 380 MHz | n/a | Analogue NFM | Radio link – GHz-band |
| 6 "Typhon" Alarm | 406 MHz | n/a | no data |  |
| 7 Fire alarm on overnight trains | 439 MHz | n/a | FSK |  |
| 8 Tunnel Rescue | 448 MHz | n/a | Analogue NFM, radiating Cable | Tetra – 378 MHz |
| 9 Shunting | 460 MHz | n/a | Analogue NFM |  |
| 10 Radio Block | 468 MHz | n/a | AFSK | GSM‑R/ERTMS – 925 MHz |
| 11 RFIB for train identification | 860 MHz | <http://www.etsi.org/technologies-clusters/technologies/radio/rfid> |  |  |
| 12 Train communications | 925 MHz | <http://www.etsi.org/technologies-clusters/technologies/intelligent-transport/railway-communications> | GSM-R | FRMCS – tbd |
| 13 Level crossing detection | 77 GHz | ETSI TR 103 148 | Radar |  |

# Switzerland

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| 2.1 What are the frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 GSM-R:  - Dispatcher ↔ Train Driver & Shunting Staff, voice communication  - Trackside ↔ Train, data communication | 873-876 / 876-880 MHz and 918-921 / 921-925 MHz | Radio System : R-GSM  *Standard 1:* 3GPP: TS45.005 Radio transmission and reception)  <http://www.3gpp.org/DynaReport/45005.htm>  *Standard 2:* European Union Agency for Railways: GSM-R System Requirements Specification  <http://www.era.europa.eu/Document-Register/Pages/Set-1-and-2-and-3-EIRENESRS.aspx> | Channel separation:  200 kHz  Antenna type: Omni- and directional antenna systems  Antenna gain: 2 dBi – 21 dBi  Polarization: Vpol und Xpol  e.i.r.p.: min. -14 dBW, max. 37 dBW  Receiving noise figure: app. 8 dB  Transmission data rate: Up to 8 × 22.8 kbit/s (brutto)  Transmission distance (km): typically: ca. 3 km, max. 35 km  Modulation: GMSK  Multiplexing method: TDMA  Protection criteria: Milenage | Yes, the successor system of GSM-R (FRMCS) will originally be operated in 7 MHz of the 873-876 / 876-880 MHz and 918-921 / 921-925 MHz band. The services of GSM-P in 2G and 3G for non-critical railway applications will be migrated by 4G/LTE in 800 MHz, 1 800 MHz, 2 100 MHz and 2 600 MHz.  *Radio System:* FRMCS (working title)  *Standard 1:* 3GPP: TS 36.2xx, TS 36.3xx, TS 36.4xx (t.b.d)  *Standard 2:* European Union Agency for Railways: FRMCS System Requirements Specification (under construction) |
| 2 GSM-P, UMTS:  – Dispatcher ↔ Train Conductor ↔ Train Driver, voice communication, data communication | 880-915 / 1 920-1 980 MHz and 925-960 / 1 805-1 880 MHz | Radio System : GSM/EDGE  *Standard 1:* 3GPP: TS45.005 Radio transmission and reception)  <http://www.3gpp.org/DynaReport/45005.htm>  Radio System : UMTS  *Standard 2:* 3GPP: TS25.101 User Equipment (UE) radio transmission and reception (FDD)  <http://www.3gpp.org/DynaReport/25101.htm> | GSM-P *(see GSM-R)*  UMTS:  Channel separation: 5 MHz  Antenna type: Omni- and directional antenna systems  Antenna gain: 2 dBi – 18 dBi  TxPower: 46 dBm  Receiving noise figure: 7 dB  Transmission data rate: Up to 40 Mbit/s  Modulation: QPSK/16QAM  Multiplexing method: CDMA |  |
| 3 Analog Radio:  – Dispatcher ↔ Train Driver & Shunting Staff, voice communication | 410-430 MHz  450-470 MHz | Radio System : analog railway radio  *Standard 1:* “Radio equipment with an internal or external RF connector intended primarily for analogue speech;  Part 1: Technical characteristics and methods of measurement”  <http://www.etsi.org/deliver/etsi_en/300001_300099/30008601/01.04.01_60>  *Standard 2:* “Radio equipment with an internal or external RF connector intended primarily for analogue speech;  Part 2: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive”  <http://www.etsi.org/deliver/etsi_en/300001_300099/30008602/01.03.01_60>  *Standard 3:* VOEV 04.05.3:1982, Technical requirements for data and speech mobile radios  <http://infostore.saiglobal.com/EMEA/Details.aspx?ProductID=773026> | Channel separation: 25 kHz/12.5 kHz  Antenna type: omni- and directional antenna systems  Antenna gain: 1.8-17 dBi  Polarization: Vpol  e.i.r.p.: min. –3.1 dBW, max. 24.5 dBW  Receiving noise figure: app. 4-5 dB  Transmission data rate: -/-  Transmission distance (km): 10‑20 km  Modulation: FM  Multiplexing method: -/-  Protection criteria: n/a |  |
| 4 POLYCOM:  – Police/ Firefighters/Ambulance ↔ Train Emergency Staff, voice and data communication | 380-400 MHz | Radio System POLYCOM:  Technology Overview  <http://www.tetrapol.com/>  “TETRAPOL Specifications; Part 2: Radio Air Interface”, Owner TETRAPOL Forum, Version 3.0.0, 10. November 1999  Guideline: Bundesamt für Verkehr BAV “Richtlinie betreffend POLYCOM in Bahntunneln” 7. Juni 2010  <https://www.bav.admin.ch/bav/de/home/rechtliches/rechtsgrundlagen-vorschriften/richtlinien/richtlinien-bahn/polycom-in-bahntunneln.html> | Channel separation 12.5 kHz  Antenna type: omni- and directional antenna systems  e.i.r.p.: 25 Watt  Receiving noise figure: app. 8 dB  Transmission data rate: 8 kBit/s  Transmission distance (km): 6-20 km  Modulation: GMSK, BT = 0.25  Multiplexing method: FDMA  Protection criteria: n/a |  |
| 5 Eurobalise | 0.984‑7.484 MHz (part of ETCS, Balise sends to train) | *Standard 1:* ERTMS Subset 36 FIS for Eurobalise  URL: <http://www.era.europa.eu/Document-Register/Pages/Set-3-FIS-for-Eurobalise.aspx> | Antenna type: loop antenna  Transmission data rate: 564 kBaud  Modulation: FSK  Transmission distance: 1 m |  |
| 6 ZUB 121/262ct Train Running Control | 850 kHz transmission train to trackside  50 kHz transmitter circuit  100 kHz energy supply during communication | *Standard 1:* ERTMS Subset-044 FFFIS for Euroloop  <http://www.era.europa.eu/Document-Register/Documents/Set-2-Index016-SUBSET-044%20v240.pdf>  <http://w1.siemens.ch/mobility/ch/de/nahverkehr/schienenverkehr/bahnautomatisierung/zugbeeinflussung/konventionelle-zugbeeinflussung/Seiten/konventionelle-zugbeeinflussung.aspx> | Antenna type: loop antenna  Loop length: up to 500 m  Transmission data rate: 50 kBaud  Modulation: FSK  Transmission distance: 1 m |  |
| 7 LocControl100:  Radio Remote Control System of Traction Vehicle for Freight Vehicles  <http://www.schweizer-electronic.com/loccontrol100-funk-fernsteuerung.html> | 410-470 MHz | *Standard 1:* EN 50239:  EN 50159-2, EN60870-5-1 Class I3 | - no information - |  |

# Thailand

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| 2.1 What are the Frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| VHF Land Mobile Radio | 137-174 MHz | VHF/FM |  | We are considering the possibility and appropriateness of the frequency band 800/900 MHz to support the introduction of GSM-R/LTE-R systems. Possible options of frequency ranges include:  1) 885-895 MHz and 930-940 MHz  2) 876-880 MHz and 921-925 MHz  3) Other bands, if the above are not applicable. |
| UHF Land Mobile Radio | 380-510 MHz | UHF/FM, TETRA |  |

# United Arab Emirates

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| GSM-R | A sub-system of [European Rail Traffic Management System](https://en.wikipedia.org/wiki/European_Rail_Traffic_Management_System) (ERTMS), it is used for communication between train and railway regulation control centres. The system is based on [GSM](https://en.wikipedia.org/wiki/GSM) and *EIRENE – MORANE* specifications which guarantee performance at speeds up to 500 km/h (310 mph), without any communication loss.  Uplink: 876-880 MHz  Downlink: 921-925 MHz | Standard 1:  Name:\_\_\_\_\_\_\_\_\_\_\_\_ (URL) :\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | GSM-R is a [TDMA](https://en.wikipedia.org/wiki/Time_division_multiple_access) (“Time Division Multiple Access”) system. Data transmission is made of periodical *TDMA frames* (with a period of 4.615 ms), for each carrier frequency (physical channel). Each *TDMA frame* is divided in 8 time slots, named logical channels (577 µs long, each time-slot), carrying 148 [bits](https://en.wikipedia.org/wiki/Bit) of information.  Antenna type: panel antenna duel polarization  Transmission distance (km): 5-10  Antenna gain 20.8 dbi |  |
| Eurobalise | A balise typically needs no power source. In response to [radio frequency](https://en.wikipedia.org/wiki/Radio_frequency) energy broadcast by a [Balise Transmission Module](https://en.wikipedia.org/w/index.php?title=Balise_Transmission_Module&action=edit&redlink=1) mounted under a passing train, the balise either transmits information to the train ('Uplink') | FFFIS for Eurobalise SUBSET-036  <http://www.era.europa.eu/Document-Register/Documents/Set-2-Index009-SUBSET-036%20v300.pdf> | The On-board Transmission Equipment is transmitting a 27 MHz toggling 50 kHz modulated Tele-powering signal. The BTM function shall be informed by the train control system to start-up, and whenever there is a change of operating conditions, whether it shall transmit a 27 MHz signal |  |

# United Kingdom

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| 2.1 What are the frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 Network Rail GSM-R System | UIC 876-880 MHz & 921‑925 MHz | European Union Agency for Railways: GSM-R System Requirements Specification  <http://www.era.europa.eu/Document-Register/Documents/SRS-16.0.0%20UIC%20951-0.0.2.pdf>  <https://en.wikipedia.org/wiki/GSM-R> | 3GPP 2G 200 kHz channel bandwidth GMSK 62 dBm e.i.r.p. | No programme is in place to replace either system, although a proposal to deploy GPRS over GSM-R is under review to support European Rail Traffic Management System (ERTMS) roll-out. RETB is deployed on two lines of route (Far North and West Highland).and the system supports train control (RETB) and driver to signaler voice communications. For areas other than the Far North and West Highland lines, where GSM-R is fully deployed, Network Rail will review technological approaches which could eventually replace GSM-R. Network Rail brings this thinking to its presence on the UIC FRMCS and Shift2Rail Adaptable Communication System work programmes. |
| 2 Network Rail RETB (Radio Electronic Token Block) System | 180-183 MHz &  188-191 MHz | <http://www.rssb.co.uk/rgs/standards/GKGN0554%20Iss%202.pdf>  <http://www.rssb.co.uk/rgs/standards/BR1654%20Iss%202.pdf>  <https://en.wikipedia.org/wiki/MPT-1327> | 12.5 kHz analogue duplex voice and 1200baud data. 25W ERP |

# United States

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| 2.1 What are the Frequency bands in use? | 2.2 Which Radiocommunication standard(s) are applied for each system? Please list the name and provide the Uniform Resource Locator (URL) for the standard(s). | | 2.3 What are the technical parameters of the Radio Frequency (RF) interfaces of each system? |
| 1 Dispatch | 160.215-161.565 MHz 12.5 kHz channel bandwidth(analog), 6.25 kHz digital NXDN | [http://www.ecfr.gov/cgi-bin/text-idx? SID=3dc6ce6a4dac5d202a6aa0d0a49fc70f&mc=true&node=pt47.5.90&rgn=div5](http://www.ecfr.gov/cgi-bin/text-idx?%20SID=3dc6ce6a4dac5d202a6aa0d0a49fc70f&mc=true&node=pt47.5.90&rgn=div5)  Part 27- Subpart G, Part 80- Subpart J, Part 90- Subparts C, S and T, Part 95- Subpart F. | All standards can be found in FCC regulations CFR 47 Part 27, Part 80, Part 90.91, Part 95, or Part 101. | The specific technical parameters of the Radio Frequency (RF) interfaces depend upon the specific product/system implementation.  Note: Due to the private ownership of railways in the United States, the above list of answers for questions #1 and #2 can be considered typical for railway communications systems in the United States but not definitive. | PTC implementation was originally scheduled to be completed by 2015; however, the completion for installation date has been moved to 31 Dec, 2018. In certain cases, the Federal Railroad Administration FRA has the authority to grant a n extension of up to 2 additional years. |
| 2 Train-to-Train/Mobile |
| 3 Defect detector |
| 4 Locomotive health / fuel management reporting |
| 5 Crossing health reporting |
| 6 Switchman communications |
| 7 Yard Operations |
| 8 Engineering performance monitoring |
| 9 Positive Train Control | 217-222 MHz Advanced Civil Speed Enforcement System (ACSES) and Incremental Train Control System (ITCS) 217.6-222 MHz Electronic Train Management System, (ETMS), 700 MHz Guard Band (Communication System TBD) |
| 10 End of Train | 450-460 MHZ Telemetry; End of Train; intra train control of distributed power |
| 11 Automatic Train Control System | 896.888-936.988 MHz Automatic Train Control System |
| 12 Microwave | 2,6,11,18 GHz PtP Microwave | [http://www.ecfr.gov/cgi-bin/text-idx? SID=3dc6ce6a4dac5d202a6aa0d0a49fc70f&mc=true&node=pt47.5.90&rgn=div5](http://www.ecfr.gov/cgi-bin/text-idx?%20SID=3dc6ce6a4dac5d202a6aa0d0a49fc70f&mc=true&node=pt47.5.90&rgn=div5)  Part 101- Subpart H |
| 13 Hi-Rail Compliance limits Warning System | 403-420 MHz PMR, 25 kHz channel bandwidth, 403-420 MHz DMR tier 3. | [http://www.ecfr.gov/cgi-bin/text-idx? SID=3dc6ce6a4dac5d202a6aa0d0a49fc70f&mc=true&node=pt47.5.90&rgn=div5](http://www.ecfr.gov/cgi-bin/text-idx?%20SID=3dc6ce6a4dac5d202a6aa0d0a49fc70f&mc=true&node=pt47.5.90&rgn=div5)  Part 90- Subparts C and S |
| 14 Automatic Equipment Identification | 902-928 MHz Location and Monitoring System |
| 15 Remote Control Switches and Signals | 900 MHz Multiple Address System |

# Uzbekistan

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| **Analogue systems** |  |  |  |  |
| 46MTsV-MS, 43RTS, 71RTS “Motorola” “Vertex” | VHF band: 150‑174 MHz  MF band: 2 130 kHz, 2 150 kHz | Standard: MPT-1327 | Channel split: 12.5; antenna type: rod; antenna gain: 3.6 dB, 9 dB; polarization: vertical; speed: 1.2 kbit/s; range: 30 km; modulation: TDMA |  |
| Fixed radio station RS-46MTsV.01, RS-46MTsV-02, PS-46-MTsV-41 manufactured in the Russian Federation | MF band: 2 130 and 2 150 kHz  VHF band: (for RS-46-MTsV-41): 151.725‑156.000 MHz |  | Modulation: angle; sensitivity: 5 μV; receiver selectivity: not less than 60 dB; electrical power supply: 24V DC and 220V AC, storage temperature (for RPO-unit): ‑25ºC – +50ºC; humidity: 93% at 25ºC: antenna type (for AS-5/2M): circular; antenna gain coefficient (for AS-5/2M): not less than 7 dB; antenna input resistance (for AS-5/2M): 50 Ω |  |
| Mobile radio station 55R22V-1.2 MK  “Transport – RV-1.2 MK” manufactured in the Russian Federation | MF band: 2 130 and 2 150 kHz  VHF band: 151.725‑156.000 MHz | Effect of climate and mechanical factors as per YaUISH.464421.002 TU | Electrical power: 35‑155V, channel width: 25 kHz, MF power up to 14W; VHF power up to 10W; sensitivity (MF) for SINAD 12 dB – not more than 0.5 μV, sensitivity (VHF) for SINAD 12 dB not more than 0.5 μV; operating temperature from -40º to +50ºC, humidity 93% at 25º. |  |
| **Digital systems** |  |  |  |  |
| HYT, manufacturer “Hytera”, People’s Republic of China | VHF band: 150‑174 MHz | Standard: DMR (Digital Mobile Radio) | Channel split 6.25, 12.5; antenna type – rod; antenna gain – 3.6 dB, 9 dB; polarization – vertical; speed – 2 kbit/s; range – 25 km; modulation – TDMA. |  |
| “DRM”-standard radiocommunication system, manufacturer “Hytera”, People’s Republic of China | VHF band: 136‑174 MHz | Protocol DRM Tier II TDMA  Digital protocol – ETSI-TS102 361-1, -2, -3  Military standard (for MD-785, PD-705, PD-785)  (USA) – MIL-STD-810 C/D/E/F/G  Dust and water protection (for MD-785) – IP54  Dust and water protection (for PD-705, PD-785) – IP67 | Channel width – 12.5 kHz, antenna type - circular, antenna gain coefficient – 0 dBi, sensitivity 0.3 μV/m, transmitter output power (for RD.985 and MD-785) 5 – 50 W, modulation – 4FSK (digital mode) and FM (analogue mode), emission class 7K60FXW (digital mode) and 16K0F3E (analogue mode), frequency stability 1.5 ppm, operating voltage (for RD-985 and MD-785) 13.6V ±15 % DC, operating voltage (for PD-705 and PD-785) 7.4V DC, accumulator battery capacity (for PD-705 and PD-785) 2000 mA, antenna resistance 50 Ω;  dimensions (for RD-985) 88 × 483 × 366 mm,  weight (for RD-985) 8.5 kg; dimensions (for MD-785) 60 × 174 × 200 mm, weight (for MD-785) 1.7 kg, dimensions (for PD-705 and PD-785) 125 × 55 × 37 mm, weight (for PD-705 and PD-785) 0.355 kg, operating temperature from -30º to +60ºC, storage temperature -40º to +85ºC. |  |
| RD-985-type relay |  |  |  |  |
| Type MD-785G fixed/mobile radio station |  |  |  |  |
| Type PD-705G and PD‑785 portable radio station |  |  |  |  |

# Viet Nam

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| National railway (The North – South train) |  |  |  | Not yet |
| – Fixed | 1 450-1 500 MHz | ITU Recommendations | BW = 4 MHz,  ITU Recommendations |
| – Private Land Mobile | VHF/UHF | ITU Recommendations | ITU Recommendations |
| Urban rail systems are under construction in Ho Chi Minh City and Ha Noi. |  |  |  |
| We are considering a radio communications for Ben Thanh – Suoi Tien line (a line of the urban rail system in Ho Chi Minh City): |  | We are considering |  |
| – Tetra | 410-415 / 420-425 MHz |  |  |
| – On boad CCTV | 12/13 GHz |  | Considering |
| – Signalling (Balise) | 3‑12 MHz |  | – Balise transmission module: BW = 10 kHz;  analog modulation  – Balise:  BW = 1 600 kHz;  FSK modulation |

# CEPT

**Attachment to doc. FM(16)225 Annex 34**

**Reference**: **Administrative Circular, 5/LCCE/60, 3 June 2016**

**Subject**: **Questionnaire on the usage of railway radiocommunications systems**

**Source: CEPT/ECC (Working Group Frequency Management)**

**Date: 24 October 2016**

Please consider the information provided herein as it may be of assistance to the BR with regard to the frequency usage, the technical characteristics (the relevant documentation is indicated), and a reasonable overview on implementation of GSM-R networks throughout Europe. In this regard, it was felt better to provide the information as given below, instead of using the questionnaire format which may be intended for information submitted by a single country.

1 Available CEPT and ECC documentation

2 ETSI/EU documentation

3 Background – explanations

4 Available implementation information collected by means of two questionnaires to CEPT administrations in 2014 and 2016

This information has been developed and agreed within the framework of CEPT/ECC WGFM.

1 Available CEPT and ECC documentation

CEPT and ECC Documentation (Decisions, Recommendations, Reports)

ECC Report 096: Compatibility between UMTS 900/1800 and systems operating in adjacent bands. Remark: This report was developed by ECC PT1

ECC Report 146: Compatibility between GSM MCBTS and other services (TRR, RSBN/PRMG, HC-SDMA, GSM-R, DME, MIDS, DECT) operating in the 900 and 1800 MHz frequency bands. Remark: Developed in co-operation between WGSE (SE7) and ECC PT1

ECC Report 162: Practical mechanism to improve the compatibility between GSM-R and public mobile networks and guidance on practical coordination

ECC Report 229: Guidance for improving coexistence between GSM-R and MFCN in the 900 MHz band

ECC/REC/(05)08: Frequency planning and coordination of GSM 900, GSM 1800, E-GSM and GSM-R systems

ECC/DEC/(02)05: ECC Decision of 8 March 2013 on the designation and availability of frequency bands for railway purposes in the 876-880 MHz and 921-925 MHz bands

ECC/DEC/(02)09: Free circulation and use of GSM-R mobile terminals 876-880/921-925 MHz for railway purposes

ECC/DEC/(02)10: Exemption from individual licensing of GSM-R mobile terminals 876-880/921-925 MHz for railway purpose

ECC/DEC/(04)06: ECC Decision of 19 March 2004 on the availability of frequency bands for the introduction of Wide Band Digital Land Mobile PMR/PAMR in the 400 MHz and 800/900 MHz bands

2 ETSI/EU Documentation (Directives, Decisions, Recommendations, other), if applicable

ETSI [EN 301 502 Global System for Mobile communications (GSM); Base Station and Repeater equipment](http://www.efis.dk/documents/14386)

ETSI [EN 301 511 Mobile stations in the GSM 900 and GSM 1800 bands covering essential requirements](http://www.efis.dk/documents/14419)

Commission Regulation (EU) 2016/919 of 27 May 2016 on the technical specification for interoperability relating to the ‘control-command and signalling’ subsystems of the rail system in the European Union

European Union Railway Agency: EIRENE SRS-16.0.0 und EIRENE FRS-8.0.0 System Requirement Specifications; adopted on 10 February 2016; new vehicles obliged to have improved reception capabilities (as of 1 June 2016); no obligation to retrofit.

3 Background - Explanations

ECC/DEC/(02)05 designates frequency bands for railway purposes in the 876-880 MHz and 921-925 MHz bands, this is used by GSM-R in Europe.

According to ECC/DEC(02)05 and ECC/DEC/(04)06, the bands 873-876 MHz UL / 918-921 MHz DL can be made available on national level for an extension of GSM-R. This is the E-GSM-R band. With these amended Decisions, CEPT/ECC responded to the request as submitted by ETSI with the System Reference Document ETSI TR 102 627 in 2007. The E-GSM-R band has been covered by the relevant 3GPP standards since Release 12 (3GPP TS 45.005 in September 2013). Currently the revisions of the ETSI European Harmonised Standards are performed to reflect the latest changes in the regulatory domain in Europe (RE Directive).

ETSI EN 301 502 V12.5.1, relevant for GSM and GSM-R base station requirements, was published in July 2016. This version also includes the conditions for the GSM-R extension band (E-GSM-R). The latest draft version of amended ETSI EN 301 511, relevant for GSM and GSM-R user equipment, also includes the conditions for the GSM-R extension band (E-GSM-R).

The Commission Regulation (EU) 2016/919 of 27 May 2016 ”on the technical specification for interoperability relating to the ‘control-command and signalling’ subsystems of the rail system in the European Union” shall be binding in its entirety and directly applicable in all EU Member States. This Commission Regulation refers to the EIRENE (European Integrated Railway Radio Enhanced Network) specifications, i.e. on mandatory specifications. The EIRENE SRS v16.0.0 (System Requirements Specification) and FRS v8.0.0 (System Requirements Specification) both define requirements for the network equipment and the user equipment.

4 Available Implementation information

This information has been collected by means of two questionnaires to CEPT administrations in 2014 and 2016.

Table 1

Country situation in Europe (2014)

|  |  |
| --- | --- |
| Situation | Country |
| GSM-R network implemented and in operation, or in test/ trial phase | Austria, Finland, France, Germany, Norway, United Kingdom, Czech Republic, Greece, Italy, Lithuania, Portugal, Russian Federation, Slovak Republic, Spain, Sweden, Switzerland, Turkey, Belarus, Denmark, Hungary, Ireland, FYROM, Poland |
| GSM-R implemented in the national frequency plan but no network implementation yet | Bosnia Herzegovina, Croatia, Estonia, Latvia, Moldova, Montenegro, Serbia, Slovenia |

According to information in 03/2013, GSM-R (voice and data bearer) was deployed and covers around 68 000 km of tracks in Europe and this approximate figure is confirmed by the answers received in response to a CEPT questionnaire. In Europe, where the total railway network taken into account is about 221 000 km, GSM-R coverage was planned for about 150 000 km according to ETSI TR 102 627, published in 11/2008, also explaining that in September 2007 the network comprised 60 507 km equipped with GSM-R infrastructure, of which 40 918 were in operation by that date.

Figure 1

Country related implementation information (2014)

Figure 1 includes the equipped distances of the railway tracks in the respective years with GSM-R technology. Portugal has up to now only 8 BS covering 40 km railways, Slovak Republic has only 17 BS covering 100 km and the Russian Federation is deploying GSM-R systems in the Krasnodar Territory and Kaliningrad Region.

Spain, United Kingdom: estimates from ETSI TR 102 627 (11/2008) are included in figure 1.

Information about GSM-R deployment in 2016

|  | a) What is the total length of rail tracks (length in km) in your country? | b) What amount of rail tracks (length in km) has been covered by GSM-R? | c) How much remains to be covered? | d) How many GSM-R base stations are currently deployed in your country? |
| --- | --- | --- | --- | --- |
| Czech Republic | 9500 km | 1500 km | 1200 km | 320 |
| Finland | 5944 | ≈5000 | None. Railway traffic will move from GSM-R to existing TETRA based network in the 400 MHz band from year 2018 (planned). | - |
| France | 30 000 km | 16 000 km of deployed GSM-R network  8 000 km of operational GSM-R coverage | The roll out of the GSM-R network infrastructure is done. The process to migrate the analog system to GSM-R system is in progress (end planned in 2017) | 2 500 BTS |
| Germany | ca. 34 000 km | ca. 29 000 km | ca. 1 000 km | ca. 3 800 |
| Greece | about 2 500 km | about 690 km | 17 km | 96 |
| Hungary | 7 938 km | 935 km | approx. 2 394 km | 147 |
| Ireland | Approximately 2 400 km | Approximately 100 km | 2 300 | 42 |
| Italy | 16 726 Km | 11 166 Km | 5 560 Km | 1 825 |
| Liechtenstein | ~10 Km | ~10 Km |  | 1 |
| Lithuania | 1 779 | 1 563 | 216 | 127 |
| Netherlands | ~4 000 km | All | n/a | ~250 |
| Norway | Approximately 3 800 km. | Approximately 3 800 km. | Most of the Norwegian track is already covered. Only some low used side tracks are not covered, and they are not planned to be covered either. | Approximately 540 BTSs. |
| Slovak Republic | 3 625 | 400 | 3 225 | 64 |
| Slovenia | N/A | N/A | N/A | N/A |
| Sweden | 11 000 km | 11 000 km | 0 km | 1 400 base stations and 250 repeaters |
| Switzerland | ~5 380 km (normal gauge) | SBB ~2 050 km  SBB including other companies ~2 280 km | SBB ~2 800 km  SBB including other companies ~3 100 km | SBB ~650 (planed 840 more)  SBB including other companies ~700 (planed 900 more) |
| United Kingdom | 15 500km | 15 108 km | All Network Rail controlled infrastructure has been fitted with GSM-R, with the exception of a few remote lines, where no fitment plans exist | 3 053 cells / 2 427 sites |

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