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| **Radiocommunication Study Groups** |  |
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| Source: Document 5A/TEMP/306 | **Annex 15 to** **Document 5A/844-E** |
| **1 June 2018** |
| **English only** |
| Annex 15 to Working Party 5A Chairman’s Report |
| WORKING DOCUMENT TOWARDS A PRELIMINARYDRAFT NEW RECOMMENDATIONITU-R M.[RSTT\_FRQ] |
| [Harmonization of] frequencies and related frequency arrangements, for railway radiocommunication systems between train and trackside |

([Question ITU-R 37-6/5](http://www.itu.int/pub/R-QUE-SG05.37))

*[****Editor’s note:*** *Title should be updated in the case that not only harmonized band but also country specific frequencies could be described in this Recommendation.]*

(…)

**Scope**

This Recommendation provides guidance on possible harmonization of frequency arrangements for existing and future railway radiocommunication systems between train and tracksides (RSTT) on global or regional basis. [This recommendation provide countries’ frequency arrangements as well.] The relevant frequency arrangements are addressed in the Annexes to this Recommendation.

*[****Editor’s note:*** *scope should be updated in the case that not only harmonized band but also country specific frequencies could be described in this Recommendation. Update could be done by referring to another existing recommendation, for example, Rec. ITU-R M.2015 (PPDR frequency arrangement)]*

Keywords

[Railway Radiocommunication Systems, Frequency arrangement, Train, Trackside, RSTT]

Abbreviations

RSTT Railway Radiocommunication Systems between Train and Trackside

Related ITU Recommendations and Reports

1 Report ITU-R [M.2418](https://www.itu.int/pub/R-REP-M.2418)

2 [Report ITU-R M.](https://www.itu.int/pub/R-REP-M/en)[RSTT.USAGE]

*[****Editor’s note:*** *Hyper-link for the above two documents is needed.]*

The ITU Radiocommunication Assembly,

considering

*a)* that railway transportation systems are growing and evolving;

*b)* that railway radiocommunications systems between train and trackside (RSTT) are vital to provide improved railway traffic control, passenger safety, and improved security for train operations;

*c)* that many administrations wish to facilitate RSTT interoperability, for both national and cross-border operations;

*d)* that some national and international railway organizations and standards bodies have begun investigating new technologies for railway radiocommunication systems;

*e)* that, over time, traditional (analogue or narrowband) RSTT, such as operational voice and data, may be provided by advanced digital systems, where appropriate;

*f)* that there is a need to integrate different technologies in order to facilitate various functions, for instance dispatching commands, operating control and data transmission, into railway train and trackside systems to also meet the needs of a high-speed railway environment;

*g)* that continuing development of new technologies may be able to serve, support or supplement RSTT;

*h)* that administrations may have different requirements for railway operations depending on their national needs, spectrum requirements, policy objectives, and operating environments;

*i)* that the deployment of railway radiocommunication systems between train and trackside requires significant infrastructure investment;

*j)* that cooperation and bilateral [and multilateral] consultation with other concerned administrations and railway organisations will facilitate greater levels of spectrum harmonization;

*k)* that usage of harmonised frequency bands will enable administrations to benefit from harmonization while continuing to meet national planning requirements,

*l)*  that international standards and harmonized frequency spectrum would facilitate worldwide deployment of RSTT and provide for economies of scale in railway transportation

*m)* the continuing need for development of globally or regionally harmonized frequency arrangements for the purposes of implementing RSTT;

*n)* [that, in the context of this Recommendation, the term “harmonized frequency range” means a range of frequencies harmonized globally or regionally over which relevant radio equipment is envisaged to be capable of operating in specific frequency bands/conditions; however, the actual use may be limited according to national and regional conditions and requirements];

*o)* that the harmonization of those frequency bands or parts thereof for RSTT does not preclude the use of, nor establish priority over, any other frequencies for RSTT in accordance with the Radio Regulations and does not preclude the use of these bands/frequencies by any application within the services to which these bands/frequencies are allocated;

*p)* that the frequency bands harmonized by this Recommendation are allocated to a variety of services in accordance with the relevant provisions of the Radio Regulations, especially to the mobile service on primary basis;

*q)* that other radiocommunication systems may effectively complement the dedicated systems in support of RSTT,

recognizing

*a)* that information on RSTT technologies and applications that may be appropriate for use in the frequency arrangements in the Annexes is provided in Report ITU‑R M.[RSTT.USAGE] – “Current and future usage of railway radiocommunication systems between train and trackside” and Report ITU‑R M. 2418– “Description of Railway Radiocommunication Systems between Train and Trackside”;

*b)* that [Recommendation ITU-R SM.1896 Frequency ranges for global or regional harmonization of short-range devices],

*[****Editor’s note:*** *The recognizing b) needs to be improved.]*

noting

*a)* that the benefits of spectrum harmonization for railways are:

– ensured interoperability of railway operations, especially cross-border;

– enabled usage of commercial off the shelf equipment;

– increased volume of equipment resulting in economies of scale and expanded equipment availability; and

– improved spectrum management and planning;

*b)* that the current and future RSTT system use of frequencies for RSTT are listed in Report ITU-R M.[RSTT.USAGE];

*c)* that spectrum planning for RSTT is performed at the national level, taking into account the need for interoperability and benefits of neighbouring administrations using harmonized frequency bands;

*d)* that railway transportation contributes to global economic and social development, especially for developing countries;

*e)* that railway transportation contributes to the goal of reducing carbon emissions;

*f)* the needs of countries, particularly the developing countries, for cost-efficient communication equipment;

*g)* that administrations have the flexibility at national level:

– to determine, how much spectrum is to be made available for RSTT under which conditions in order to meet their particular national requirements;

*h)* that RSTT as a whole consists of subcategories of systems and applications, which operate in various frequency bands under varying restrictions/limitations mostly under mobile service allocations,

recommends

1 that administrations consider using the following harmonized frequency ranges (or parts thereof )for RSTT to extent possible, taking into account the national and regional requirements and also having regard to any necessary coordination with other concerned administrations ;

*[****Editor’s note:*** *The following table is just filled with administrations’ contribution, as it is, which might contain some problems.]*

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| *System/Application* | *Region 1* | *Region 2* | *Region 3* | *[Global]* |
| for train radio  | [541](http://www.itu.int/md/R15-WP5A-C-0541)(Russian);*440-470 MHz;**876-880 MHz;**921-925 MHz;*[612](http://www.itu.int/md/R15-WP5A-C-0612)(African Group)ATU:Simplex138-140 MHz, 150.5-153 MHzDuplex141-143 MHz /146-148 MHz, 153‑154 MHz / 158-159 MHzSimplex417-418 MHz, 443-444 MHzDuplex387-390 MHz / 397-399.99 MHz,415-417 MHz / 425-427 MHz,DuplexFDD 876-880 MHz (UL)921-925 MHz (DL)FDD 452.5-457.475 MHz(UL)462.5-567.475 MHz (DL)[620](http://www.itu.int/md/R15-WP5A-C-0620)(CEPT)ATU:..ASMG:…CEPT:876-880/921-925 MHz (optional extension on national basis 873-876/918-921 MHz)RCC:SAFD:[CEPT’s Note: The other regional organisations in Region 1 are invited to provide further information on their spectrum usage as well] |  | [541](http://www.itu.int/md/R15-WP5A-C-0541)(Russian);*440-470 MHz;**876-880 MHz;**921-925 MHz;*[568](http://www.itu.int/md/R15-WP5A-C-0568)(Korea)*718-728, 773-783 MHz*[590](http://www.itu.int/md/R15-WP5A-C-0590)(Japan)*137-144 MHz**146-156.4 875 MHz**156.5 625-156.7 625 MHz**156.8375-161.9 625 MHz**161.9875-162.0125 MHz**162.0375-174 MHz**335.4-399.9 MHz**401-406 MHz**406.1-430 MHz**440-510 MHz**718-934 MHz**1770-1 880 MHz**[6 GHz, 8 GHz, 10 GHz]**43.5-45.5 GHz*737(Thiland)*876-915 MHz/921-960 MHz*749(Australia)*703-748/758-803 MHz**1 775-1 785/1 870-1 880 MHz* | [568](http://www.itu.int/md/R15-WP5A-C-0568)(Korea)*[718-728, 773-783 MHz]*737(Thiland)*876-915 MHz/921-960 MHz*820(Vietnum)*138-144 MHz**146-174 MHz**406.2-430 MHz**440-470 MHz* |
| for train positioning  |  |  | [568](http://www.itu.int/md/R15-WP5A-C-0568)(Korea)*4.234 MHz, 27 MHz*[590](http://www.itu.int/md/R15-WP5A-C-0590)(Japan)*[3-12 MHz]* | 820(Vietnum)*[984-7 484 kHz]**27.09-27.10 MHz* |
| for train remote  | [541](http://www.itu.int/md/R15-WP5A-C-0541)(Russian);*440‑470 MHz;* |  | [541](http://www.itu.int/md/R15-WP5A-C-0541)(Russian);*440 470 MHz;*[568](http://www.itu.int/md/R15-WP5A-C-0568)(Korea)*443.3125 MHz*[590](http://www.itu.int/md/R15-WP5A-C-0590)(Japan)*403-406 MHz**406.1-420 MHz*820(Vietnum)*2 400-2 483.5 MHz**5 725-5 925 MHz* |  |
| for train surveillance |  |  | [568](http://www.itu.int/md/R15-WP5A-C-0568)(Korea)*18.86-18.92 19.2-19.26 GHz*[590](http://www.itu.int/md/R15-WP5A-C-0590)(Japan)*12-13 GHz**18.86-19.26 GHz**43.5-45.5 GHz**57-66 GHz*820(Vietnum)*12.75-13.25 GHz**92-94 GHz**94.1-100 GHz**102-109.5 GHz* |  |

 *[****Japan’s note:*** *As for frequency bands in Region 3 with [ ] in the table above, more detailed information of band plan is needed in order to consider harmonized ranges.]*

*Editor’s Note: the following table-bis is the result of analysis of frequency excel sheet in [RSTT.USAGE]* (version of 2018/05/27 *which is attached in the end of APPEDIX of this document) and input documents, according to the harmonizing concept which is described in ATTACHMENT.*

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| System/Application | Freq | Option | Region 1 | Region 2 | Region 3 |
| for train radio  | *150 MHz**band**within LMS* | *Option1* | *138-174 MHz* |
| *[Option2]* | *[160-174 MHz]* |
| *[138-160 MHz]* |  | *[138-160 MHz]* |
| *400 MHz band**within**LMS* | *Option1* | *335.4-470 MHz* |
| *Option2* | *403-420 MHz* |
| *340-403 MHz**420-470 MHz* |  | *335.4-403 MHz**420-470 MHz* |
| *700 MHz band**within**LMS* | *Option1* |  |  | *703-803 MHz* |
| *900 MHz band within LMS* | *Option1* | *873-960 MHz* |
| *Option2* | *896.888-925 MHz* |
| *873-896.888 MHz* | *925-936.988 MHz* | *885-896.888 MHz**925-960 MHz* |
| *Option3* | *876-880/921-925 MHz**[873-880/918-925 MHz]* | *[xxx-xxx/xxx-xxxMHz]* | *880-915/925-960 MHz* |
| *Option4* | *876-890 / 921-935 MHz* |
| *873-876/ 918-921 MHz* | *[xxx-xxx/xxx-xxxMHz]* | *890-915/935-960 MHz* |
| *1 700 MHz band within LMS* | *Option1* | *1 775-1 880 MHz* |
| *Option2* |  |  | *1 775-1 880 MHz* |
| *40 GHz**Band**Within**LMS* | *Option1* | *43.5-45.5 GHz* |
| *Option2* |  |  | *43.5-45.5 GHz* |
| *100 GHz**Band**Within**LMS* | *Option1* | *92-109.5 GHz* |
| *Option2* |  |  | *92-109.5 GHz* |
| for train positioning |  |  |  |  |  |
| for train remote |  |  |  |  |  |
| for train surveillance |  |  |  |  |  |

]

2that the frequency arrangements of the harmonized frequency ranges in *recommend 1*in the Annexes *,* should be considered by administrations as guidance when making spectrum available for RSTT applications;

2bis that the frequency arrangements in the Annexes should be considered by administrations when making spectrum available for RSTT applications;

*[****Editor’s note:*** *The following paragraph will be considered whether to be moved to other section at next WP 5A meeting.]*

[3that administrations implementing the frequency arrangements in the Annexes should make all necessary efforts to ensure compatibility between RSTT and stations of other services in neighbouring countries;]

4that administrations follow the development of standards applicable to railway radiocommunications.

Annex 1

Frequency arrangements for railway radiocommunication systems between train and trackside in Region 1

*[****Editor’s note:*** *This annex needs to be further considered in Nov. 2018 meeting.]*

# 1 Train radio

## 1.1 Frequency arrangement in the band 440-470 MHz

*b)* Digital UHF-band systems with a channel bandwidth of 25 kHz in the frequency band 440-470 MHz shall use the operational frequencies as defined by the following expression:

 *fN* = 440 + 0,025 × *N*, where *N* = 1, 2 … 1200;

## 1.2 Frequency arrangement in the band 876-880 MHz and 921-924 MHz

*b)* Digital UHF-band systems with a channel bandwidth of 200 kHz in the frequency bands 876-880 MHz and 921-924 MHz shall use the operational frequencies as defined by the following expressions:

 for the frequency band 876-880 MHz: *fN* = 876 + 0.2×*N*, where *N* = 0, 1, 2 … 19;

 for the frequency band 921-925 MHz: *fN* = 921 + 0.2×*N*, where *N* = 0, 1, 2 … 19.

## 1.3 Frequency arrangement in CEPT

 Technology: GSM-R

 Channel bandwidth: 200 kHz

 Duplex frequency separation: 45 MHz

**Harmonised band**

 Uplink: 876-880 MHz

 Downlink: 921-925 MHz

**Extension band on national basis**

 Uplink: 873-876 MHz

 Downlink: 918-921 MHz

# 2 Train positioning

# 3 Train remote

# 4 Train surveillance

Annex 2

Frequency arrangements for railway radiocommunication systems between train and trackside in Region 2

*[****Editor’s note:*** *This annex needs to be further considered in Nov. 2018 meeting.]*

# 1 Train radio

North America: 160.200 MHz to 161.5725 MHz

# 2 Train positioning

# 3 Train remote

# 4 Train surveillance

Annex 3

Frequency arrangements for railway radiocommunication systems between train and trackside in Region 3

*[****Editor’s note:*** *This annex needs to be further considered in Nov. 2018 meeting.]*

# 1 Train radio

## 1.1 Frequency arrangement in the band 440-470 MHz

*b)* Digital UHF-band systems with a channel bandwidth of 25 kHz in the frequency band 440-470 MHz shall use the operational frequencies as defined by the following expression:

 *fN* = 440 + 0,025 × *N*, where *N* = 1, 2 … 1200;

## 1.2 Frequency arrangement in the band 876-880 MHz and 921-924 MHz

*b)* Digital UHF-band systems with a channel bandwidth of 200 kHz in the frequency bands 876-880 MHz and 921-924 MHz shall use the operational frequencies as defined by the following expressions:

 for the frequency band 876-880 MHz: *fN* = 876 + 0.2×*N*, where N = 0, 1, 2 … 19;

 for the frequency band 921-925 MHz: *fN* = 921 + 0.2×*N*, where N = 0, 1, 2 … 19.

## 1.3 Frequency arrangement in the band 718-728 MHz, 773-783 MHz

c) For systems with a channel bandwidth of more than 10 MHz

 LTE based system

## 1.4 Frequency arrangement in band [yyy,zzz]

*b) For systems with a channel bandwidth of 25 kHz*

 *TRS system*

 *806-811 MHz, 851-856 MHz*

## 1.5 Frequency arrangement in band [400 MHz]

*a) For systems with a channel bandwidth of up to 8.5 kHz*

*TRPD system*

 *443.3125 MHz*

## 1.6 Frequency arrangement in the band 410-430 MHz

TRS UHF-band systems with a channel bandwidth of 12.5 kHz, 25 kHz in the frequency bands 410-430 MHz shall use the operational frequencies as defined by the following expressions:

for the 12.5 kHz channel spacing:

 Mobile station transmit channel centre frequency (MHz): *fN* = 410.00625 + ( N − 1) × 0.0125

Base station transmit Channel centre frequency (MHz): *fN* = 420.00625 + ( N − 1) × 0.0125

 where N = 0, 1, 2 … 800;

for the 25 kHz channel spacing:

 Mobile station transmit channel centre frequency (MHz): *fN* = 410.0125 + ( N − 1) × 0.025

Base station transmit Channel centre frequency (MHz): *fN* = 420.0125 + ( N − 1) × 0.025

 where N = 0, 1, 2 … 400;

# 2 Train positioning

## 2.1 Frequency arrangement in band *27.09-27.10 MHz and 3.951-4.516 MHz* [xxx, yyy]

 *27.09-27.10 MHz band, center frequency 27.095 MHz, is for downlink in balise systems. (bandwidth of 100 kHz)*

*3.951-4.516 MHz band, center frequency 4.234 MHz, is for uplink in balise systems to provide the positioning information of trains. (frequency deviation of 565 kHz)*

# 3 Train remote

# 4 Train surveillance

## 4.1 18 GHz frequency band

*c) For systems with a channel bandwidth of more than 10 MHz*

 Video streaming systems are operating for providing information on platform when the trains are entering the stations. (6 channels)

*18.86-18.92 GHz (10 MHz × 6)*

*19.2-19.26 GHz (10 MHz × 6)*

## 4.2 Future System: Frequency arrangement in 90-GHz band

Channel separation: 400 MHz



## 4.3 13 GHz frequency band (12 750 – 13 250 MHz)

*a) For the 28 MHz channel spacing: fN = 12 737 + N x 28 where N = 1, 2,…, 18*

*b) For the 7 MHz channel spacing: fN = 12 747.5 + N x 7 where N = 1, 2, …, 70*

[ATTACHMENT

One proposed concept or method of harmonizing frequencies for RSTT

*[****Editor’s note:*** *Main part of this attachment might be in the report of M.[RSTT. USAGE]*

As for existing systems, the response to the Questionnaire is fundamental material to develop especially the table as “harmonized frequency ranges” in *recommends* part in the working document towards preliminary draft new Recommendation ITU-R M.[RSTT\_FRQ].

Here, it is proposed how to develop that table as “harmonized frequency ranges” with “logical OR approach” and within existing mobile-service allocations which is principle condition of Resolution **236 (WRC-15)**, as follows.

For example, in case of spectrum usage in 300-600 MHz addressed as “spectrum map” in Chapter 7 Spectrum Usage of RSTT in a working document towards a PDNR ITU-R M.[RSTT.USAGE] which visualizes the response to the Questionnaire, we extract, for example, Region 3 from that spectrum map. Then we get a frequency range with logical OR from each frequency. Finally we get harmonized frequency ranges by filtering it with the condition of existing mobile-service allocations as seen in the figure below.

With this “logical OR approach”, each frequency could be involved in harmonized frequency ranges and each administration would use those frequency ranges or part of thereof for RSTT on their national needs, spectrum requirements, policy objectives, and operating environments which satisfies considering n) of this Recommendation.

(1)Logical OR from each frequency

(2)Within existing mobile-service allocations

Harmonized frequency ranges

With this “logical OR approach” mentioned above, we filled each cells of the table-bis in *recommends* part based on the table in recommends which reflect input contribution, and the excel file in chapter 5 of ITU-R M.[RSTT.USAGE] as well , with the procedure as follows.

1) Selecting “Original” sheet attached in Annex 1 in a working document towards a PDNR ITU-R M.[RSTT.USAGE].

2) Filling the application column with 4 categories, i.e. , TRN RAD, TRN POS INFO, TRN REMOTE, and TRN SURV CCTV in accordance with the parameters/characteristics tables in Chapter 5 of a working document towards a PDNR ITU-R M.[RSTT.USAGE], which addresses the technical and operational characteristics for RDTT.

3) Splitting into 4 sheets according to 4 categories.

4) Sorting each sheet by frequency.

5) Grouping rows in each sheet with frequency ranges by coloring relevant cells.

6) Extracting the lowest and the highest frequencies among each group and make color of the cells dark as frequency ranges.

7) Filtering them with the condition of existing mobile-service allocations into the sheet of “Harmonized Frequency Ranges” as seen in the attached excel file.

**

 *[Note that as for some of frequency bands which are colored by yellow in the sheet, more detailed information of band plan is needed in order to consider harmonized ranges.]*

8) Filling all the cells in of the table- in *recommends* part in a working document towards preliminary draft new Recommendation ITU-R M.[RSTT\_FRQ] with the list of the frequency ranges in the sheet of “Harmonized Frequency Ranges”].