

## INDEPENDENT COMMUNICATIONS AUTHORITY OF SOUTH AFRICA

NO. 3065

20 February 2023

**HEREBY ISSUES A NOTICE REGARDING SECOND DRAFT RADIO  
FREQUENCY ASSIGNMENT PLANS FOR THE IMT850 BAND FOR PUBLIC  
CONSULTATION.**

1. The Independent Communications Authority of South Africa ("the Authority"), hereby publishes the Second Draft Radio Frequency Spectrum Assignment Plan for the frequency band 825 MHz to 830 MHz and 870 MHz to 875 MHz for public consultation in terms of Regulation 3 of the Radio Frequency Spectrum Regulations 2015. Regulation 5 of the Radio Frequency Migration Regulations 2013 and the International Mobile Telecommunications (IMT) Roadmap 2019.
2. The Authority published ten (10) Draft Radio Frequency Spectrum Assignment Plans (RFSAPs) for International Mobile Telecommunications (IMT) Systems for public consultation, in Government Gazette No 46160 (31 March 2022, Notice No 1965 of 2022) which contained the "Draft Radio Frequency Spectrum Assignment Plan for IMT in the frequency band 825 MHz to 830 MHz and 870 MHz to 875 MHz".
3. The Authority, in analysing and considering submissions made by stakeholders, and on the strength of the views expressed, has determined that there is a need to consult further on the Frequency Band 825 MHz to 830 MHz and 870 MHz to 875 MHz;
4. Interested persons are hereby invited to submit written representations of their views on the RFSAPs, in both MS Word and pdf format.
5. Submissions must be made no later than 16h00 on Monday 06 March 2023.
6. Persons making representations are further invited to indicate whether they require an opportunity to make oral representations.
7. Written representations or enquiries may be directed by email to:

Attention:

Mr Manyapelo Richard Makgotlho

e-mail: [rmakgotlho@icasa.org.za](mailto:rmakgotlho@icasa.org.za)

Copy: [jdikgale@icasa.org.za](mailto:jdikgale@icasa.org.za)

8. All written representations submitted to the Authority pursuant to this notice will be made available for inspection by interested persons from 09 March 2023 at the ICASA Library. Electronic copies of such representations are obtainable on request, and printed copies will be obtainable on payment of a fee.
9. The draft plans and non-confidential representations will be uploaded to the ICASA website under this link: <https://www.icasa.org.za/legislation-and-regulations/radio-frequency-spectrum-plans/draft-radio-frequency-spectrum-plans>.
10. Where persons making representations require that their representation or part thereof be treated as confidential, then an application in terms of section 4D of the ICASA Act, 2000 (Act No 13 of 2000) must be lodged with the Authority. Such an application must be submitted simultaneously with the representation on the draft plan, together with a non-confidential, redacted version of the submission. If, however, the request for confidentiality is not granted, the person making the request will be allowed to withdraw the representation or document in question.
11. The guidelines for confidentiality requests are contained in Government Gazette No 41839 (Notice No 849 of 2018).



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**DR CHARLES LEWIS**  
**ACTING CHAIRPERSON**



# Second Draft Radio Frequency Spectrum Assignment Plan

Rules for Services operating in the Frequency  
Band  
from 825 MHz to 830 MHz and  
870 MHz to 875 MHz  
(IMT850)

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# 1 Glossary

In this Radio Frequency Spectrum Assignment Plan, terms used shall have the same meaning as in the Electronic Communications Act 2005 (no. 36 of 2005); unless the context indicates otherwise:

<b>“3GPP”</b>	means the 3rd Generation Partnership Project (3GPP), which consists of six telecommunications standard development organisations
<b>“Act”</b>	means the Electronic Communications Act, 2005 (Act No. 36 of 2005) as amended
<b>“CRASA ECC”</b>	means the Communications Regulators’ Association of Southern Africa (CRASA) Electronic Communications Committee (ECC)
<b>“DM RS”</b>	means Demodulation Reference Signal
<b>“ECC/REC (11)04”</b>	means ECC Recommendation (11)04 - Cross-border Coordination for Mobile/Fixed Communications Networks (MFCN) in the frequency band 790-862 MHz, Edition 3 February 2017
<b>“ECC”</b>	means Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT)
<b>“FDD”</b>	means Frequency Division Duplex
<b>“HCM”</b>	means harmonised calculation method
<b>“HIPSSA”</b>	means Sub-Saharan Africa Assessment Report on Harmonization of ICT Policies in Sub-Saharan Africa
<b>“ICNIRP”</b>	means International Commission on Non-Ionizing Radiation Protection (ICNIRP)
<b>“IMT”</b>	means International Mobile Telecommunications
<b>“IMT850”</b>	means IMT in the 850 MHz band (825 MHz to 830 MHz and 870 MHz to 875 MHz)
<b>“ITA”</b>	means Invitation to Apply
<b>“ITU”</b>	means the International Telecommunication Union
<b>“ITU-R”</b>	means the International Telecommunication Union Radiocommunication Sector
<b>“LTE”</b>	means Long Term Evolution, which is a standard for wireless communication of high-speed data for mobile phones and data terminals. It is based on the GSM/EDGE and UMTS/HSPA network technologies
<b>“NRFP”</b>	means the National Radio Frequency Plan 2013 for South Africa
<b>“PCI”</b>	means Physical-Layer Cell Identities
<b>“PPDR”</b>	means Public Protection and Disaster Relief as defined in ITU-R Report M.2033.

<b>“PRACH”</b>	means Physical Random Access Channel
<b>“PSTN”</b>	means public switched telephone network
<b>“PUCCH”</b>	means Physical Uplink Control Channel
<b>“RFSAP”</b>	means Radio Frequency Spectrum Assignment Plan
<b>“TCA”</b>	means terrain clearance angle
<b>“TDD”</b>	means Time Division Duplex
<b>“WRC-12”</b>	means the World Radiocommunication Conference 2012 held in Geneva
<b>“WRC-15”</b>	means the World Radiocommunication Conference 2015 held in Geneva
<b>“WRC-19”</b>	means the World Radiocommunication Conference 2019 held in Sharm el-Sheikh

## 2 Purpose

**2.1** A Radio Frequency Spectrum Assignment Plan (RFSAP) provides information for the band IMT850 on the requirements attached to using a frequency band in line with the allocation and other information in the National Radio Frequency Plan (NRFP). This information includes technical characteristics of radio systems, frequency channelling, coordination, and details on required migration of existing users of the band and the expected method of assignment.

**2.2** The feasibility study<sup>1</sup> consultation concerning the band 825 to 830 MHz and 870 to 875 MHz, mandated by the Frequency Band Migration Regulation and Plan contained in the IMT Roadmap 2014<sup>2</sup> and IMT Roadmap 2019<sup>3</sup>, concluded that the Authority should proceed with an RFSAP for IMT in the lower part i.e., 825-830 MHz of this band. The lower part i.e., 825-830 MHz, now falls in the guard band of Region 1 800 MHz band plan (i.e., 832–862/791–821 MHz). The upper part of the band i.e., 870-875 MHz (paired with 825-830 MHz) falls outside the IMT800 band plan.

**2.3** In addition, this RFSAP is to ensure the protection of the assignments operating IMT Systems in accordance with the “Final Radio Frequency Spectrum Assignment Plan for the frequency band 791 to 821 MHz and 832 to 862 MHz”, published in Government Gazette 47788 (Notice 2888 of 2022)

**2.4** Therefore, immediately post the clearance date of the current sole IMT850 MHz incumbent Licensee from this band, the Authority will repeal this IMT850 MHz RFSAP.

<sup>1</sup> Implementation of the Radio Frequency Migration Plan and the International Mobile Telecommunications (IMT) Roadmap for public consultation, Government Gazette No. 45690, 24 December 2021

<sup>2</sup> Final (Draft) IMT Roadmap 2014, Government Gazette Vol. 593, 14 November 2014 No. 38213

<sup>3</sup> Final (Draft) IMT Roadmap 2019, Government Gazette Vol. 645, 29 March 2019 No. 42361

**2.5** In addition, the Authority, will, in accordance with regulation 6 of the Radio Frequency Migration Regulations 2013, published in Government Gazette No 36334 (Notice 352 Of 2013), publish a notice to inform users to be migrated for their Radio Frequency Spectrum licences to be amended.

**2.6** In this Second Draft RFSAP consultation, the Authority is consulting on the destination band (see Section 8 Destination Options for Incumbent Licensee Migration) for the incumbent.

**2.7** The ITU states that International Mobile Telecommunications (IMT) systems are mobile systems that provide access to a wide range of telecommunication services including advanced mobile services, supported by mobile and fixed networks, which are increasingly packet-based. Key features:

- a high degree of commonality of functionality worldwide while retaining the flexibility to support a wide range of services and applications in a cost efficient manner
- compatibility of services within IMT and with fixed networks
- capability of interworking with other radio access systems
- high quality mobile services
- user equipment suitable for worldwide use
- user-friendly applications, services, and equipment
- worldwide roaming capability
- enhanced peak data rates to support advanced services and applications

### **3 General**

**3.1** Technical characteristics of equipment used in IMT800 systems shall conform to all applicable South African standards, international standards, International Telecommunications Union (ITU) and its radio regulations as agreed to and adopted by South Africa

**3.2** All installations must comply with safety rules as specified in applicable standards.

**3.3** The equipment used shall be certified under South African law and regulations.

**3.4** The allocation of this frequency band and the information in this Radio Frequency Spectrum Assignment Plan (RFSAP) are subject to review.

**3.5** The Frequency band 694 to 960 MHz is associated with footnote 5.317A, identifying the band for IMT in Table 9 extracted from the edition 2020 of the Radio Regulations (RR), Article 5, for ease of reference. The Frequency Band 825 to 830 MHz and 870 to 875 MHz, falls with the frequency range 694 to 960 MHz, and has been identified for IMT through National Footnote 9 (NF9) in the National Radio Frequency Plan 2021, published in Government Gazette No 46088 (Notice 911 of 2022)

**3.6** Likely use of this band will be for mobile voice and data communications.

**3.7** The requirements for the family of standards which can provide IMT800 services include, but are not limited to:

- IMT-2000;
- IMT-Advanced; and

- IMT-2020.

**3.8** Typical technical and operational characteristics of IMT systems as identified by the ITU are described in the following documents<sup>4</sup>:

- Recommendation ITU-R M.2012-5 (02/2022): Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-Advanced (IMT Advanced);
- Report ITU-R M.2241-0 Compatibility studies in relation to Resolution 224 in the bands 698 - 806 MHz and 790 – 862 MHz;
- Report ITU-R M.2074-0 (2006): Report on Radio Aspects for the terrestrial component of IMT-2000 and systems beyond IMT-2000;
- Recommendation ITU-R M.1645 (06/2003): Framework and overall objectives of the future development of IMT-2000 and systems beyond IMT-2000;
- Recommendation ITU-R M.1036-6 (10/2019): Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications (IMT) in the bands identified for IMT in the Radio Regulations (RR); and
- Recommendation ITU-R M.2150-1 (02/2022): Detailed specifications of the terrestrial radio interfaces of International Mobile Telecommunications-2020 (IMT-2020).

The ITU also provides guidelines for modelling and simulation, e.g.:

- Recommendation ITU-R M.2070-1 (02/2017): Generic unwanted emission characteristics of base stations using the terrestrial radio interfaces of IMT-Advanced;
- Recommendation ITU-R M.2071-1 (02/2017): Generic unwanted emission characteristics of mobile stations using the terrestrial radio interfaces of IMT-Advanced;
- Recommendation ITU-R M.2101 (02/2017): Modelling and simulation of IMT networks and systems for use in sharing and compatibility studies.

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<sup>4</sup> These and other IMT documents are available at <https://www.itu.int/rec/R-REC-M/en>

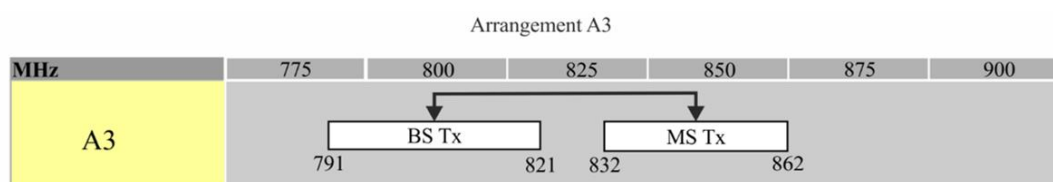


## 4 Channelling Plan

- 4.1 The inclusion of the frequency block 825 - 830 MHz into the 832–862 MHz paired with 791–821 MHz provides a total bandwidth of
- 2×30 MHz FDD for IMT800
- 4.2 Channel arrangements for the IMT800 band are based on the Region 1 recommendation by the ITU. The lower part, i.e., 825 MHz to 830 MHz, now falls in the guard band of the 800 MHz band plan in ITU Region 1 (i.e., 832–862/791–821 MHz).

Frequency arrangements	Paired arrangements (FDD)				Un-paired arrangements (TDD) (MHz)
	Mobile station transmitter (MHz)	Centre gap (MHz)	Base station transmitter (MHz)	Duplex separation (MHz)	
A3	832-862	11	791-821	41	None

**Table 1:** Frequency arrangements in the 791-862 MHz frequency range



**Figure 1:** Frequency arrangements for IMT 800 A3 (BS=base station, MS=mobile station, Tx=transmitter)

## 5 Requirements for usage of radio frequency spectrum

- 5.1 This chapter covers the minimum key characteristics considered necessary in order to make the best use of the available frequencies.
- 5.2 The use of the band is limited to IMT services.
- 5.3 Only systems using digital technologies that promote spectral efficiency will be issued with an assignment. Capacity enhancing digital techniques are being rapidly developed and such techniques that promote efficient use of spectrum, without reducing quality of service are encouraged.
- 5.4 In some cases, a radio system conforming to the requirements of this RFSAP may require modifications if harmful interference is caused to other radio stations or systems.
- 5.5 The allocation of spectrum and shared services within these bands are found in the National Radio Frequency Plan (NRFP), and an extract of the NRFP is shown in **Error! Reference source not found.**
- 5.6 Maximum radiated power
- 5.6.1 Base Station transmissions should not exceed 61 dBm/5 MHz EIRP.

- 5.6.2 Mobile Station transmissions should not exceed 23 dBm EIRP.
- 5.6.3 On a case to case basis, higher EIRP may be permitted if acceptable technical justification is provided.
- 5.6.4 Where appropriate, subscriber terminal stations should comply with the technical specification outlined under the latest version of 3GPP specifications, e.g., TS 36.521-1 for LTE, 38.521-1 for 5G New Radio (NR).
- 5.7 ICNIRP Guideline compliance is required, where applicable; and
- 5.8 Criteria and guidelines for interference mitigation are described in **Error! Reference source not found.**

## 6 Implementation

- 6.1 The Feasibility Study [5] conducted for this band stated the Authority's plan to proceed with the implementation of the RF migration plan *partly* for the benefit of the important 800 MHz band, specifically the 790MHz to 862 MHz band already partly auctioned. The study proposed the following two steps for the consultation:
  - 6.1.1 Clear the 825 MHz to 830 MHz and 870 MHz to 875 MHz band as per the current regulations.
  - 6.1.2 Assure the licencing to IMT System conforming to the ITU frequency arrangement A3 arrangement as a part of the 800 MHz band plan in ITU Region 1 (i.e., 832 – 862 / 791 – 821 MHz). This is because this 800 MHz 3GPP Band 20 band plan is one of the most important sub 1 GHz bands for IMT deployment in Region 1. There is a significantly matured global ecosystem developed for this band.
- 6.2 This Radio Frequency Spectrum Assignment Plan (RFSAP) comes into effect upon publication of the final RFSAP in the Government Gazette.
- 6.3 The Authority has concluded from the feasibility study<sup>6</sup> consultation concerning the band 825 to 830 MHz and 870 to 875 MHz (i.e., the IMT 850MHz) that no new assignment in this band will be approved.
- 6.4 Indeed, as noted earlier in Section 2.4 and 2.5, immediately post the clearance of the current IMT850 MHz Licensee from this band, through the amendment of the incumbent's licence for the destination band, the Authority will repeal this IMT850 MHz RFSAP.

## 7 Co-ordination Requirements

- 7.1 Cross Border Frequency Coordination will abide by the Harmonised Calculation Method for Africa (HCM4A) Agreement. This follows the 3rd CRASA AGM that agreed that CRASA should implement the Cross Border Frequency Coordination Harmonised Calculation Method for Africa (HCM4A) Agreement.

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<sup>5</sup> Implementation of the Radio Frequency Migration Plan and the International Mobile Telecommunications (IMT) Roadmap for public consultation, December 2021, Government Gazette No. 45690, 24 December 2021

<sup>6</sup> Implementation of the Radio Frequency Migration Plan and the International Mobile Telecommunications (IMT) Roadmap for public consultation, Government Gazette No. 45690, 24 December 2021

- 7.2 The ECC had noted the need for greater understanding of the concept and need for harmonisation in the signing of the HCM4A Agreement by SADC Member States if the implementation of the Agreement is to be effective. The ECC, therefore, agreed to convene a workshop on HCM4A and requested the CRASA Members to consider signing the agreement. These activities were part of the Frequency Planning Sub Committee (FPSC) Operations Plan 2015/16.
- 7.3 At the 5th CRASA AGM, Swakopmund, Namibia – 07-08 April 2016 [7], the subject of Cross Border Frequency Coordination using the Harmonised Calculation Method for Africa (HCM4A) was discussed in detail, following similar efforts in Europe. The Resolution CRASA/AGM/15.16/07 stipulates, “The AGM urged CRASA Members to prioritise the motivation to their administrations who are yet to indicate their interest to sign the Harmonised Calculation Method for Africa (HCM4A), to do so as soon as possible”.
- 7.3.1 Therefore, coordination would follow the HCM4A as detailed in Sub-Saharan Africa Assessment Report on Harmonization of ICT Policies in Sub-Saharan Africa<sup>8</sup> (HIPSSA).
- 7.4 A harmonized calculation method (HCM4A) brings these benefits
- 7.4.1 Based on HCM Agreement used in Europe
  - 7.4.2 Optimize spectrum usage;
  - 7.4.3 Prevent harmful interferences;
  - 7.4.4 Confer an adequate protection for stations;
  - 7.4.5 Define technical provisions and administrative procedures;
  - 7.4.6 Quick assignment of preferential frequencies;
  - 7.4.7 Transparent decisions through agreed assessment procedures;
  - 7.4.8 Quick assessment of interference through data exchange
- 7.5 HCM4A involves all 4 sub regions of Africa. This means the HCM4A projects includes performing a survey and a comparative analysis of existing administrative and technical procedures related to bilateral and multilateral cross-border frequency coordination agreements across the 4 geographical sub-regions as defined by the African Union (AU), namely,
- 7.5.1 **Central Africa** [Burundi, Central African Republic, Chad, Congo, Democratic Republic of Congo, Equatorial Guinea, Gabon, Sao Tome, and Principe];
  - 7.5.2 **East Africa** [Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Mauritius, Rwanda, Seychelles, Somalia, Sudan, Tanzania, Uganda];
  - 7.5.3 **Southern Africa** [Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, Zimbabwe];

<sup>7</sup>[https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwi81bOFz6P2AhUwQUEAHe1YDIgQFnoECAIQAAQ&url=https%3A%2F%2Fextranet.crasa.org%2Fzip-agm.php%3Fid%3D332&usg=AOvVaw1bVAuEnE8a2iJnP20F\\_b\\_2](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwi81bOFz6P2AhUwQUEAHe1YDIgQFnoECAIQAAQ&url=https%3A%2F%2Fextranet.crasa.org%2Fzip-agm.php%3Fid%3D332&usg=AOvVaw1bVAuEnE8a2iJnP20F_b_2)

<sup>8</sup>[https://www.itu.int/en/ITU-D/Projects/ITU-EC-ACP/HIPSSA/Documents/FINAL%20DOCUMENTS/FINAL%20DOCS%20ENGLISH/hcm4a\\_agreement.pdf](https://www.itu.int/en/ITU-D/Projects/ITU-EC-ACP/HIPSSA/Documents/FINAL%20DOCUMENTS/FINAL%20DOCS%20ENGLISH/hcm4a_agreement.pdf)

- 7.5.4 West Africa** [Benin, Burkina-Faso, Cape Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Sierra Leone, Senegal, Togo]. Optimise spectrum usage by accurate interference field strength calculations;
- 7.6** HCM4A also comes with a software tool for Sub-Saharan Africa <sup>9</sup>
- 7.6.1** Optimise spectrum usage by accurate interference field strength calculations;
- 7.6.2** Establish general parameters, improvement, and supplementation of technical provisions, individual restrictions;
- 7.6.3** Establish models for computer-aided interference range calculations
- 7.6.4** Harmonise parameters: objectively predictable towards transparent decisions
- 7.7** Use of these frequency bands shall require coordination with the neighbouring countries within the coordination zones of 6 kilometres in case of LTE-to-LTE or 9 kilometres in case of LTE-to-other technologies from the neighbouring country. The coordination distance is continuously being reviewed and may be updated from time to time.
- 7.8** The following field strength thresholds have to be assured based on (ECC/REC (11)04 for 790 - 862 MHz. Operator-to-operator coordination may be necessary to avoid interference.
- In general, stations of FDD systems may be used without coordination with a neighbouring country if the mean field strength produced by the cell (all transmitters within the sector) does not exceed the value of 55 dB $\mu$ V/m/5 MHz at a height of 3 m above ground at the border line between countries and does not exceed a value of 29 dB $\mu$ V/m/5 MHz at a height of 3 m above ground at a distance of 9 km inside the neighbouring country.
- In the case that LTE is deployed on both sides of the border, the field strength levels can be increased to 59 dB $\mu$ V/m/5 MHz at the border (0 km) and 41 dB $\mu$ V/m/5 MHz at 6 km from the border line inside the neighbouring country for preferential PCI codes (discussed in Appendix C). For the use of non-preferential PCI codes and aligned centre frequencies, the trigger field strength level is 41 dB $\mu$ V/m/5 MHz at the border.
- If TDD is in operation across both sides of a border and is synchronised across the border, then field strength levels are the same as for LTE-to-LTE coordination case. For unsynchronised TDD, the trigger field strength level is 24 dB $\mu$ V/m/5 MHz at the border.
- For field strength predictions, the calculations should be made according to Appendix B. In cases of other frequency block sizes,  $10 \cdot \log_{10}$  (frequency block size / 5 MHz) should be added to the field strength values, e.g.:

BW (MHz)	Field strength level at 3 m height for a given distance inside the neighbouring county (General case)	Field strength level at 3 m height for a given distance inside the neighbouring county (LTE case)
5 MHz	55.0 dB $\mu$ V/m/5 MHz @0km	59.0 dB $\mu$ V/m/5 MHz @0km
	29.0 dB $\mu$ V/m/5 MHz @9km	41.0 dB $\mu$ V/m/5 MHz @6km
10 MHz	58.0 dB $\mu$ V/m/10 MHz @0km	62.0 dB $\mu$ V/m/10 MHz @0km

<sup>9</sup> [PowerPoint Presentation \(itu.int\) https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Events/2017/May%20BKK/Presentations/HCM%20and%20HCM4A%20BKK%2020170504%20IB.pdf](https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Events/2017/May%20BKK/Presentations/HCM%20and%20HCM4A%20BKK%2020170504%20IB.pdf)

	32.0 dB $\mu$ V/m/10 MHz @9km	44.0 dB $\mu$ V/m/10 MHz @6km
15 MHz	59.8 dB $\mu$ V/m/15 MHz @0km	63.8 dB $\mu$ V/m/15 MHz @0km
	33.8 dB $\mu$ V/m/15 MHz @9km	45.8 dB $\mu$ V/m/15 MHz @6km
20 MHz	61.0 dB $\mu$ V/m/20 MHz @0km	65.0 dB $\mu$ V/m/20 MHz @0km
	35.0 dB $\mu$ V/m/20 MHz @9km	47.0 dB $\mu$ V/m/20 MHz @6km

**Table 2: Field Strength Adjustments**

If neighbouring administrations wish to agree on frequency coordination based on preferential frequencies, while ensuring a fair treatment of different operators within a country the Authority will add these within mutual agreements.

As per ECC/REC (11)04<sup>10</sup>, stations of IMT systems may be operated without coordination if the mean field strength produced by the cell (all transmitters within the sector) does not exceed the value of 15 dB $\mu$ V/m/5 MHz at 10% time, 50% of locations at 3 metres above ground level at the border line

- 7.9 Technical analysis may be conducted by the Authority before an assignment is issued according to Appendix B taken from ECC/REC (11)05.
- 7.10 Specific information regarding coordination may be found in **Error! Reference source not found.** taken from ECC/REC (11)05.
- 7.11 In the event of any interference, the Authority will require affected parties to carry out coordination. In the event that the interference continues to be unresolved after 24 hours, the affected parties may refer the matter to the Authority for a resolution. The Authority will decide the necessary modifications and schedule of modifications to resolve the dispute. The Authority will be guided by the Frequency Coordination Process as shown in **Error! Reference source not found.**
- 7.12 Assignment holders shall take full advantage of interference mitigation techniques such as antenna discrimination, tilt, polarization, frequency discrimination, shielding / blocking (introduce diffraction loss), site selection, and/or power control to facilitate the coordination of systems.

## 8 Destination Options for Incumbent Licensee Migration

- 8.1 The Authority considered the process of identifying the designation band for the incumbent in the 825MHz to 820MHz and 870MHz to 875MHz bands to migrate to.
- 8.2 In undertaking this process, three consequential issues arose and were considered:
- 8.2.1 What is an 'equivalent' destination spectrum band and 'equivalent' amount of spectrum?
- 8.2.2 What is the process for resolving the identification and concluding of the destination band/amount acceptable.
- 8.2.3 What attributes should such a process possess?

<sup>10</sup> This information is available in the first edition of ECC/REC (11)04 (also, per Report ITU-R M.2241 (11/2011): Compatibility studies in relation to Resolution 224 in the bands 698-806 MHz and 790-862 MHz).

**8.3** Taking into consideration the provisions of Regulations 5 (2) and 5 (3) of the Radio Frequency Migration Regulation 2013, the Authority is aims to proceed, guided by the principles of fairness, reasonableness, non-discrimination and transparency.

**8.4** The table below illustrates the frequency bands that were assessed for consideration as potential destination bands.

Item	Proposed destination Frequency Band	Bandwidth available	Factors considered	Availability
1.	450MHz	2 x 5 MHz	The Radio Frequency Spectrum Assignment is currently under consultation in order to access the extent to which the incumbent can be migrated. It is therefore a challenge to assess its availability in the future, given the dynamics and challenges posed by the current incumbent in this band.	1 April 2025
2.	700MHz	2X30 MHz	Not available due to the recent licensing process	01 April 2023
3.	IMT750	1x 20 MHz	IMT750 has a 20 MHz Supplementary Downlink (SDL) with a 5 MHz guard band between the uplink and SDL downlink. The Frequency Band is subject to the transitional arrangements in terms of the Analogue Television Switch-off Process currently under way. The challenge in considering the IMT850 is that the channel arrangements provide for Frequency Division Duplex (FDD), whereas the IMT750 is a supplementary downlink only where the uplink is unavailable.	01 April 2023
4.	800 MHz	2 x 30 MHz	Not available due to the recent licensing process	01 April 2023
5.	900MHz	2 x 5 MHz	This spectrum band is earmarked to be assigned through an Invitation to Apply that will be published for a new assignment in the frequency block 900 - 905 / 945 - 950 MHz.  The Authority may amend provision 8.1 under "Assignment" of the Radio Frequency Spectrum Assignment Plan for IMT900 in order to implement the migration.	1 April 2024

6.	1500MHz	90 MHz	The Radio Frequency Spectrum Assignment is currently under consultation in order to access the usage. The requirement of between 80 and 100 MHz spectrum to meet the capabilities of IMT2020 poses a challenge in fragmenting the frequencies. In order to ensure efficient use of the spectrum resource, and their application, it is not advisable reduce and or fragment the current available spectrum	01 April 2024
7.	2.3GHz	40 MHz	The requirement of between 80 and 100 MHz spectrum to meet the capabilities of IMT2020 poses a challenge in fragmenting the frequencies. In order to ensure efficient use of the spectrum resources, and their application, it is not advisable to reduce and or fragment the current available spectrum.	1 April 2024
8.	2.6GHz	190 MHz	Not available due to the recent licensing process	22 May 2020
9.	3.3 GHz	100 MHz	The requirement of between 80 and 100 MHz spectrum to meet the capabilities of IMT2020 poses a challenge in fragmenting the frequencies. In order to ensure efficient use of the spectrum resources, and their application, it is not advisable reduce and or fragment the current available spectrum.	1 April 2023
10.	26GHz.		Not available. The Radio Frequency Migration Plan and the IMT Roadmap are yet to be developed prior to the development of the RFSAP.	To be determined

**Table 3: Consideration of Incumbent Destination Band Options**

## 9. Assignment

- a. The Authority has already partly assigned via an auction the spectrum in 791-821 MHz paired with 832-862 MHz band through an Invitation to Apply<sup>11</sup> in line with regulations developed in terms of Section 31(3) of the Electronic Communications Act (Act No. 36 of 2005).
- b. As noted in Section 2.3, post the clearance of the current IMT850 MHz Licensee from this band, the Authority will repeal this IMT850 MHz RFSAP.

<sup>11</sup> Electronic Communications Act: Licensing process for international mobile applications in respect of the provision of Mobile Broadband Wireless Access Services: Invitation To Apply, Government Gazette No. 45628, 10 December 2021

## 10. End of Transitional Arrangements

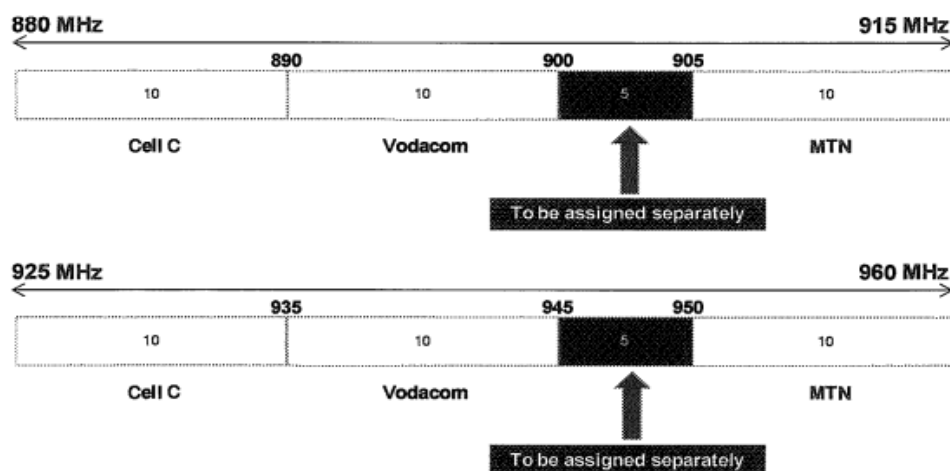
- c. The Frequency Band 694 to 862 MHz is Allocated on Primary Basis, to the Mobile Services and Identified for International Mobile Telecommunications through Foot Note 9 (NF9) in the National Radio Frequency Plan 2021. The frequency band has been prioritised for mobile services

## 11. Assignment

- d. Existing radio frequency spectrum licences for the use of the band will be amended to align with the destination frequency band in accordance with regulation 6 of the Radio Frequency Migration Regulations 2013.
- e. This RFSAP shall be repealed once the incumbent spectrum licensee in the band clears the band, and its Radio Frequency Spectrum Licence has been amended.

## 12. Radio Frequency Clearance and Migration

- a. Since this IMT850 RFSAP will be repealed, all existing transmissions from 825 to 830 MHz paired with 870 to 875 MHz band should be cleared. The Authority understands that the sole licensee in this band has already switched off its network in the IMT850 band, and therefore the spectrum is currently already unutilised.
- b. The current licensee in the band should therefore fully clear the band by the 31<sup>st</sup> of March 2024.
- c. Following on from Section 9.1 (i.e., End of Transitional Arrangements), all broadcasting licences will be revoked by the Authority as of the 1<sup>st</sup> of April 2023.
- d. The Authority proposes that as of 1<sup>st</sup> of April 2024, the sole licensee of this IMT 850 MHz band is assigned the 2 x 5 MHz spectrum in the IMT 900 MHz band as depicted in Figure 2.





**Figure 2: New Proposed FDD assignment in the 900 MHz band for the Licensee migrating from the proposed-to-be-repealed IMT 850 MHz Band**

### 13. Repeals

The Authority will repeal the following upon completion of this assignment plan:

- a. Government Gazette No 42337 (Notice 165 of 2019) - the current existing RFSAP for this 825 to 830 MHz paired with 870 to 875 MHz band is repealed on publication of this RFSAP;
- b. This present IMT 850 MHz RFSAP will be repealed on the 1<sup>st</sup> of April 2024.

## Appendix A National Radio Frequency Plan

Table 4 shows an extract from the National Radio Frequency Allocation Plan for South Africa

ITU Region 1 allocations and footnotes	South African allocations and footnotes	Typical Applications	Notes and Comments
<p>790 - 862 MHz FIXED</p> <p>MOBILE except aeronautical mobile 5.316B 5.317A</p> <p>BROADCASTING</p>	<p>790 - 862 MHz FIXED</p> <p>MOBILE except aeronautical mobile 5.316B 5.317A NF9</p>	<p>Fixed Links (856 – 864.1 MHz)</p> <p>Wireless Access (827.775 – 832.695 MHz)</p> <p>IMT800 MTX (832 - 862 MHz)</p> <p>IMT850 MTX (825 – 830 MHz)</p>	<p>Paired with 868.1 – 876 MHz</p> <p>Paired with 827.775- 832.695 MHz</p> <p>Paired with BTX (791 – 821 MHz)</p> <p>Paired with BTX (870 – 875 MHz)</p> <p>International Mobile Telecommunication Roadmap (GG No. 42829 Notice 600 of 2019). Radio Frequency Spectrum Assignment Plan (GG 38640 Notice 271 and 272 of 2015) as amended</p> <p>IMT in accordance with ITU-R Recommendation ITU-R M.2090 latest version and Resolution <b>760 (WRC-15)</b> applies</p> <p>Recommendation ITU-R M.1036-6</p> <p>Consideration of the future spectrum needs of Broadband Public Protection and Disaster Relief (PPDR) in the range 694-790 MHz as described in the most recent ITU-R M.2015, while taking into account studies called for by Resolution 646 (WRC15) for technical and operational measures.</p> <p>Band IV/V analogue television is to be migrated to digital television and ensure harmonisation with SADC.</p> <p>WRC-07, WRC-12 and WRC-15 allocated this band to Mobile service except aeronautical mobile and identified it for IMT.</p> <p>Fixed links operating in this band will have to be migrated in order to accommodate IMT.</p> <p>Radio Frequency Spectrum Assignment Plan GG 42337 Notice 165 of 2019</p> <p>Radio Frequency Spectrum Assignment Plan (GG 38640 Notice 273 of 2015) as amended</p> <p>Radio Frequency Spectrum Assignment Plan GG 41082 Notice 648 of 2017</p>
5.312 5.319	5.312A 5317A		

862-890 MHz	862-890 MHz		
FIXED MOBILE except aeronautical mobile 5.317A	FIXED MOBILE except aeronautical mobile 5.317A NF10	Fixed Links (856 – 864.1 MHz)	Paired with 868.1 – 876 MHz
BROADCASTING 5.322		Wireless Access (872.775 – 877.695 MHz)	Paired with 827.775 – 832.695 MHz
		GSM-R MTX (877.695 – 880 MHz) NF10	Paired with 921 – 925 MHz
		IMT900 MTX (880-915 MHz)	Paired with BTX (925 – 960 MHz)
		IMT850 BTX (870-875 MHz)	Paired with MTX (825-830 MHz)
		Wireless Audio systems and Wireless microphones (863 – 865 MHz)	Radio Frequency Spectrum Regulations as amended (Annex B) (GG. No. 38641, 30 March 2015).
		CT2 cordless phones (864.1 – 868.1 MHz)	Recommendation ITU-R M.1036-6
		FWA (864.1 – 868.1 MHz)	Radio Frequency Spectrum Assignment Plan GG 42337 Notice 165 of 2019
5.319 5.323		RFID (865 – 868 MHz)	Radio Frequency Spectrum Assignment Plan (GG 38640 Notice 275 of 2015) as amended
		Non-specific SRD and RFID (869.4 – 869.65 MHz)	International Mobile Telecommunication Roadmap GG No. 42829 Notice 600 of 2019).
		Non-Specific SRDs (868 – 868.6 MHz, 868.7 – 869.2 MHz, 869.4 – 869.65 MHz, 869.7 – 870.0 MHz)	
		Alarms (868.6 – 868.7 MHz, 869.25 – 869.3 MHz, 869.65 – 869.7 MHz)	

**Table 4: National Radio Frequency Plan for South Africa for 825 to 830/870 to 875 MHz band<sup>12</sup>**

<sup>12</sup> National Radio Frequency Plan 2021, (NRFP-21) 8.3 kHz – 3000 GHz, Independent Communications Authority of South Africa

## Appendix B Propagation Model

The following methods are proposed for assessment of anticipated interference inside a neighbouring country based on established trigger values. Due to the complexity of radio-wave propagation, different methods are proposed to be considered by administrations and are included here for guidance purposes only. It should be noted that the following methods provide theoretical predictions based on available terrain knowledge. It is practically impossible to recreate these methods with measurement procedures in the field. Therefore, only some approximation of measurements could be used to check compliance with those methods based on practical measurement procedures. The details of such approximation are not included in this recommendation and should be negotiated between countries based on their radio monitoring practices.

### Path specific model

Where appropriately detailed terrain data is available, the propagation model for interference field strength prediction is the latest version of ITU-R Rec. P.452<sup>13</sup>. For the relevant transmitting terminal, predictions of path loss would be made at  $x$  km steps along radials of  $y$  km at  $z$  degree intervals<sup>14</sup>. The values for those receiver locations within the neighbouring country would be used to construct a histogram of path loss – and if more than 10% of predicted values exceed the threshold, the station should be required to be coordinated.

### Site General model

If it is not desirable to utilise detailed terrain height data for the propagation modelling in the border area, the basic model to be used to trigger coordination between administrations and to decide, if coordination is necessary, is ITU-R Rec. P.1546, “Method for point to area predictions for terrestrial services in the frequency range 30 to 3000 MHz”<sup>15</sup>. This model is to be employed for 50% locations, 10% time and using a receiver height of 3 m. For specific reception areas where terrain roughness adjustments for improved accuracy of field strength prediction are needed, administrations may use correction factors according to terrain irregularity and/or an averaged value of the TCA parameter in order to describe the roughness of the area on and around the coordination line.

Administrations and/or operators concerned may agree to deviate from the aforementioned model by mutual consent.

### Area calculations

In the case where greater accuracy is required, administrations and operators may use the area calculation below. For calculations, all the pixels of a given geographical area to be agreed between the Administrations concerned in a neighbouring country are taken into consideration. For the relevant base station, predictions of path loss should be made for all the pixels of a given geographical area from a base station and at a receiver antenna height of 3 m above ground.

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<sup>13</sup> Recommendation ITU-R P.452-17 (09/2021, with Editorial corrections on 28 October 2021) “Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz” (<https://www.itu.int/rec/R-REC-P.452/en>)

<sup>14</sup> Values for  $x$ ,  $y$ ,  $z$ , and path specific field strength levels are to be agreed between the administrations concerned

<sup>15</sup> ITU-R Recommendation P.1546-6 (08/2019): Method for point-to-area predictions for terrestrial services in the frequency range 30 MHz to 3 000 MHz (<https://www.itu.int/rec/R-REC-P.1546/en>)

For evaluation,

- Only 10 percent of the number of geographical area pixels between the border line (also including the border line) and the 6 km line itself inside the neighbouring country may be interfered with by higher field strength than the trigger field strength value given for the border line in the main text above at a height of 3 m above ground.
- Only 10 percent of the number of geographical area pixels between the 6 km (also including 6 km line) and 12 km line inside the neighbouring country may be interfered by higher field strength than the trigger field strength value given for the 6 km line in the main text above at a height of 3 m above ground.

It is recommended that during area calculations, not only detailed terrain data but also clutter data be taken into account. Use of correction factors for clutter is crucial in particular where the border area is ‘open’ or ‘quasi-open’ from the point of view of clutter or where the interfering base station is just a few kilometres from a border line.

If the distance between a base station and a terrain point of a border line is closer than or equal to 1 km, the free space propagation model needs to be applied. Furthermore, if there is no terrain obstacle within the 1<sup>st</sup> Fresnel zone, the free space propagation model should also be applied.

If clutter data is not available, it is proposed to extend the usage of the free space propagation model to a few kilometres, depending on the clutter situation in border areas.

For area type interference calculations, propagation models with path specific terrain correction factors are recommended (e.g., the latest Recommendation ITU-R P.1546<sup>16</sup> with the terrain clearance angle correction factor TCA, HCM<sup>17</sup> method with the terrain clearance angle correction factor or Recommendation ITU-R P.1812<sup>[18], [19]</sup>).

As to correction factors for clutters ‘open area’ and ‘quasi-open area’, 20 dB and 15 dB should be used, respectively. Recommendation ITU-R P.1406<sup>[20]</sup> and/or ITU-R P.2108<sup>[21]</sup> should be used if a finer selection of clutter is required.

<sup>16</sup> ITU-R Recommendation P.1546-6 (08/2019): Method for point-to-area predictions for terrestrial services in the frequency range 30 MHz to 3 000 MHz (<https://www.itu.int/rec/R-REC-P.1546/en>)

<sup>17</sup> HCM Agreement (Harmonised Calculation Method) between the administrations of Austria, Belgium, the Czech Republic, Germany, France, Hungary, the Netherlands, Croatia, Italy, Liechtenstein, Lithuania, Luxembourg, Poland, Romania, the Slovak Republic, Slovenia, and Switzerland on the Coordination of frequencies between 29.7 MHz and 43.5 GHz for the Fixed Service and the Land Mobile Service. The latest version of this agreement can be found from [http://www.hcm-agreement.eu/http/englisch/verwaltung/index\\_europakarte.htm](http://www.hcm-agreement.eu/http/englisch/verwaltung/index_europakarte.htm)

<sup>18</sup> Recommendation P.1812-6 (09/2021) “A path-specific propagation prediction method for point-to-area terrestrial services in the frequency range 30 MHz to 6 000 MHz” (<https://www.itu.int/rec/R-REC-P.1812/en>).

<sup>19</sup> Annex 5: Determination of the interference field strength in the Land Mobile Service (<https://www.itu.int/en/ITU-D/Projects/ITU-EC-ACP/HIPSSA/Documents/REGIONAL%20documents/HCM4A-E-Annex05.pdf>)

<sup>20</sup> Recommendation P.1406-2 (07/2015) “Propagation effects relating to terrestrial land mobile and broadcasting services in the VHF and UHF bands” (<https://www.itu.int/rec/R-REC-P.1406/en>).

<sup>21</sup> Recommendation P.2108-1 (09/2021) “Prediction of clutter loss” (<https://www.itu.int/rec/R-REC-P.2108/en>).

It must be noted that terrain irregularity factor  $\Delta h$  is not recommended to be used in area calculations. Administrations and/or operators concerned may agree to deviate from the aforementioned models by mutual consent.

## Appendix C Coordination for IMT-Systems

### PREFERENTIAL PHYSICAL-LAYER CELL IDENTITIES (PCI) FOR IMT-2000/LTE<sup>22</sup>

The following is extracted from ECC/REC (11)05 as an operational example and can be adapted for the SADC countries for LTE. A respective extract from ECC/REC (15)01 may be considered for expanding the same onto NR.

PCI coordination is only needed when channel centre frequencies are aligned independently of the channel bandwidth.

3GPP TS 36.211<sup>23</sup> defines 168 “unique physical-layer cell-identity groups” in §6.11, numbered 0...167, hereafter called “PCI groups” for LTE. Within each PCI group, there are three separate PCIs giving 504 PCIs in total.

Administrations should agree on a repartition of these 504 PCIs on an equitable basis when channel centre frequencies are aligned, as shown in the table below. It has to be noted that dividing the PCI groups or PCIs is equivalent. Each country should only use their own preferential PCIs close to the border and can use all PCIs away from the border. This transition distance between “close to the border” and “away from the border” should be agreed between neighbouring countries.

Administrations may wish to define different field strength levels (than those provided in the main text referring to this Appendix) for non-preferential PCIs.

As shown in the table below, the PCIs should be divided into 6 sub-sets each containing one sixth of the available PCIs. Each country is allocated three sets (half of the PCIs) in a bilateral case and two sets (one third of the PCIs) in a trilateral case.

Four types of countries are defined in a way such that no country will use the same code set as any one of its neighbours. The following lists describe a sample distribution for African countries:

**Country type 1:** Botswana, Cameroon, Comoros, Democratic Republic of the Congo, Ghana, Guinea-Bissau, Kenya, Liberia, Malawi, Mauritius, Niger, Republic of the Sudan, Swaziland;

**Country type 2:** Algeria, Angola, Benin, Cape Verde, Chad, Cote d'Ivoire, Egypt, Ethiopia, Madagascar, Senegal, United Republic of Tanzania, Zimbabwe;

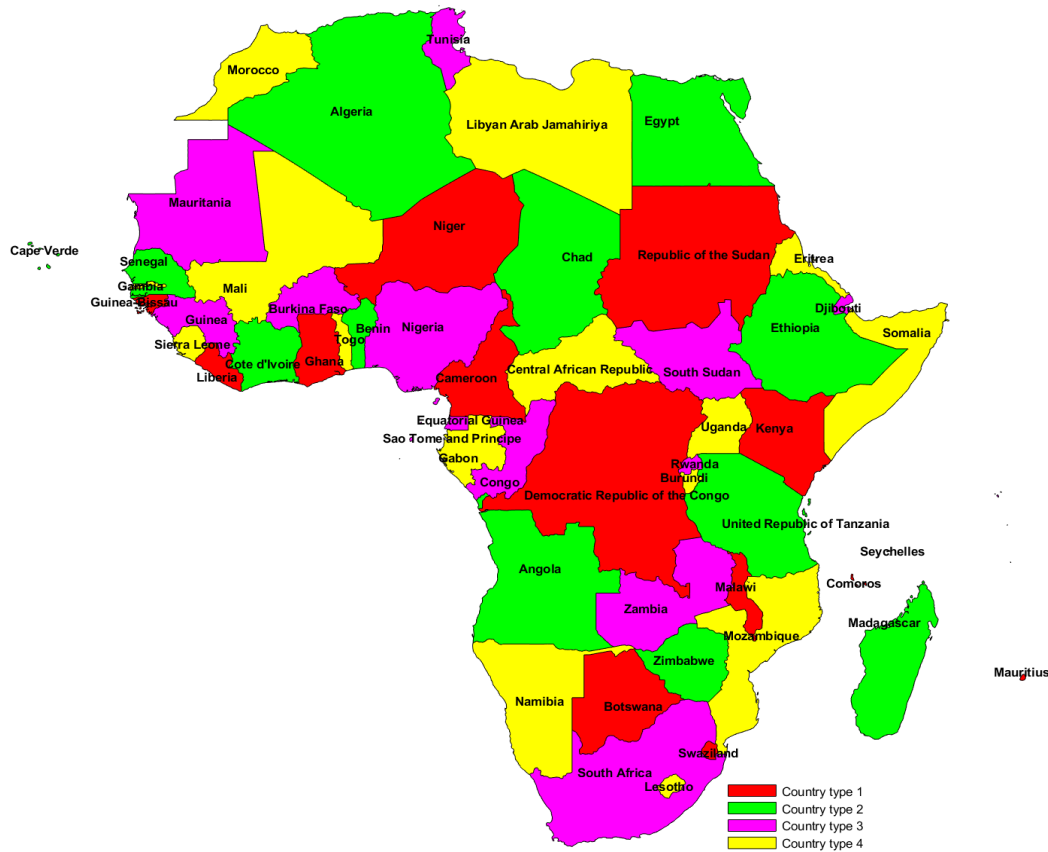
**Country type 3:** Burkina Faso, Congo, Djibouti, Equatorial Guinea, Guinea, Mauritania, Nigeria, Rwanda, Sao Tome and Principe, Seychelles, South Africa, South Sudan, Tunisia, Zambia;

**Country type 4:** Burundi, Central African Republic, Eritrea, Gabon, Gambia, Lesotho, Libyan Arab Jamahiriya, Mali, Morocco, Mozambique, Namibia, Sierra Leone, Somalia, Togo, Uganda.

(Note: A sample country type map can be found in the figure below).

<sup>22</sup> ECC/REC (11)05

<sup>23</sup> 3GPP TS 36.211 “Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation”.  
(<https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=2425> , also provided in ETSI TS 136 211). In comparison, 3GPP 38.211 (and ETSI TS 138 211) define NR Physical channels and modulation, in NR 2-step identification using PSS/SSS detection of the Physical Cell ID (same as LTE), the number of different cell IDs has been increased from 504 in LTE to 1008 for NR. Thus, for the deployment of LTE systems only the PCIs between 0 to 503 should be used and for NR systems PCIs between 0 to 1007 may be used.



**Figure 3: Country type map/PCI distribution map**

For each type of country, the following tables and figure describe the sharing of the PCIs with its neighbouring countries, with the following conventions of writing:

	Preferential PCI
	Non-preferential PCI

The 504 physical-layer cell-identities should be divided into the following 6 sub-sets when the carrier frequencies are aligned in border areas:

							PCI	Set A	Set B	Set C	Set D	Set E	Set F
<b>Country 1</b>	0..83	84..167	168..251	252..335	336..419	420..503	<b>Country 2</b>	0..83	84..167	168..251	252..335	336..419	420..503
Border 1-2							Border 2-1						
Zone 1-2-3							Zone 2-3-1						



Border 1-3							Border 2-3								
Zone 1-2-4							Zone 2-1-4								
Border 1-4							Border 2-4								
Zone 1-3-4							Zone 2-3-4								

PCI	Set A	Set B	Set C	Set D	Set E	Set F	PCI	Set A	Set B	Set C	Set D	Set E	Set F
<b>Country 3</b>	0..83	84..167	168..251	252..335	336..419	420..503	<b>Country 4</b>	0..83	84..167	168..251	252..335	336..419	420..503
Border 3-2							Border 4-1						
Zone 3-1-2							Zone 4-1-2						
Border 3-1							Border 4-2						
Zone 3-1-4							Zone 4-2-3						
Border 3-4							Border 4-3						
Zone 3-2-4							Zone 4-3-1						

**Table 5: Sharing of PCIs between Countries****Notes**

- 1) All PCIs are available in areas away from the border.
- 2) In certain specific cases (e.g., if Angola and Botswana happened to have the same Country type/PCI code) where the distance between two countries of the same type number is very small (below a few tens of kilometres), it may be necessary to address the situation in bilateral /multilateral coordination agreements as necessary and may include further subdivision of the allocated codes in certain areas.

**GUIDANCE ON THE CONSIDERATION OF LTE RADIO PARAMETERS FOR USE IN BILATERAL AND MULTILATERAL AGREEMENTS**

This section is provided for guidance purposes for use in bi-lateral and multilateral discussions. For LTE, it may be beneficial to coordinate other radio parameters besides PCI in order to minimise deteriorating effects of uplink interference.

The parameters described in this section are usually optimised during LTE radio network planning of an operator's network. The idea of optimisation is to plan the parameters taking into account specific correlation properties of the uplink control signals, which enable more stable and predictable operation of the network. In the cross-border scenario the optimisation of parameters among neighbouring operators could provide better control of uplink interference. However, because of the difference between intra-network and inter-network interference and due to limited experience in LTE cross-

border deployment, it is difficult to assess the benefits of such optimisation. The following guidance provides the basis for operators to consider in border areas in cases of high levels of uplink interference.

### **1. Demodulation Reference Signal (DM RS) coordination**

Demodulation reference signals (DM RS) are transmitted in the uplink and used for channel estimation. There is a risk of intercell interference between neighbouring cells even in case of no frame synchronisation. That is why special measures for DM RS allocation between networks in neighbouring countries occupying the same channel may need to be applied.

The case of partial channel overlap has not been studied but due to DM RS occupying resource blocks of separate users, there is a risk of DM RS collisions between neighbouring networks when the subcarriers' positions coincide (the frequency offset between central carriers of neighbouring networks is a multiple of 300 kHz). Some minor benefits from DM RS coordination in these particular cases could be expected.

There are a number of possible approaches to the coordination of DM RS:

- In the basic planning procedure, only 30 DM RS sequence groups with favourable correlation characteristics are available:  $\{0 \dots 29\}$ . In this case, each cell could be assigned one of the 30 DM RS sequence groups providing a cluster size of 30.
- It is possible to extend each DM RS sequence group to generate up to 12 time shifted sequence groups by applying the cyclic shift parameter stated in 3GPP TS 36.211 for LTE. For example, each tri-sector site could be assigned one DM RS sequence group with each co-sited cell having its own cyclic shift of  $2\pi/3$ , which provides cluster size 30 with only 10 DM RS sequence groups. The latter case corresponds well to the case of DM RS sequence group repartition between neighbouring countries when only a limited number of groups is available for network planning. The drawback of DM RS sequence group cyclic shift is a loss of orthogonality of DM RS due to fading channels which has been found during trials of LTE and caused throughput loss as well as time alignment problems.
- Another approach for DM RS coordination is to implement dynamic DM RS sequence group allocation, also called pseudo-random group hopping. In this method, nearby cells are grouped into clusters of up to 30 cells, and within each cell cluster, the same hopping-pattern is used. At the border of two clusters, inter-cell interference is averaged since two different hopping patterns are utilised. There are 17 defined hopping patterns, numbered  $\{0 \dots 16\}$ , which leads to some minor unfairness in case of apportioning these patterns between neighbouring countries. Even in a trilateral case each operator will have at least 5 hopping patterns available near the border, which should be enough for planning purposes. It should be noted the pseudo-random group hopping option could be absent in the first generations of LTE equipment.

The decision of which of these methods to use in cross-border coordination should be agreed upon by the interested parties. Specific DM RS sequence groups or hopping patterns repartition is not provided in this text but could be deduced in a similar manner to the PCI repartition.

### **2. Physical Random Access Channel (PRACH) coordination**

Another radio network parameter that is considered during radio network planning is PRACH configuration which is needed to distinguish random access requests addressed to different cells.

PRACH resources are allocated by specifying the PRACH Resource Blocks time positions within the uplink frame, their frequency position within the LTE channel bandwidth and by apportioning cell-specific root sequences. During radio network planning, these parameters are usually used in the following way:

- Time positions for PRACH resource allocations are usually used to create time collision of PRACH resources of co-sited/frame synchronised cells because PRACH-to-PRACH interference is usually less severe than PUSCH-to-PRACH interference;
- Frequency positions within the LTE channel bandwidth are usually the same for all cells, again because PRACH-to-PRACH interference case is a more favourable one.
- Cell-specific root sequences are used to distinguish between PRACH requests addressed to different cells.

For cross-border coordination, it is proposed to use frequency position offsets to exclude the possibility of so-called “ghost” PRACH requests caused by neighbouring networks. The PRACH is configured in LTE to use only 6 Resource Blocks or 1.08 MHz of the LTE channel bandwidth except in regions used by PUCCH. In case of overlapping or partially overlapping channel bandwidths of neighbouring networks, it is enough to establish non-overlapping PRACH frequency blocks to perform coordination. Because it is difficult to establish an implementation dependent procedure for such allocation, it will be the responsibility of operators to manage such frequency separation during coordination discussions.

In an early implementation, it is possible that a very limited number of frequency positions could be supported by LTE equipment which will not be enough to coordinate in the trilateral case. In such cases, root-sequence repartition could be used. There are 838 root sequences in total to be distributed between cells, numbered  $\{0 \dots 837\}$ . There are two numbering schemes for PRACH root sequences (physical and logical) and only logical root sequences numbering needs to be used for coordination. Unfortunately, the process of root sequences planning doesn't involve direct mapping of root sequences between cells because the number of root sequences needed for one cell is dependent on the cell range. The table showing such interdependency is presented below:

PRACH Configuration	Number of root seq. per cell	Cell Range (km)
1	1	0.7
2	2	1
3	2	1.4
4	2	2
5	2	2.5
6	3	3.4
7	3	4.3
8	4	5.4
9	5	7.3
10	6	9.7
11	8	12.1
12	10	15.8
13	13	22.7
14	22	38.7
15	32	58.7
0	64	118.8

**Table 6: PRACH – Range Interdependency**

Thus, in the case of root sequence repartition, it will be the responsibility of radio network planners to assign the correct number of root sequences in order to not overlap with the root sequence ranges of other operators. It also should be noted that different root sequences have different cubic metrics and correlation properties, which affect PRACH coverage performance and planning of so-called high-speed cells. For simplicity of cross-border coordination, it is proposed to ignore these properties.

In summary, it should be stipulated that frequency separation of PRACH resources should be used as the main coordination method. PRACH root sequences repartition should be avoided and used only in exceptional cases. Specific PRACH root sequences repartition is not provided in this text but could be deduced in a similar manner to the PCI repartition.

Additional guidance for cross-border coordination of synchronised and unsynchronised LTE and 5G/NR TDD systems may be found in ECC/REC/ (15)01 <sup>[24]</sup> and ECC Report 296 <sup>[25]</sup>. The text above is based on these.

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<sup>24</sup> ECC Recommendation (15)01 “Cross-border coordination for Mobile/Fixed Communications Networks (MFCN) in the frequency bands: 694-790 MHz, 1427-1518 MHz and 3400-3800 MHz”. Amended on 14 February 2020.

<sup>25</sup> ECC Report 296: “National synchronisation regulatory framework options in 3400-3800 MHz: a toolbox for coexistence of MFCNs in synchronised, unsynchronised, and semi-synchronised operation in 3400-3800 MHz”, March 2019.

## Appendix D Frequency Coordination Process

Technical procedures related to bilateral and multilateral cross-border frequency coordination agreements for 4 geographical sub-regions are defined by the African Union which includes the Southern African sub-region of 10 countries. Cross-Border Frequency Coordination and interference resolution should follow the Harmonized Calculation Method for Africa (HCM4A).<sup>26</sup>

When requesting coordination, the relevant characteristics of the base station and the code or PCI group number should be forwarded to the Administration affected. All of the following characteristics should be Included:

- a) carrier frequency [MHz]
- b) name of transmitter station
- c) country of location of transmitter station
- d) geographical coordinates [latitude, longitude]
- e) effective antenna height [m]
- f) antenna polarisation
- g) antenna azimuth [degrees]
- h) antenna gain [dBi]
- i) effective radiated power [dBW]
- j) expected coverage zone or radius [km]
- k) date of entry into service [month, year].
- l) code group number used
- m) antenna tilt [degrees]

The Administration affected shall evaluate the request for coordination and shall within 30 days notify the result of the evaluation to the Administration requesting coordination. If in the course of the coordination procedure, the Administration affected requires additional information, it may request such information.

If no reply is received by the Administration requesting coordination within 30 days, it may send a reminder to the Administration affected. An Administration not having responded within 30 days following communication of the reminder shall be deemed to have given its consent, and the code coordination may be put into use with the characteristics given in the request for coordination.

The periods mentioned above may be extended by common consent.

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<sup>26</sup> Cross-Border Frequency Coordination: Harmonized Calculation Method for Africa (HCM4A)  
[https://www.itu.int/en/ITU-D/Projects/ITU-EC-ACP/HIPSSA/Documents/FINAL%20DOCUMENTS/FINAL%20DOCS%20ENGLISH/hcm4a\\_agreement.pdf](https://www.itu.int/en/ITU-D/Projects/ITU-EC-ACP/HIPSSA/Documents/FINAL%20DOCUMENTS/FINAL%20DOCS%20ENGLISH/hcm4a_agreement.pdf)