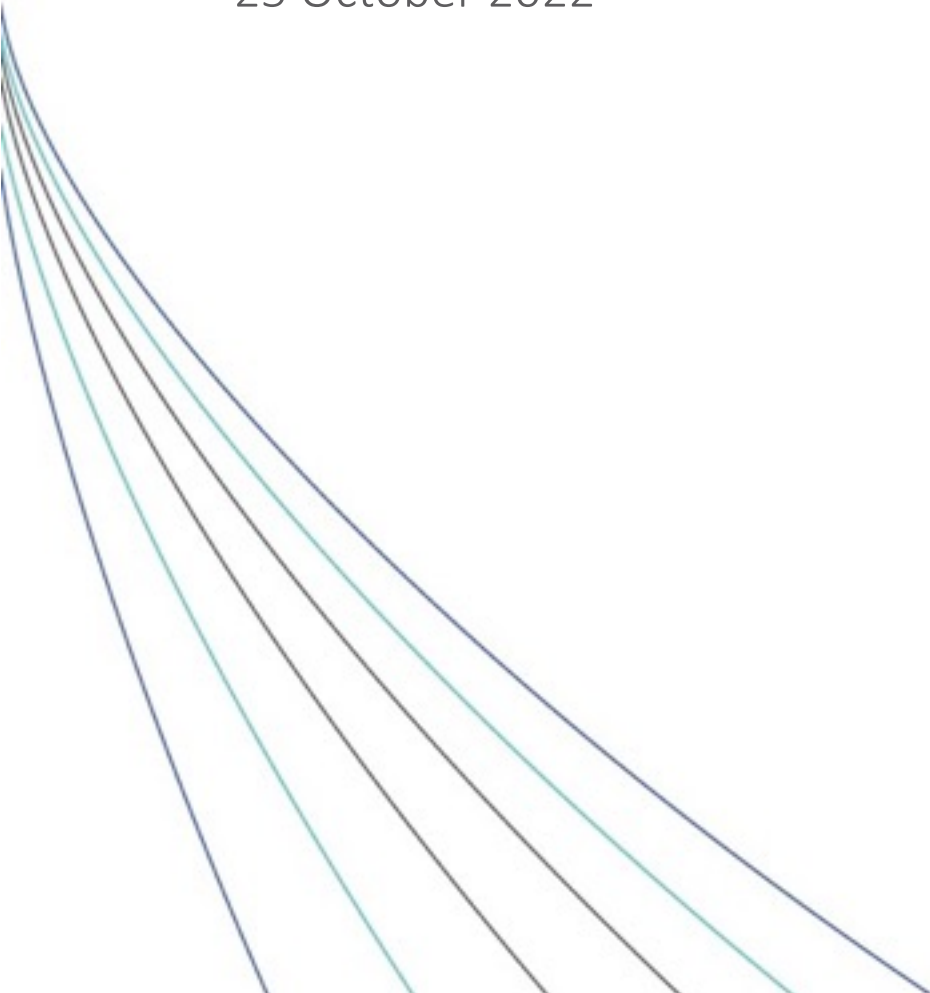




Digital Switchover in Sub-Saharan Africa

Annex

25 October 2022



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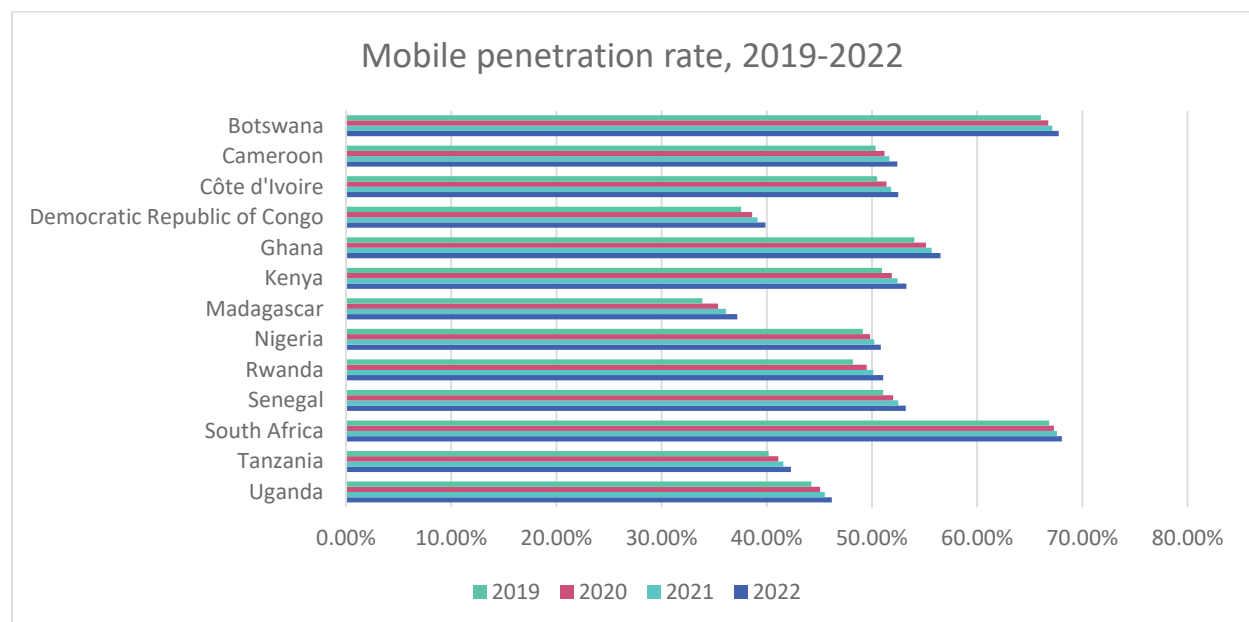
Overview of current use of the 470-694 MHz band in specific countries

For fuller regional context, this Annex includes information relevant to the current use of the 470-694 MHz frequency band for 13 countries, including the case study countries – Botswana, Cameroon, Kenya, Senegal, and Tanzania – as well as an additional information for eight other Sub-Saharan African countries: Côte d'Ivoire, the Democratic Republic of Congo (DRC), Ghana, Madagascar, Nigeria, Rwanda, South Africa, and Uganda. It discusses the use of the 470-694 MHz band for DTT, in addition to TV channel arrangements to the extent available. It also provides mobile and TV penetration statistics for each country.

Mobile penetration rate in the region

Figure 28 presents the mobile penetration rate, based on unique mobile subscribers, for each country analysed. As evidenced by this data, mobile service adoption continues to rise in all countries considered, despite the significant global economic shock caused by the COVID-19 pandemic.

Figure 1: Mobile penetration rates in selected countries



Source: GSMA Intelligence.

Television broadcasting spectrum utilisation analysis

DVB-T2 characteristics

The 470-694 MHz band contains a total of 224 MHz that is under consideration for additional allocation to mobile services. While there are several parameters to be considered in planning a digital television network, up to six programs in high-definition (HD) quality can be transmitted in an 8 MHz television

channel when using the DVB-T2 standard.¹ This represents a theoretical maximum of up to 28 television channels of 8 MHz, or up to 168 TV programs, in a given location. The number of programs possible is already an indication that it could address much more content than those currently available in most countries in the Sub-Saharan African region, even when considering its future expansion.

GE06 Agreement planning

The GE06 Agreement addressed channel planning in various sub-regions, including within the African continent. Furthermore, it contained provisions for instances where other services would be used in the UHF band, such as mobile services.² The safeguards required to protect neighbouring countries under the GE06 Agreement to avoid cross-border interference include the digital TV plans with coordination triggers, spectrum masks, and maximum level of acceptable interference from both TV and other services.

While the digital plan may require additional spectrum to ensure interference-free TV channel planning, there is plenty of spectrum available to also assign the 600 MHz band to mobile services (80 MHz in total). This would still ensure the availability of 144 MHz to broadcasting services, meaning 18 channels of 8 MHz that could provide up to 108 television programs in a given region. Note that a greater amount of spectrum is usually needed in the major metropolitan areas of each country, where there are a higher number of television programs available, and a greater number of the population.

Depending on the country, digital television network planning may require additional channels to avoid interference between different cities and regions within a country, as well as cross-border interference. Conditions for such planning vary from place to place, noting that it is possible to optimize the spectrum utilisation of the various DTT multiplexers and channels available in a country with the possibility of using a Single Frequency Network (SFN).

DTT spectrum utilisation

Based on the data in each country reviewed, it is possible to estimate the total bandwidth currently occupied by DTT channels. In most instances, this is considered for the location with greatest occupation within a country, either based on the actual number of television channels or multiplexers deployed, or taking the number of TV programs available, and assuming that six programs could be carried by each multiplexer, define the number of TV channels. Further, each multiplexer would occupy an 8 MHz channel. Some countries only provide the number of TV channels on a national level, and the same approach is considered in estimating the number of multiplexers.

Broadcasting spectrum utilisation methodology

The analysis of the current broadcasting spectrum occupation consists of:

1. Consider the number of TV programs in the city/region of a country with the highest occupation.
 - For cases where the information on the city/region are not available, TV programs at a national level are considered.

¹ Considering national experiences, and network planning under fixed reception parameters, such as 32K FFT, 256 QAM, FEC 2/3, as per European Broadcasting Union (EBU), Tech 3348, Frequency and Network Planning Aspects of DVB-T2 (January 2020), available [here](#).

² Final Acts of the Regional Radiocommunication Conference for planning of the digital terrestrial broadcasting service in parts of Regions 1 and 3, in the frequency bands 174-230 MHz and 470-862 MHz (RRC-06) Geneva, 15 May - 16 June 2006, available [here](#).

- In some instances, the actual utilisation of the TV channels or multiplexers are available, and thus this is the number considered, noting that they may carry more than six TV programs per multiplexer, as some programs are provided in standard definition (SD).
- 2. Translate the number of TV programs in total spectrum needed, considering that DVB-T2 could have six HD TV programs using an 8 MHz channel.
 - $DTT \text{ spectrum needed} = \left(\frac{\text{Number of TV programs}}{6} \right) \times 8 \text{ MHz}$
- 3. Difference in spectrum occupation, when subtracting the DTT spectrum needed from the total available in the band (224 MHz), can be considered for possible expansion of broadcasting and mobile services.
 - As it is the case for most countries, when the available spectrum is greater than 80 MHz, which is the bandwidth of the 600 MHz band, it could be available for mobile services.
 - The additional spectrum may be needed and used to support TV channel plans, ensuring coexistence, either of different regions inside a country, or of cross border cases in accordance with the G06 Agreement. It can also support future expansion of the DTT.

Summary – spectrum utilisation for the countries examined

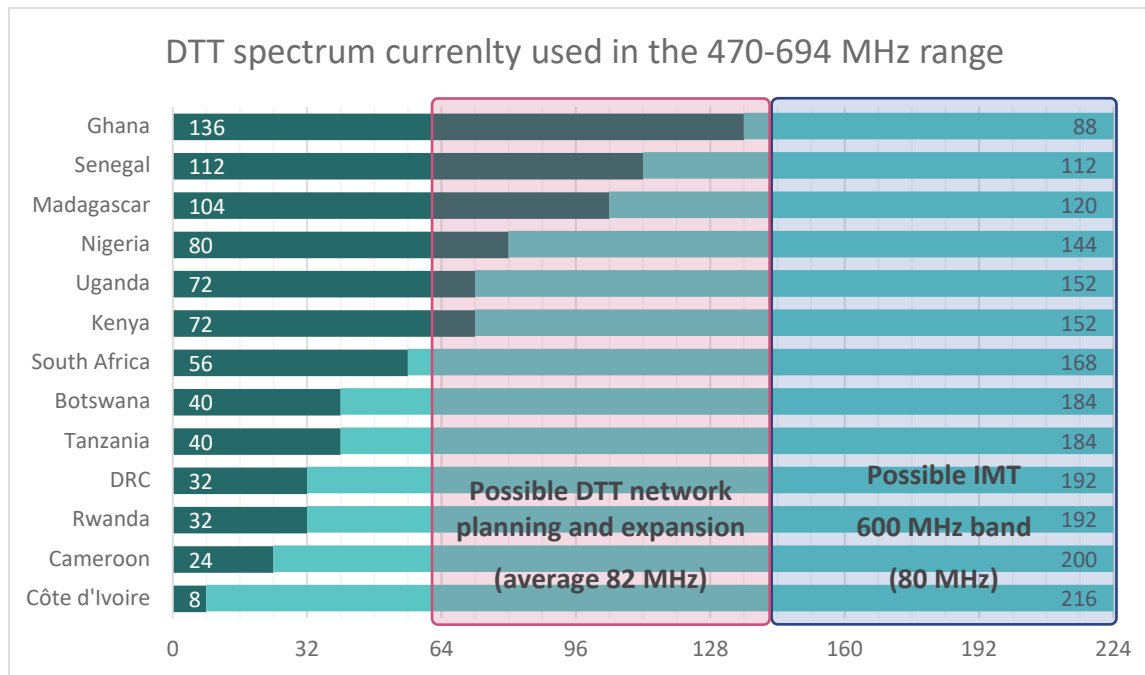
Based on the information available in the countries of interest, as shown in Table 14 and Figure 29, there is strong evidence that more spectrum is currently allocated to DTT than is necessary to support the number of channels available. Of the countries analysed, with the exception Kenya, none had over 80 existing digital TV programs in any one location. With these exceptions, no market analysed would require more than 112 MHz of spectrum to support broadcasting needs, allowing its use for mobile services.

Table 1: Summary of the current use of the frequency band 470-694 MHz in selected countries

Country	NTFA allocation	Current use	Number of TV programs	TV penetration (households)	Mobile penetration (unique subs)	UHF bands assigned to IMT
Botswana	Broadcasting	DTT	5	62%	67.8%	800 MHz
Cameroon	Broadcasting	DTT	12	57%	52.4%	800 MHz 700 MHz
Côte d'Ivoire	Broadcasting	DTT	7	65%	52.5%	800 MHz
DRC	Broadcasting	DTT	24	16%	39.9%	800 MHz 700 MHz
Ghana	Broadcasting	DTT	48	69%	56.5	800 MHz
Kenya	Broadcasting	DTT	142	51%	52.3%	800 MHz 700 MHz
Madagascar	Broadcasting	DTT	74	19%	37.2%	800 MHz
Nigeria	Broadcasting	DTT	60	50%	50.8%	700 MHz 800 MHz
Rwanda	Broadcasting	DTT	25	12%	51.1%	700 MHz 800 MHz
Senegal	Broadcasting	DTT	80	63%	53.2%	800 MHz
South Africa	Broadcasting	DTT	53	88%	68.1%	800 MHz 700 MHz
Tanzania	Broadcasting	DTT	29	39%	42.1%	800 MHz 700 MHz
Uganda	Broadcasting	DTT	54	20%	46.2%	800 MHz

Source: TMG, GSMA Intelligence

Figure 2: Spectrum utilisation and availability for IMT use in the frequency band 470-694 MHz



Source: TMG.

Côte d'Ivoire

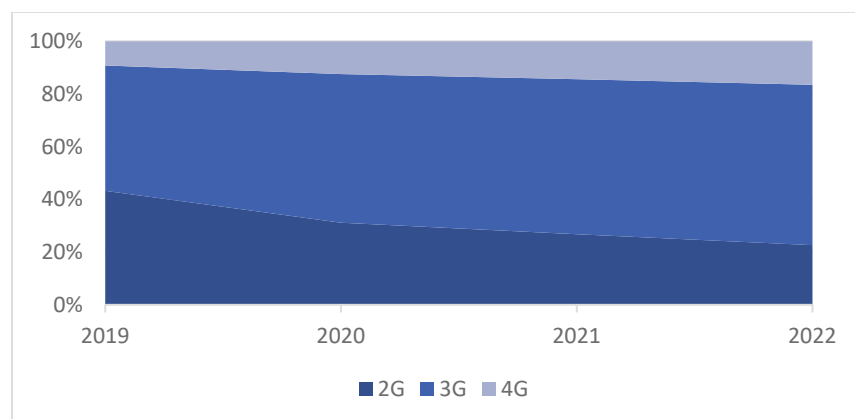
Current use of the frequency band 470-694 MHz

The 470-694 MHz band in Côte d'Ivoire is allocated to broadcasting services and utilised for DTT, according to the National Table of Frequency Allocations.³ The adjacent 694-790 MHz band has been noted in the frequency plan as DD2, while the 790-862 MHz band has been noted as DD1 and is used for mobile services.⁴ According to GSMA data, Côte d'Ivoire has a mobile penetration rate of 52.5 percent when considering unique mobile subscribers, although penetration numbers are far higher when including total mobile connections. While most of the mobile connections are still based on 3G technologies, there is a steady growth 4G connections, emphasizing the importance of making new frequency bands in lower ranges available to mobile operators (see Figure 30).

³ ARTCI, Plan for Frequency Band Occupation, available [here](#).

⁴ ARTCI, Plan for Frequency Band Occupation, available [here](#).

Figure 3: Mobile connections by technology – Côte d'Ivoire – 2019-2022



Source: GSMA Intelligence.

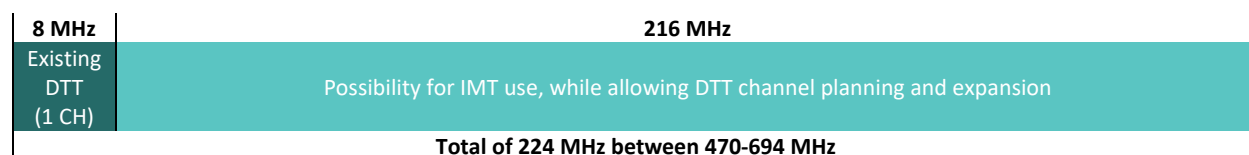
Table 2: Summary of the current use of the frequency band 470-694 MHz in Côte d'Ivoire

NTFA allocation	Current use	Number of TV programs	TV penetration (households)	Mobile penetration (unique subs)	UHF bands assigned to IMT
Broadcasting	DTT	7	65%	52.5%	800 MHz

Sources: ARTCI, GSMA Intelligence, Dataxis.

Further, Côte d'Ivoire's household TV penetration rate was 65 percent as of 2021.⁵ According to the *Société Ivoirienne de Télédiffusion* (SIDT), there are seven television programs in the country, being provided using one multiplexer.⁶

Figure 4: Spectrum utilisation in the frequency band 470-694 MHz in Côte d'Ivoire



Source: TMG.

Democratic Republic of Congo (DRC)

Current use of the frequency band 470-862 MHz

Although the most recent national frequency allocation table is not publicly available, correspondence with the Authority for Regulation of Posts and Telecommunications (ARPTC) confirms that the 470-694 MHz band is allocated to broadcasting services and utilised for DTT in the DRC.⁷ According to GSMA data, mobile penetration when considering only unique mobile subscribers is 39.9 percent, which is lower than the average of all countries analysed (52.6%). While most of the mobile connections are still based on 2G technologies, there is a steady growth in 3G, emphasizing the importance of making new frequency bands

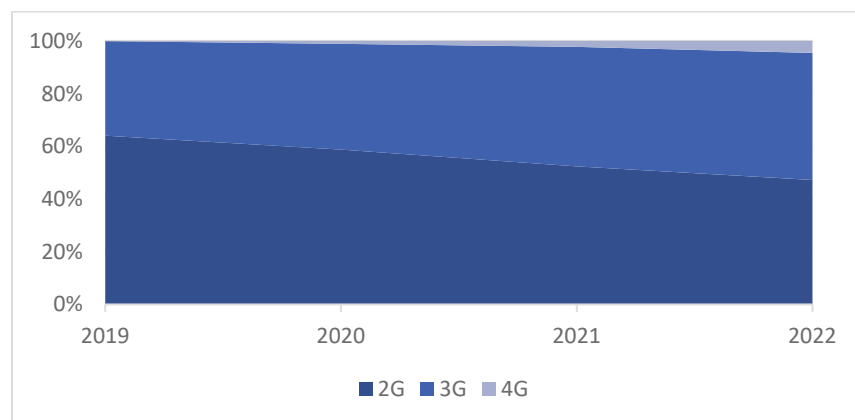
⁵ Dataxis, Ivory Coast Television Market Report, available [here](#).

⁶ SIDT, Les chaînes TV (visited on August 31, 2022), available [here](#).

⁷ Correspondence with representative of the ARPTC, June 2022.

in lower ranges available to mobile operators to support continued 3G and eventual 4G service growth (see Figure 32).

Figure 5: Mobile connections by technology – the DRC – 2019-2022



Source: GSMA Intelligence.

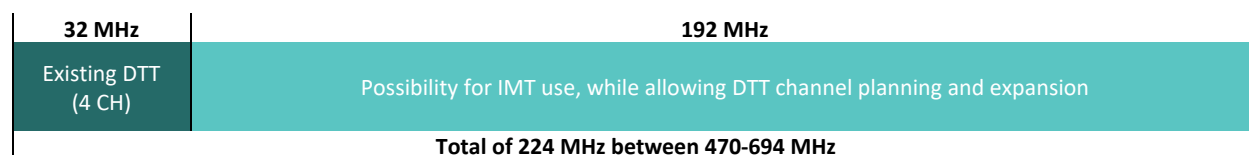
Table 3: Summary of the current use of the frequency band 470-694 MHz in the DRC

NTFA allocation	Current use	Number of TV programs	TV penetration (households)	Mobile penetration (unique subs)	UHF bands assigned to IMT
Broadcasting	DTT	24	16%	39.9%	800 MHz 700 MHz

Sources: ARPTC, GSMA Intelligence, Dataxis.

DRC's household TV penetration rate reached 16 percent as of 2021, which is far lower than the average of countries analysed, of over 44 percent.⁸ Since the introduction of DTT, several new television programs have been introduced, although not always with the necessary authorization, so the Ministry of Communications and Media has been in the process of enforcing the required authorizations.⁹ Consultations with ARPTC indicate still low number of TV channels available, although in the capital Kinshasa, up to 24 TV programs may be available. Further, DTT channels are currently only available in the largest cities in the DRC, while DTT availability and television penetration rates in rural areas are low.¹⁰

Figure 6: Spectrum utilisation in the frequency band 470-694 MHz in the DRC



Source: TMG.

⁸ Dataxis, DRC Television Market Report, available [here](#).

⁹ Ministère de la Communications et Médias, Communiqué Officiel (August 18, 2022), available [here](#).

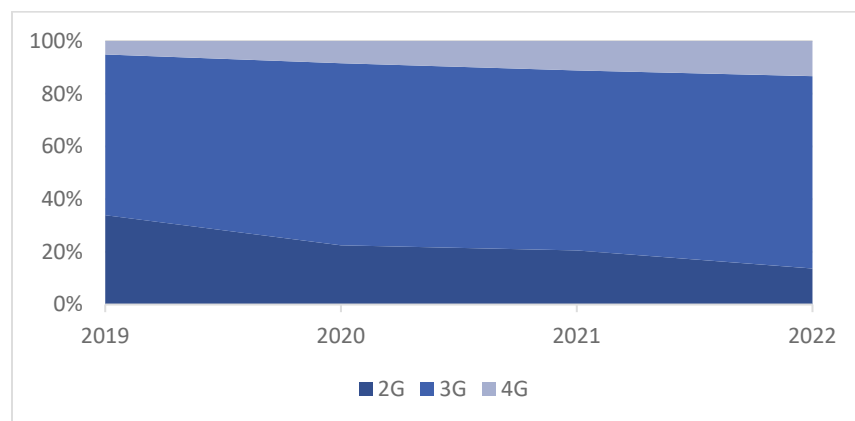
¹⁰ Correspondence with representative of the ARPTC, June 2022.

Ghana

Current use of the frequency band 470-862 MHz

According to the Ghanaian national frequency allocation table, the 470-694 MHz range is allocated for broadcasting services. However, land mobile services may also be used in this range on a secondary basis.¹¹ The adjacent 694-790 MHz band is allocated to mobile (except aeronautical) services, while the 790-862 MHz band has allocations to fixed and mobile services. Further, the adjacent 450-470 MHz band and the 440-450 MHz band are allocated to fixed and mobile services. According to GSMA data, Ghana has a mobile penetration rate of 56.5 percent when considering only unique mobile subscribers, which is slightly higher than the average of countries analysed (52.6%). A 2019 Household Survey on ICT in Ghana noted that 54.1% of individuals aged 5 years and older own a mobile phone.¹² While most of the mobile connections are still based on 3G technologies, there is growth in 4G, emphasizing the importance of making new frequency bands in lower ranges available to mobile operators (see Figure 34).

Figure 7: Mobile connections by technology – Ghana – 2019-2022



Source: GSMA Intelligence.

Table 4: Summary of the current use of the frequency band 470-694 MHz in Ghana

NTFA allocation	Current use	Number of TV programs	TV penetration (households)	Mobile penetration (unique subs)	UHF bands assigned to IMT
Broadcasting	DTT	48	69%	56.5%	800 MHz

Sources: NCA, GSMA Intelligence.

The National Communications Authority (NCA) publishes a List of Authorised TV Stations, which shows five digital terrestrial pay TV stations are operating with two multiplexers each.¹³ Statistics published by the NCA indicate that there are 36 DTT free-to-air television programs with nationwide coverage, and six DTT Free-To-Air program channels with regional coverage, noting that the capital has two of these

¹¹ National Communications Authority, Ghana National Frequency Allocation Table 2016, available [here](#).

¹² National Communications Authority and Ghana Statistical Service, Household Survey on ICT in Ghana, 2020, available [here](#).

¹³ National Communications Authority, List of Authorised TV Broadcasting Stations in Ghana, 2019, available [here](#).

regional channels.¹⁴ The 2019 Household Survey on ICT in Ghana indicates that 68.9 percent of households in Ghana owned a functional television, which is far higher than the average of countries analysed at 44.6 percent.¹⁵ TV ownership is much higher in urban areas (82.4%) than in rural areas (51.7%).

Figure 8: Spectrum utilisation in the frequency band 470-694 MHz in Ghana



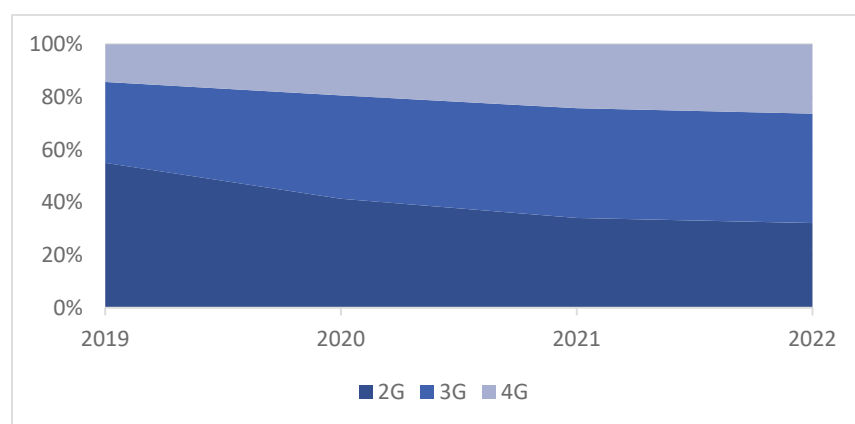
Source: TMG.

Madagascar

Current use of the frequency band 470-862 MHz

According to Madagascar's National Table of Frequency Allocation, the 470-790 MHz range is allocated to broadcasting services.¹⁶ The adjacent 790-862 MHz range, despite ITU regional allocations, is allocated entirely to broadcasting services in Madagascar. According to GSMA data, Madagascar has a mobile penetration rate of only 37.2 percent when considering unique mobile subscribers. While most of the mobile connections are still based on 2G and 3G technologies, there is sustained growth in 4G, emphasizing the importance of making new frequency bands in lower ranges available to mobile operators (see Figure 36).

Figure 9: Mobile connections by technology – Madagascar – 2019-2022



Source: GSMA Intelligence.

Table 5: Summary of the current use of the frequency band 470-694 MHz in Madagascar

¹⁴ National Communications Authority, Authorised TV Broadcasting Stations, available [here](#).

¹⁵ National Communications Authority and Ghana Statistical Service, Household Survey on ICT in Ghana, 2020, available [here](#).

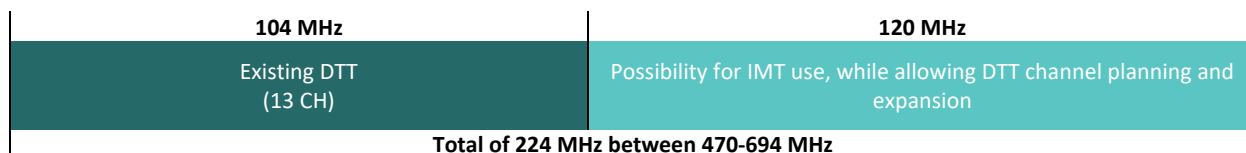
¹⁶ ARTEC, National Frequency Band Attribution Plan, available [here](#).

NTFA allocation	Current use	Number of TV programs	TV penetration (households)	Mobile penetration (unique subs)	UHF bands assigned to IMT
Broadcasting	DTT	74	19%	37.2%	800 MHz

Sources: ARTEC, GSMA Intelligence, Dataxis.

Madagascar's household TV penetration rate reached 19 percent as of 2021.¹⁷ The National Television Malagasy (TVM) channel covers the entire island of Madagascar, and there are local/regional television channels offered.¹⁸ In the Antananarivo Province, there are currently eight TV programs being offered. In addition, there is one pay TV provider using DTT, currently offering up to 66 television channels, mostly in SD.¹⁹

Figure 10: Spectrum utilisation in the frequency band 470-694 MHz in Madagascar



Source: TMG.

Nigeria

Current use of the frequency band 470-862 MHz

According to the Nigerian National Table of Frequency Allocation, the 470-790 MHz range is utilised for DTT, and includes allocations to mobile (except aeronautical), broadcasting, and radio astronomy. Per notes included in the table, the 470-854 MHz range is available for analogue TV, while the 474-698 MHz range is available for DTT, following the GE06 Agreement. Further, spectrum in the 790-862 MHz range is allocated to fixed, mobile, and broadcasting, with broadcasting allocations used for television.²⁰ Per GSMA data, mobile penetration rates when considering only unique mobile subscriptions are just above 50 percent, which is consistent with the average of countries analysed (52.6%). As in many of the countries examined, most of the mobile connections are currently based on 3G technologies, there is growth in 4G, (see Figure 38).

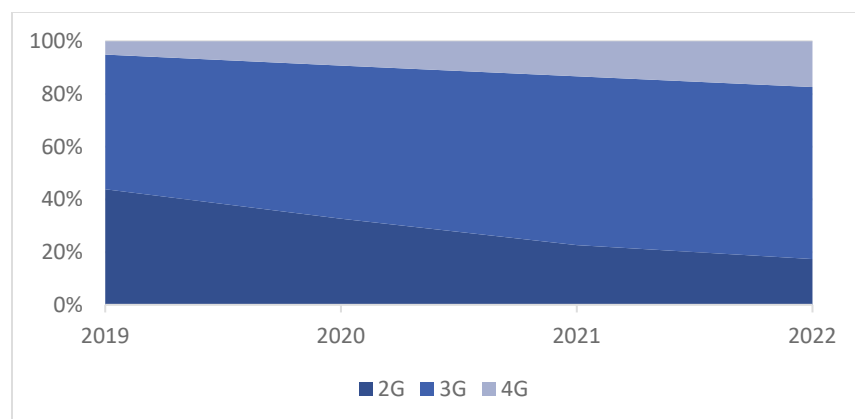
¹⁷ Dataxis, Madagascar Television Market Report, available [here](#).

¹⁸ FR Academic, Malagasy TV Channels, available [here](#).

¹⁹ Blueline, Packages (visited on August 31, 2022), available [here](#).

²⁰ NCC, Frequency Allocation Table, available [here](#).

Figure 11: Mobile connections by technology – Nigeria – 2019-2022



Source: GSMA Intelligence.

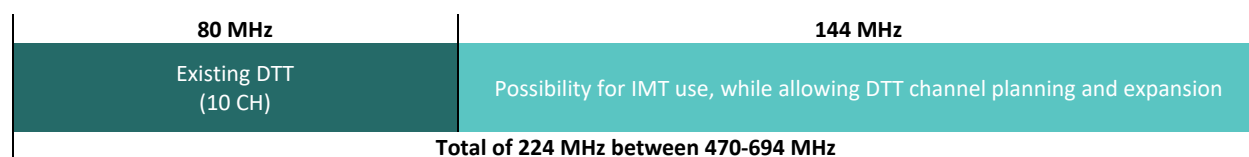
Table 6: Summary of the current use of the frequency band 470-694 MHz in Nigeria

NTFA allocation	Current use	Number of TV programs	TV penetration (households)	Mobile penetration (unique subs)	UHF bands assigned to IMT
Broadcasting	DTT	60	50%	50.8%	700 MHz 800 MHz

Sources: NCC, GSMA Intelligence, Dataxis.

Nigeria is among the largest television markets in its region. Per Gallup and Broadcasting Board of Governors statistics from 2014, almost two-thirds of Nigerians watch TV at least once per week.²¹ TV penetration is around 50 percent of Nigerian homes as of 2021.²² Rural TV penetration is still lacking significantly behind penetration in urban and suburban areas. As of 2020, the National Broadcasting Commission (NBC) indicated that there were 111 TV programs offered throughout Nigeria, while Free TV, entity created to manage DTT, indicates that there are 60 television programs in Lagos.²³

Figure 12: Spectrum utilisation in the frequency band 470-694 MHz in Nigeria



Source: TMG.

Rwanda

Current use of the frequency band 470-862 MHz

Per the Rwanda National Table of Frequency Allocations, the 470-694 MHz range is allocated to broadcasting services and has been assigned to DTT.²⁴ Short Range Devices are also permitted in this range

²¹ USAGM, Contemporary Media Use in Nigeria, available [here](#).

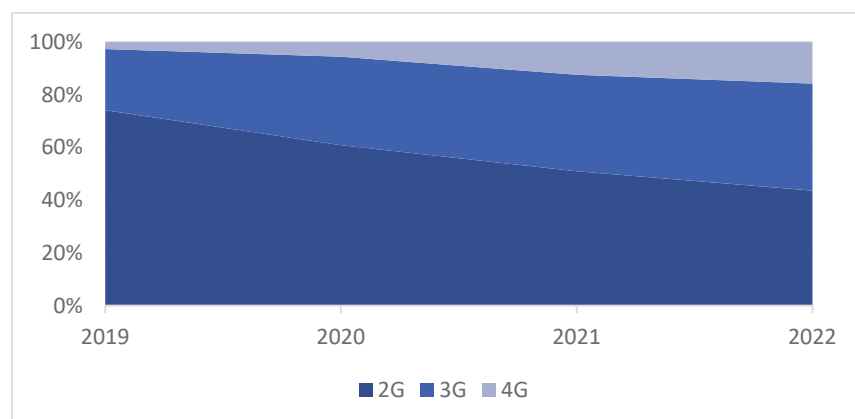
²² Dataxis, Nigeria Television Market Report, available [here](#).

²³ Free TV, available [here](#).

²⁴ RURA, National Frequency Allocation Table 2016, available [here](#).

subject to licensing requirements. Spectrum in the adjacent 694-790 MHz and 790-862 MHz is used for IMT. According to GSMA data, Rwanda has a mobile penetration rate of about 51 percent when considering only unique mobile subscribers, which is similar to the average of countries analysed. While most of the mobile connections are currently based on 2G and 3G technologies, there is some growth in 4G, emphasizing the importance of making new frequency bands in lower ranges available to mobile operators (see Figure 40)

Figure 13: Mobile connections by technology – Rwanda – 2019-2022



Source: GSMA Intelligence.

Table 7: Summary of the current use of the frequency band 470-694 MHz in Rwanda

NTFA allocation	Current use	Number of TV programs	TV penetration (households)	Mobile penetration (unique subs)	UHF bands assigned to IMT
Broadcasting	DTT	25	12%	51.1%	700 MHz 800 MHz

Sources: RURA, GSMA Intelligence.

The 2019-2020 Household Survey indicates that 12.4 percent of Rwandan households own a TV set, which is lower than the average of countries reviewed (44.6%). According to market statistics published by the Rwanda Utilities Regulatory Authority (RURA), Rwanda is currently home to four pay TV operators and 21 television programs.²⁵ According to documents published by RURA in 2020, there were nine TV programs carried by the Rwanda Broadcasting Agency Network, which is Rwanda's national public broadcaster, while 13 additional programs were carried by the PanAfrica Network Group.²⁶

Figure 14: Spectrum utilisation in the frequency band 470-694 MHz in Rwanda

32 MHz	192 MHz
Existing DTT (4 CH)	Possibility for IMT use, while allowing DTT channel planning and expansion
Total of 224 MHz between 470-694 MHz	

Source: TMG.

²⁵ RURA, Statistics Report for Telecom, Media and Broadcasting Sector as of the First Quarter of the Year 2022, available [here](#).

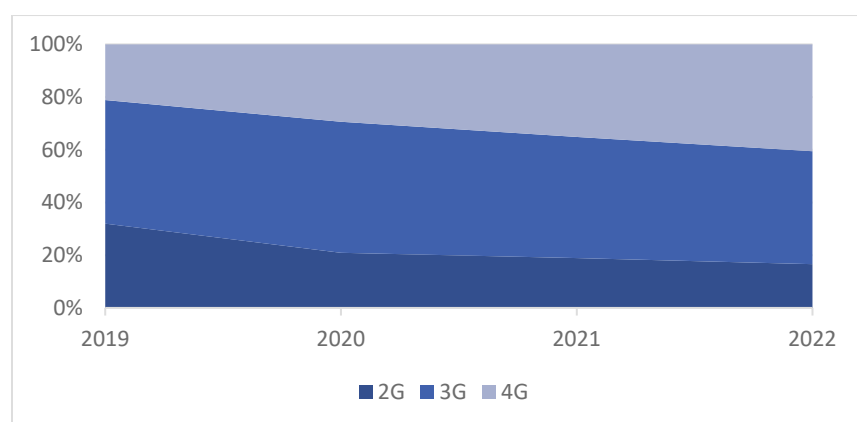
²⁶ RURA, List of FM and TV Stations Operating in Rwanda and their Approximate Coverage, available [here](#).

South Africa

Current use of the frequency band 470-862 MHz

According to the National Table of Frequency Allocation, the 470-694 MHz range is allocated to broadcasting and radio astronomy services, being used by DTT.²⁷ The adjacent 694-790 MHz band is allocated to mobile and broadcasting services and utilised for IMT. According to GSMA data, South Africa has a mobile penetration rate of about 68 percent when considering only unique mobile subscribers, which is significantly higher than the average of countries analysed (52.6%). In contrast to many other countries analysed, most of the mobile connections are currently based on both 3G and 4G technologies. There is continued growth in 4G, emphasizing the importance of making new frequency bands in lower ranges available to mobile operators (see Figure 42).

Figure 15: Mobile connections by technology – South Africa – 2019-2022



Source: GSMA Intelligence.

Table 8: Summary of the current use of the frequency band 470-694 MHz in South Africa

NTFA allocation	Current use	Number of TV programs	TV penetration (households)	Mobile penetration (unique subs)	UHF bands assigned to IMT
Broadcasting	DTT	53	88%	68.1%	800 MHz 700 MHz

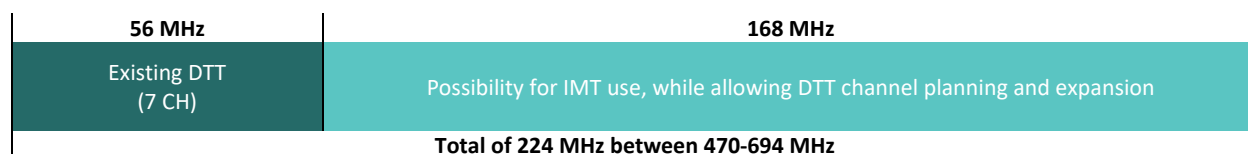
Sources: ICASA, GSMA Intelligence.

More households in South Africa own televisions (87.7%) than refrigerators (87.3%), which is nearly twice the average of countries analysed (44.6%). Over 90 percent of homes in metropolitan areas owned a television, as compared to 88 percent in urban and 82 percent in rural areas. According to the Independent Communications Authority of South Africa (ICASA), there are currently 282 DTT stations operating in the 470-694 MHz range in South Africa, spread across Channels 21-46. The province with the most channels is Eastern Cape, which has 53 stations offered throughout the province. The DTT channel planning defined seven multiplexers' channels per region.²⁸

Figure 16: Spectrum utilisation in the frequency band 470-694 MHz in South Africa

²⁷ Government of South Africa, National Radio Frequency Plan, available [here](#).

²⁸ ICASA, Radio Frequency Spectrum Assignment Plan for the frequency band 470 to 694 MHz (May 22, 2020), available [here](#).



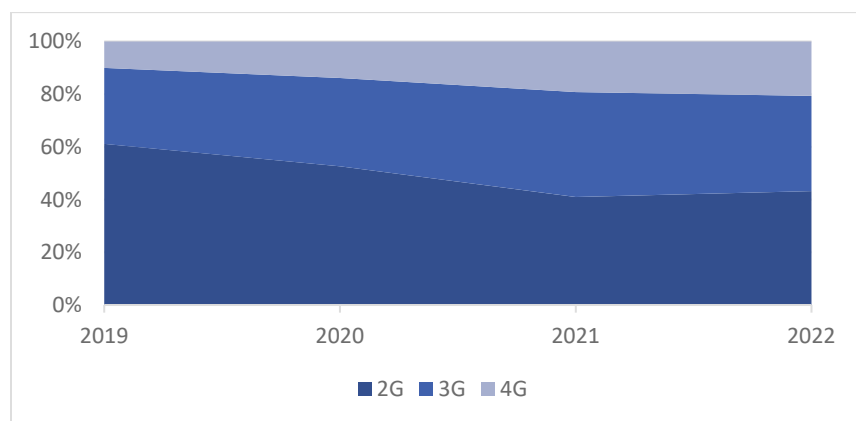
Source: TMG.

Uganda

Current use of the frequency band 470-862 MHz

According to the Uganda Communications Commission (UCC) National Table of Frequency Allocation, the frequency band 470-790 MHz is allocated to broadcasting services, following the ITU Region 1 allocation, and it is used for DTT. Spectrum in the adjacent 694-790 MHz band is allocated to mobile and broadcasting services and is planned for IMT use. The additional spectrum from 790-890 MHz is allocated to fixed, mobile, and broadcasting services, and it is currently being utilised for IMT.²⁹ According to GSMA data, Uganda has a mobile penetration rate of about 46 percent when considering only unique mobile subscribers. While most of the mobile connections are still based on 2G technologies, there is a steady growth in more advanced 4G connections, emphasizing the importance of making new frequency bands in lower ranges available to mobile operators (see Figure 44).

Figure 17: Mobile connections by technology – Uganda – 2019-2022



Source: GSMA Intelligence.

Table 9: Summary of the current use of the frequency band 470-694 MHz in Uganda

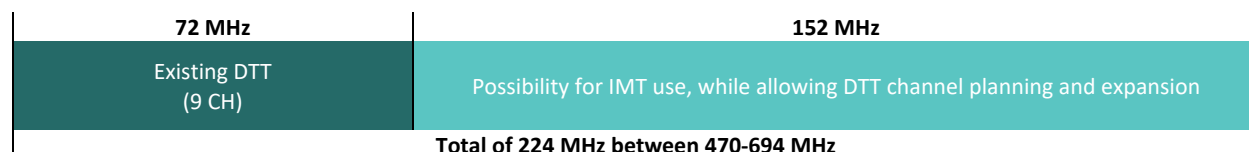
NTFA allocation	Current use	Number of TV programs	TV penetration (households)	Mobile penetration (unique subs)	UHF bands assigned to IMT
Broadcasting	DTT	54	20%	46.2%	800 MHz

Sources: UCC, GSMA Intelligence.

²⁹ UCC, Uganda Table of Frequency Allocation, 8.3 kHz – 3000 GHz, 2020, available [here](#).

When compared to other countries reviewed service penetration rates in Uganda are generally lower than average. For example, Uganda has mobile penetration rates (unique mobile subscribers) of about 46 percent, as compared to an average of 52.6 percent in the countries reviewed. As of 2021, only 20 percent of households own a television set.³⁰ There are at least 54 licenced TV broadcasters in Uganda.³¹ The region with the greatest broadcasting spectrum occupation is the greater Kampala area. In this region, the DTT site was commissioned with the capacity to carry 48 content streams over four frequency channels of 8 MHz bandwidth, thus occupying a total of 32 MHz. Each frequency channel can carry 12 SD television programs or could carry 6 HD programs.³²

Figure 18: Spectrum utilisation in the frequency band 470-694 MHz in Uganda



Source: TMG.

³⁰ Dataxis, Uganda Television Market Report, available [here](#).

³¹ UCC, Licensed Television Broadcasters, available [here](#).

³² See ministerial statement by the minister of state for ICT digital migration in Uganda, available [here](#).



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