PROPOSED SPECTRUM SCREEN

JULY 9, 2021

SPECTRUM MANAGEMENT AUTHORITY
KINGSTON, JAMAICA

DEVELOPMENT
OF
MOBILE SPECTRUM SCREEN

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A. Introduction

1. This Position Paper has been prepared by the Spectrum Management Authority ("the SMA" or "the Authority"), the regulatory body with responsibility for the management of the radio frequency spectrum in Jamaica and an agency under the Ministry of Science, Energy and Technology (MSET).

2. The document was prepared by the SMA, in collaboration with the Fair Trading Commission (FTC), the administrative body responsible for implementing the Fair Competition Act (FCA) and the Office of Utilities Regulation (OUR), which was established by an Act of Parliament in 1995 to regulate the operations of utility companies.

3. The information provided herein are primarily for those parties currently providing or are considering providing mobile services to the public in Jamaica. The paper outlines the proposed guidelines, rules and operation of the mobile spectrum screens that are as follows:

- Establishing a trigger point for assignments above 120 MHz of spectrum in the listed frequency bands: 700MHz, 850MHz, 900MHz, 1900MHz, and 1700/2100 MHz (AWS Band);
- Establish **a pass mark of 70% for applicants** to be recommended for the licence;
- Removing the 1800 MHz frequency band from the list of frequency bands under the 120 MHz trigger point;
- Establishing a trigger point at 30% in-band Screen on the listed bands allocated for mobile services, (1500 MHz, 25 GHz, 37 GHz, 43 GHz, and 66 GHz); and,
- Review period remains 6 months after a World Radiocommunications Conference (WRC).

4. **Comments and or recommendations are being solicited with rationale for your position, on**:

- General guidelines and rules in relation to the screen; and,
- The evaluation process and criteria;

5. All comments in relation to the Position Paper must be addressed **in writing to**:

The Managing Director
Spectrum Management Authority
13-19 Harbour Street,
Kingston
consultation@sma.gov.jm

6. **The deadline for submission of initial comments is 2021 July 23**

7. **Publication of Submission**

The SMA will publish in whole or in part, all comments received in relation to this Position Paper. The identity of those making the comments will be published and requests for confidentiality of subject material will be considered in accordance with the need for transparency, or as authorized by law. The timeline for the consultation is summarized in the Table below.

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Events	Deadline Dates
Posting of Position Paper - **SMA**	2021 July 9
Submission of comments on Position Paper - **Industry**	2021 July 23
Posting of responses to comments received - **SMA**	2021 July 30
Submission of comments on SMA's responses - **Industry**	2021 Aug 9
Posting of Notice of Recommendation - **SMA**	2021 Aug 13

B. Background

8. The NOTICE OF DECISION TO EXTEND THE AGGREGATE SPECTRUM CAP POLICY[1], of 2017 March 24 (hereinafter "the 2017 Decision"), made provision for its review within six (6) months of the conclusion of the World Radiocommunication Conference in 2019 (WRC-19).

9. However, based on the assessment of the World Health Organization (WHO) that the Coronavirus (COVID-19) was a pandemic and the Prime Minister's declaration that the whole Jamaica was a disaster area, the SMA recommended a delay in the review of the Policy.

10. Subsequently, the Minister, acting on the recommendation of the SMA, extended the period of review for the 2017 Decision for a further period of nine (9) months commencing 2020 May. The SMA has since sought a further extension.

11. On 2020 November 16, the SMA issued a Position Paper, PROPOSED SPECTRUM HOLDINGS POLICY[2], which proposed the following spectrum holding policy:

- Removing the spectrum cap and utilizing a spectrum screen for assignments above 120 MHz of spectrum in the listed frequency bands: 700MHz, 850MHz, 900MHz, 1800MHz, 1900MHz, and 1700/2100 MHz (AWS Band); and
- A 30% in-band Screen on all other suitable and available bands allocated for mobile services, (1500 MHz, 25 GHz, 37 GHz, 43 GHz, and 66 GHz, …etc.)

12. Based on initial queries/comments received, a second round of consultations is being initiated with the issuance of this Position Paper on the Development of a Mobile Spectrum Screen.

[1] Link for SMA's website, Cap Decision.
[2] Link for SMA's website, Position Paper.

C. Policy Considerations

13. Bearing in mind the need to attract new players to the Information and Communications Technology ("ICT") sector, as directed by the former Minister, the Honourable Fayval Williams, the fair, efficient and effective management of the spectrum, the SMA is also giving thought to the policy goals, principles and objectives of the **Government of Jamaica's ICT Policy 2011**[3]**,** in particular, the following:

i. ***ICT Policy Goal - Section 2.3(ii)***: Increased local and international investments. It is anticipated that the establishment of world-class high capacity ICT infrastructure and services across the island will facilitate increased investments in the country;

ii. ***ICT Policy Main Principles - section 2.4(i)***: ICT as a development instrument. The intention is that ICT will be utilized as a key enabler for human, social and economic development and improve the quality of life of all Jamaicans;

iii. ***ICT Policy Main Principles - section 2.4(ii)***: Universal Service - ICT is to be widely available and utilized by the general population.

iv. ***ICT Policy Main Principles – Section 2.4(iii)***: Technological Neutrality - There will be a neutral approach in technology selection and regulation.

v. ***ICT Policy Main Principles – Section 2.4(iv)***: Competition within the ICT Sector - The focus of this policy is to promote competition and innovation for the benefit of consumers, producers and service providers.

vi. ***Section 4 – Spectrum: A Natural Resource***

D. General Facts about the radio frequency spectrum

14. **Wireless providers use spectrum – the invisible infrastructure used by wireless devices such as smartphones and tablets—to provide communications services.**

- Access to spectrum is an essential input for the provision of mobile wireless services.
- Demand for these services (mobile wireless) has been growing over the years and projections indicate continued growth. **(Source: GSMA Intelligence – The Mobile Economy 2020)**
- In order for wireless providers to meet increasing demand for mobile broadband, there is a need to put new spectrum to use and make more efficient use of existing spectrum holdings – that may include: the deployment of more spectrally-efficient wireless technologies and the migration of customers to these technologies; increased reuse of available radio frequencies enabled both by cell site splitting (considering Open RAN, which helps to reduce cost) and LTE-A support for enhanced small cell and Wi-Fi integration; and by tighter packing of offered data into available transmission capacity.

[3] Link for SMAs website, ICT Policy.

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15. **Spectrum is a finite resource integral to providing mobile broadband service. No one provider should be able to dominate use of wireless airwaves.**

- Not all spectrum is created equal: mobile providers use a mix of low-band "coverage" spectrum, which operates at lower frequencies, mid and high-band "capacity" spectrum, which operates at higher frequencies.
- Low-band spectrum, below 1 GHz, is relatively scarce, and has special properties that facilitate wireless service across long distances and through barriers, such as walls. It is very useful for deploying in rural areas and providing service in urban buildings.
- Mid-band spectrum (1 GHz to 6 GHz) like AWS-1, has more available bandwidth, meaning that it has more data capacity, but it does not travel as well over distances or through walls.
- High-band (above 6 GHz): Short waves cover a small area and are capable of super-fast data transmission, but can't penetrate buildings.
- The two mobile wireless providers hold a combined share of approximately 75% of all available low-band spectrum licenses (700, 850 and 900 MHz) and approximately 60% of all mid-band spectrum licenses (1900 and 1700/2100 MHz).

E. The Proposed Spectrum Screen

Spectrum Screen

16. A Spectrum screen (the screen) acts as a benchmark to determine reasonable levels of spectrum holdings. The screen as proposed by the SMA considers the total spectrum suitable and available for commercial mobile services and establishes a trigger point at which the SMA will conduct a more detailed analysis for assignment of additional spectrum above this level.

17. Therefore, mobile service providers will be able to freely acquire spectrum up to the predetermined threshold, after which, each transaction will be evaluated on a case-by-case basis. The SMA's proposals for the screen are as follows:

- Establishing a trigger point for assignments above 120 MHz of spectrum in the listed frequency bands: 700MHz, 850MHz, 900MHz, 1900MHz, and 1700/2100 MHz (AWS Band);
- Establish **a pass mark of 70% for applicants** to be recommended for the licence;
- Removing the 1800 MHz frequency band from the list of frequency bands under the 120 MHz trigger point;
- Establishing a trigger point at 30% in-band Screen on the listed bands allocated for mobile services, (1500 MHz, 25 GHz, 37 GHz, 43 GHz, and 66 GHz); and,
- Review period remains 6 months after a World Radiocommunications Conference.

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General Guidelines

18. Operationally, universal access, competition concerns and efficient use of the spectrum shall be significant as the SMA employ the spectrum screen mechanism to achieve the aforementioned policy objectives.

19. The SMA shall encourage effective competition in the mobile telecommunication markets by ensuring that reasonable spectrum aggregation rules with regards to spectrum holdings, are tailored to promote universal access and competitive level of spectrum access.

20. The SMA shall seek to assign the spectrum using the screen, to the operator with the highest value use – i.e. operators should demonstrate that they are the best candidate for the spectrum licence by outlining their plan for use of the additional spectrum as well as spectrum already held. Additionally, applications should articulate the benefits to society and any adverse effect if the requested spectrum licence is not issued.

21. Consideration shall be made of the Applicant's spectrum holding and the level of concentration relevant to the market and overall availability of spectrum.

22. The transaction will be subjected to efficient use, as well as competitive and public interest analysis once the spectrum holdings have reached the trigger point, to ensure that the overall impact of the transaction does not adversely impact the market.

23. Aggregation of approximately one third (1/3) or more of available low-band spectrum in a market will be an "enhanced factor" in the SMA's competitive analysis of a proposed transaction.

24. Based on the competitive analysis in auctions, or in a competitive evaluation process, the SMA may consider a "set-a-side" in certain bands for select bidders (generally, bidders with spectrum holdings that have less than the trigger point and can easily acquire additional spectrum without going above).

25. Operators can still surrender spectrum in another band, to the SMA to meet the requirements of being eligible for acquiring additional spectrum in a desired band. (low band for low band, high band for high band or relinquishing low band for high band may be permitted).

26. Not all spectrum bands need to be subjected to the screening process. Spectrum bands shall be added or subtracted as is deemed necessary by the SMA.

Required Submission

27. To assess applications above the trigger, point the SMA will require the following information from Applicants and **a minimum score of 70 is required** for the SMA to recommend that the applicant be awarded the licence:

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Technical Information

28. A description of the proposed service. The Applicant shall identify, and give clear and precise descriptions of, the telecommunications service(s) for which the licence application is made. The description of the proposed services shall include:

- How the service(s) will generally be utilised by target users (e.g. residential, small businesses, other service providers). Provide practical examples, as necessary.
- How the service(s) will be delivered end to end. The technical means by which a customer will access the service must be clear. It must also be made clear whether the Applicant will be deploying its own network to provide the service(s) or if it will rely primarily on wholesale facilities of other licensees.
- The intended coverage areas upon launch of the service(s).
- Clear percentage indication of any coverage in unserved and or underserved areas.
- The expected service(s) launch date.
- Detailed rollout plan outlining projected timelines and percentage coverage to be achieved within the stated timelines.

29. A detailed description of the network and a network diagram. The key network elements illustrated in the network diagram must be identified by make and model. To the extent practicable, the network illustration shall be presented in a manner that the following can be clearly identified:

- The network connection paths, for the relevant telecommunications services, from points (subscribers, networks etc) of origin to the destination (subscribers, networks, etc.). Where applicable, customer premises equipment must be shown on the network diagram.
- The antenna polarization, that is, single or dual polarization, to be used by the links in the network. In addition, the number of links using single and the number using dual polarization.
- The main switching/service hosting sites, other points of presence and transmission routes as well as the major network communications link – wired (copper or fibre) or wireless – between nodes.
- Value added service (VAS) platforms as well as key operational and support systems (e.g. Billing, DNS, DHCP servers).
- Where appropriate, any facilities/infrastructure in the network that are not owned by the Applicant.
- How the network will be interconnected with other public telecommunications networks.
- Where network facilities are located (within or outside of Jamaica).

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30. The Applicant must supply a network plan which provides a detailed description of how the key elements (identified by make and model) illustrated in the network diagram will function to provide the proposed service(s). The network description shall also outline:

- The intended geographic coverage of the network upon the commissioning of the facilities taking into account - population density, project scalability, use of existing infrastructure, and improved reliability.
- The implementation schedule showing that the Applicant is able to meet their projected geographic rollout and timescales.
- Use of appropriate technologies for the provision of wide-scale voice and mobile broadband services.
- Use of infrastructure with the capacity to scale up in order to meet potential future needs, including an increase in number of premises and other future capacity constraints on the network.
- Use of infrastructure and network solutions components to manage and recover from failures and degradation and the ability to resolve these issues.

31. Detailed existing and proposed spectrum utilization plan to include; the number of correctly received bits by user per month, number of subscribers in the area under consideration, number of cells deployed in the area under consideration per carrier, carrier bandwidth (MHz) and the frequency reuse factor per carrier. Additionally, with the data herein, the applicant should, using the algorithm in section 46, with the help of the example at **Appendix 2**, also include the calculations.

32. The Applicant shall provide the SMA with information on alternative measures considered (with documentary support), prior to determining that additional spectrum in the stated frequency band is necessary. This may include any of the following, as applicable:

- Utilization of other / new spectrum not under the screen for which the spectrum under consideration is to be assessed.
- More efficient use of existing spectrum holdings – that may include:
  i) the deployment of more spectrally-efficient wireless technologies and the migration of customers to these technologies;
  ii) increased reuse of available radio frequencies enabled both by cell site splitting (considering Open RAN, which helps to reduce cost) and LTE-A support for enhanced small cell and Wi-Fi integration;
  iii) tighter packing of offered data into available transmission capacity; etc.
- the deployment of more stations / Network upgrade - hardware upgrade to network, etc.

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Competitive Analysis Information[4]

33. Quarterly data on revenue and subscriptions during the preceding three years.

34. Mobile porting activity in the most recent three years.

Public Interest

35. The Applicant is also required to demonstrate the benefits to be derived, in the public interest, through the licensing of the spectrum. Such possible information may include, *inter alia*, the following:

- Expansion of coverage in unserved and underserved areas, (*see list provided* ***Appendix 1***);
- Improved download rate (Mbps) coverage quality, under peak traffic conditions at the deployment areas specified by the Applicant.

Evaluation

36. Evaluation of applications that reaches the trigger, shall consider the Applicant's fulfilment of the **Required Submission** section (technical information, competitive analysis information, and public interest information). Additionally, data held by the SMA and the OUR, shall also be assessed in determining the favorability of the application. This will include the following:

- Amount of spectrum available in the band under consideration.
- Amount of spectrum held by the Applicant in the band under consideration.
- If low band, the amount of low band spectrum available and the amount of low band spectrum held by the Applicant.
- List of telecommunications licences issued by the Minister that are active or became inactive during the preceding five (5) years.
- Spectrum assigned by (/surrendered) to the SMA during the preceding three (3) years.
- Outcome of assignment mechanisms during the preceding three (3) years.
- Changes in the regulatory environment in the preceding three (3) years.
- Changes in the technological environment/ecosystem in the preceding three (3) years.
- Anticipated/proposed changes in the regulatory environment in the next two (2) years.
- Anticipated technological changes in the next two (2) years.
- Mobile porting activity in the most recent three (3) years.
- Mergers, acquisitions in the local telecom's market in the preceding five (5) years and the impact on spectrum holdings.
- Relevant network performance data that justifies the need for additional spectrum.

[4] The information requested here forms only part of the data that will be utilized in the analysis. Further information will be gathered from the market and between the regulatory agencies.

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Evaluation Matrix

37. The information submitted by the applicant and information held by the regulatory agencies shall be used to determine the following criteria:

38. **Efficient use of the spectrum**; *(Weighting 40 points)*

39. **Competitive Analysis**; (*Weighting 30 point)*

40. **Public Interest**. *(Weighting 30 points)*

Efficient use of the spectrum

41. Efficient use of the spectrum will be assessed using: the population coverage and minimum download data rate as proposed by the operator; the cell[5] spectral efficiency, and the consideration of alternatives.

42. As such, the information outlined at item numbers 28 – 32, under *Required Submission* shall be critical to this assessment.

43. Cell Spectral Efficiency

44. Cell spectral efficiency (η) is defined as the aggregate throughput of all users (the number of correctly received bits, i.e., the number of bits contained in the service data units (SDUs) delivered to Layer 3, over a certain period of time) divided by the channel bandwidth divided by the number of cells. The channel bandwidth for this purpose is defined as the effective bandwidth times the frequency reuse factor, where the effective bandwidth is the operating bandwidth normalized appropriately considering the uplink/downlink ratio.

45. The cell spectral efficiency is measured in bit/s/Hz/cell.

46. So let χ_i denote the number of correctly received bits by user i (downlink) or from user i (uplink) in a system comprising a user population of N users and M cells. Furthermore, let ω denote the channel bandwidth and T the time over which the data bits are received. The cell spectral efficiency, η, is then defined according to the equation below.

$$\eta = \frac{\sum_{i=1}^{N} \chi_i}{T \,.\, \omega \,.\, M}$$

47. Based on the area identified by the applicant, that is, the area under consideration for increase capacity, the SMA would seek to determine the prevailing and the proposed levels of spectral efficiency in that area. This is to assess whether the applicant was using and will continue to

[5] A cell is equivalent to a sector, e.g. a 3-sector site has 3 cells.

use the spectrum efficiently, by comparing same with the average spectral efficiency objectives (standard) established by 3GPP for the respective LTE Release as outlined below.

48. Spectral Efficiency Objectives (bit/s/Hz)

LTE FDD ITU (Release 8) Spectral Efficiency Objectives (bit/s/Hz)									
				Downlink			Uplink		
Scenario	Antennas	Inter-Site Distance (m)	Penetration Loss (dB)	Peak (bps/Hz)	Average (bps/Hz/cell)	Cell Edge 10 users per cell (bps/Hz/cell/user)	Peak (bps/Hz)	Average (bps/Hz/cell)	Cell Edge 10 users per cell (bps/Hz/cell/user)
3GPP Case 1 Carrier: 2 GHz Bandwidth: 10 MHz	1x2	500	20				3.75	0.86	0.028
	2x2			7.5	1.63	0.05			
	4x2			15	1.93	0.06			
	4x4				2.87	0.11			

LTE-A ITU Spectral Efficiency Objectives (bit/s/Hz)									
				Downlink			Uplink		
Scenario	Antennas	Inter-Site Distance (m)	Penetration Loss (dB)	Peak (bps/Hz)	Average (bps/Hz/cell)	Cell Edge 10 users per cell (bps/Hz/cell/user)	Peak (bps/Hz)	Average (bps/Hz/cell)	Cell Edge 10 users per cell (bps/Hz/cell/user)
ITU Indoor Hot Spot	4x2	60			3	0.1		2.25	0.07
	2x4								
ITU Urban Micro	4x2	200			2.6	0.075		1.8	0.05
	2x4								
ITU Urban Macro	4x2	500			2.2	0.06		1.4	0.03
	2x4								
ITU Rural Macro	4x2	1732			1.1	0.04		0.7	0.015
	2x4								
3GPP Case 1 Carrier: 2 GHz Bandwidth: 10 MHz	1x2	500	20					1.2	0.04
	2x4							2	0.07
	2x2				2.4	0.07			
	4x2				2.6	0.09			
	4x4				3.7	0.12	15		
	8x8			30					

Competitive Analysis

49. A Competitive analysis will be conducted, utilizing the information submitted in the required submission section of the document, along with related market information to include the abovementioned data held by the SMA and the OUR. The factors to be considered are, *inter alia*, the following, and an illustrative scenario is included at **Appendix 3**:

- **Contestability** (15 points maximum)

50. This category measures the extent to which incumbents will face competitive constrains from the credible threat of entry post spectrum assignment. Competition arising from the credible threat of entry is the most robust source of competition and is therefore given the greatest weight across the three categories. The contestability category is divided into two sections: (i) Contestability Index (6 points) and (ii) rapid entry (9 points).

i. Contestability Index

51. Assignable spectrum is defined as the sum of assigned and unassigned spectrum within a given band. Contestability is based on whether and the extent to which unassigned spectrum band is adequate for an entrant to compete with incumbents in the post assignment period.

52. Points are awarded as indicated in Table 1 below.

Table 1. Points Awarded Based on Share of Unassigned Spectrum

Post Assignment Share	Points given
$s_0 \geq \max\{s_1, s_2, \dots, s_n\}$	6
$min\{s_1, s_2, \dots, s_n\} \leq s_0 < \max\{s_1, s_2, \dots, s_n\}$	3
$s_0 < \min\{s_1, s_2, \dots, s_n\}$	0

where,

s_i as the share (in %) of assignable spectrum which has been assigned to incumbent $i = 1,2 \dots, n$

s_0 as the share of assignable spectrum which remains unassigned

ii. Rapid Entry

53. The Rapid Entry potential is based on the two (2) year period preceding the request for additional spectrum holdings.

Table 2.

Entry Potential	Points given
Telecom licence granted	9
Licence requested but decision pending	5
No requests for licence/Licence denied	0

- **Competitiveness** (10 points maximum)

54. This category measures the extent to which incumbents will constrain each other and is based on the Competitiveness Index (10 points).

55. The Competitive Index is given as

$$I2 = \frac{10{,}000}{n\sum_{i=1}^{n} s_i^2}$$

where,

n is the number of mobile operators ($n > 1$),

s_i is the share (in %) of assigned spectrum held by operator $i = 1,2, \ldots n$.

Points awarded based on the change in the Index (Δ) as well as the post-assignment Index as indicated in Table 3 below:

Table 3.

		Post Assignment Competitive Index		
		$Index < 0.750$	$0.750 \leq Index \leq 0.850$	$0.850 < Index \leq 1.000$
Change (Δ)	$\Delta < 0.010$	10	10	10
	$0.010 \leq \Delta < 0.020$	3	8	10
	$0.020 \leq \Delta < 0.030$	2	7	10
	$0.030 \leq \Delta < 0.040$	1	6	10
	$0.040 \leq \Delta < 0.050$	0	5	10
	$0.050 \leq \Delta < 0.060$	0	4	10
	$\Delta \geq 0.060$	0	3	10

Where Δ is given as,

$$\Delta = I(prior) - I(post)$$

The Index approaches its maximum value of 1.000 as the market becomes competitive. A market with an Index between 0.850 and 1.000 is considered to be highly competitive. An Index between 0.750 and 0.850 is considered to be moderately competitive while an Index below 0.750 is presumed to be uncompetitive.

56. Consumer behaviour (5 points maximum)

This category measures the extent to which consumers switch among operators. This category is based on the number of mobile numbers ported during the preceding six (6) months as a share of the number of subscriptions.

If this share is less than 5%, then 0 point are assigned.

If this share is between 5% and 10%, then 3 points are assigned.

If the share exceeds 10%, then 5 points assigned.

Public Interest

57. The information submitted under this section in relation to the following will be used to determine the points for this criterion:

- Expansion of coverage in unserved and underserved areas, (*see list provided Appendix x*);
- Improved coverage quality above a download data rate of eight (8) Mbps or more, under peak traffic conditions at the deployment areas specified by the Applicant.

Terms and conditions of the licence

58. The terms and conditions of the licence shall include, *inter alia*, all actions as submitted and agreed upon by the SMA in the application such as the Public Interest factors, the proposed services, the structure of the network as outlined and agreed upon in the application, etc.

Reporting Obligations

59. The licensee shall provide status reports, in the first instance to the SMA during the rollout, on the targeted terms and condition of the licence and any information supporting same, in a timely manner, as agreed with the SMA;

60. Once the rollout conditions have been met the licensee shall provide status reports to the OUR, in relation to the maintenance of coverage and the quality of service being delivered in accordance with the targets outlined in the licence. These reports will form a part of the information to be used to assess whether or not the terms of the licence are being met.

Failure to meet terms and condition of the licence

61. Where an applicant, after being assigned the requested spectrum, fails or refuses to fulfill the obligations attaching to the licence, which is the basis on which the licence would have been granted, then the licence may be revoked or suspended in accordance with **section 23Aof the Telecommunications Act.**

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62. **Evaluation Sheet – A worked sample evaluation sheet is included in Appendix 4.**

Evaluation Criteria	Weighting	Score
Efficient use of the spectrum	**40**	**300**
- **Population coverage and minimum download data rate as proposed by the operator.**		
At **twelve (12)** months, proposed rollout plan satisfies the following:		**100**
I. 95% or more population coverage of the entire area proposed in application, at a minimum download data rate of five (5) Mbps under peak traffic conditions.		**75**
II. 75% up to 94% population coverage of the entire area proposed in application, at a minimum download data rate of five (5) Mbps under peak traffic conditions.		**60**
III. 60% up to 74% population coverage of the entire area proposed in application, at a minimum download data rate of five (5) Mbps under peak traffic conditions.		0
IV. Below 60% population coverage.		**100**
- **Cell Spectral Efficiency (CSE)**		
Scores are awarded based on actual spectral efficiency in the area specified by the operator (under consideration) versus spectral efficiency objectives as established by 3GPP for that technology:		
For current CSE Bps/Hz/cell		
$2.0 \leq$ CSE		**50**
$1.6 \leq$ CSE < 2.0		**37.5**
$1.2 \leq$ CSE < 1.6		**25**
Proposed CSE Bps/Hz/cell		
$2.0 \leq$ CSE		**50**
$1.6 \leq$ CSE < 2.0		**37.5**
$1.2 \leq$ CSE < 1.6		**25**
The points awarded will be based on the level of spectral efficiency currently and proposed, for the area under consideration.		

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Evaluation Criteria	Weighting	Score
- **Consideration of Alternatives** **For each alternative considered, 25 points are awarded, with a maximum 100 points.**		**100**
• To utilize other / new spectrum not under the screen for which the spectrum under consideration is to be assessed.		**25**
• More efficient use of existing spectrum holdings:		
i) the deployment of more spectrally-efficient wireless technologies and the migration of customers to these technologies;		**25**
ii) increased reuse of available radio frequencies enabled both by cell site splitting (considering Open RAN, which helps to reduce cost) and LTE-A support for enhanced small cell and Wi-Fi integration; and,		**25**
iii) tighter packing of offered data into available transmission capacity, etc.		**25**
• the deployment of more stations / Network upgrade - hardware upgrade to network.		**25**
Note that if the Applicant considers some other factor, which is deemed acceptable by the SMA, that factor may replace any of the abovementioned. *(Where an alternative is not considered, 0 point is awarded and the SMA may conduct its own consideration and if found to be feasible, the SMA may make an unfavorable recommendation to the Minister/Ministry with responsibility for Telecommunication.)* **Overall, for this criterion – Efficient use of the spectrum - the Applicant may attain a maximum of 300 points based on the different factors. Therefore, if actual score is 250 the calculation shall be as follows:** **Score = (actual score/maximum score possible) times weighting** **(250/300) * 30** **= 25**		

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Evaluation Criteria	Weighting	Score
Competitive Analysis	**30**	
- **Contestability**		**15**

Contestability Index: Points are awarded based on the change in this index (Δ) as a result of the requested assignment as follows:

Post Assignment Share	
$s_0 \geq \max\{s_1, s_2, \dots, s_n\}$	6
$min\{s_1, s_2, \dots, s_n\} \leq s_0 < \max\{s_1, s_2, \dots, s_n\}$	3
$s_0 < \min\{s_1, s_2, \dots, s_n\}$	0

Rapid Entry potential

Entry Potential	
Telecom licence granted	9
Licence requested but decision pending	5
No requests for licence/Licence denied	0

- **Competitiveness**

Points awarded based on the change in the Index as well as the post-assignment competition Index (PACI) as follows:

		Post Assignment Competitive Index		
		$Index < 0.750$	$0.750 \leq Index \leq 0.850$	$0.850 < Index \leq 1.000$
Change (Δ)	$\Delta < 0.010$	10	10	10
	$0.010 \leq \Delta < 0.020$	3	8	10
	$0.020 \leq \Delta < 0.030$	2	7	10
	$0.030 \leq \Delta < 0.040$	1	6	10
	$0.040 \leq \Delta < 0.050$	0	5	10
	$0.050 \leq \Delta < 0.060$	0	4	10
	$\sum_{i=0}^{n}$	0	3	10

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Evaluation Criteria	Weighting	Score
Consumer Behaviour This category is based the number of mobile numbers ported during the most recent six month period as a share of the number of subscriptions. If the share exceeds 10% If this share is between 5% and 10%, If this share is less than 5%, A total of all sub-category scores under the competitive analysis will be the final score.		**5** **3** **0**
Public Interest - **Expansion of coverage in unserved and or underserved areas as listed in Appendix 1** I. 95% or more population coverage of the entire area proposed in application, at a minimum download data rate of five (5) Mbps under peak traffic conditions. II. 75% up to 94% population coverage of the entire area proposed in application, at a minimum download data rate of five (5) Mbps under peak traffic conditions. III. 60% up to 74% population coverage of the entire area proposed in application, at a minimum download data rate of five (5) Mbps under peak traffic conditions. IV. Below 60% population coverage. - **Improved coverage quality** i. Minimum download rate of 12 Mbps at peak traffic ii. Minimum download rate of 8 Mbps at peak traffic iii. Under 8 Mbps at peak traffic **Score = (actual scores/maximum score possible) times weighting.**	**30**	**200%** **100%** 100 75 60 0 **100%** 100 80 0

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Appendix 1: List of Unserved & Underserved Communities ("Supplied List")

Name	Parish	Population
Mount James	St. Andrew	3593
St. Peter's	St. Andrew	1249
Mavis Bank	St. Andrew	5792
Irish Town	St. Andrew	2080
Content Gap	St. Andrew	1249
Bloxborough	St. Andrew	799
Cane River	St. Andrew	213
Bito	St. Andrew	375
Woodford	St. Andrew	3878
Town Head	Westmoreland	573
Bath Mountain	Westmoreland	874
Delveland	Westmoreland	2464
Strawberry	Westmoreland	1829
Mount Stewart	Westmoreland	988
Roaring River	Westmoreland	584
Paul Island	Westmoreland	770
Amity	Westmoreland	1225
Struie	Westmoreland	280
St. Leonards	Westmoreland	702
Belvedere	Westmoreland	1196
Seaford Town	Westmoreland	893
Ashton	Westmoreland	951
Beaufort	Westmoreland	113
Cairn Curran	Westmoreland	406
Dundee	Westmoreland	456
Ferris	Westmoreland	778
Enfield	Westmoreland	534
Berkshire	Westmoreland	870
Leamington	Westmoreland	381
Cave	Westmoreland	716
Kentucky	Westmoreland	522
Mearnsville	Westmoreland	1347
Content	Westmoreland	1256
New Works	Westmoreland	1198
Beeston Spring	Westmoreland	1173
Bog	Westmoreland	647
Morgans Forest	Clarendon	1617
Colonels Ridge	Clarendon	1168
Pennants	Clarendon	1825
Cumberland	Clarendon	2555
Thompson Town	Clarendon	5863
Beckford Kraal	Clarendon	3354

Name	Parish	Population
Part of Banana Ground	Clarendon	574
Rock River	Clarendon	4049
Part of Banana Ground	Clarendon	574
Turners	Clarendon	1919
Moores	Clarendon	1047
Richmond Park	Clarendon	1571
Sedge Pond	Clarendon	656
Race Course	Clarendon	4055
Banks	Clarendon	1541
Longwood	Clarendon	1089
Alley	Clarendon	1050
Rocky Point	Clarendon	5148
Portland Cottage	Clarendon	2665
Richmond Park	Clarendon	1571
Dawkins	Clarendon	785
Mount Airy	Clarendon	405
Haddington	Hanover	2096
Cascade	Hanover	1207
Askenish	Hanover	1830
Chambers Pen	Hanover	806
Pondside	Hanover	445
Dias	Hanover	2260
Copse	Hanover	733
Maryland	Hanover	783
Pell River	Hanover	254
Cash Hill	Hanover	713
Kendal	Hanover	1489
Good Intent	Manchester	2217
Hibernia	Manchester	1555
Harry Watch	Manchester	1555
Bethany	Manchester	1013
Evergreen	Manchester	529
Mile Gully	Manchester	2412
Litchfield	Manchester	1205
Maidstone	Manchester	1667
Part of Banana Ground	Manchester	502
Mike Town	Manchester	2908
Ellen Street	Manchester	653
Lancaster	Manchester	1492
Plowden	Manchester	2401

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Name	Parish	Population
Marlie Hill	Manchester	1761
Black Hill	Portland	1919
Balcarres	Portland	819
Tranquility	Portland	623
Fairfield	Manchester	477
Fruitfulvale	Portland	2366
Bangor Ridge	Portland	1359
Durham	Portland	573
Fellowship	Portland	1891
Spring Hill	Portland	1216
Windsor Forest	Portland	3079
Windsor	Portland	1924
Moore Town	Portland	1317
Comfort Castle	Portland	2259
Manchioneal	Portland	2168
Skibo	Portland	1073
Swift River	Portland	1440
Claverty Cottage	Portland	388
Beecher Town	St. Ann	906
York Castle	St. Ann	622
Inverness	St. Ann	1424
Discovery Bay	St. Ann	6708
Chester	St. Ann	528
Mount Zion	St. Ann	1727
Gibraltar	St. Ann	2265
Epworth	St. Ann	898
Lime Tree Gardens	St. Ann	1270
St. D'Acre	St. Ann	3069
Alva	St. Ann	2165
Madras	St. Ann	1488
Watt Town	St. Ann	1649
Alderton	St. Ann	742
Blackstonedge	St. Ann	3187
Calderwood	St. Ann	4587
River Head	St. Ann	970
Aboukir	St. Ann	1610
Bensonton	St. Ann	2655
Macknie	St. Ann	3501
Pear Tree Grove	St. Catherine	879
Redwood	St. Catherine	3606
Troja	St. Catherine	1750
Riversdale	St. Catherine	4475
Lluidas Vale	St. Catherine	5689
Harewood	St. Catherine	1900
Point Hill	St. Catherine	5807

Name	Parish	Population
Ginger Ridge	St. Catherine	1856
Browns Hall	St. Catherine	6241
Watermount	St. Catherine	1655
Bellas Gate	St. Catherine	658
Barton	St. Catherine	2676
Elderslie	St. Elizabeth	1620
Quick Step	St. Elizabeth	294
Merrywood	St. Elizabeth	134
Mulgrave	St. Elizabeth	547
Thornton	St. Elizabeth	4035
Ginger Hill	St. Elizabeth	2610
Retirement	St. Elizabeth	479
Pisgah	St. Elizabeth	2093
Springfield	St. Elizabeth	1086
Brighton	St. Elizabeth	2294
Carisbrook	St. Elizabeth	1475
Middle Quarters	St. Elizabeth	2965
Newton	St. Elizabeth	725
Burnt Savannah	St. Elizabeth	3243
Fullerswood	St. Elizabeth	1470
Myersville	St. Elizabeth	21
Pondside	St. Elizabeth	506
Barbary Hall	St. Elizabeth	866
Watchwell	St. Elizabeth	2184
Red Bank	St. Elizabeth	1541
Newell	St. Elizabeth	814
Treasure Beach	St. Elizabeth	3435
Aberdeen	St. Elizabeth	988
Orange	St. James	2774
Friendship	St. James	465
Unity Hall	St. James	1102
Tower Hill/Moy Hall	St. James	1584
Summer Hill	St. James	1315
Flagstaff	St. James	1071
Mount Horeb	St. James	1717
Maroon Town	St. James	479
Seven Rivers	St. James	1895
Vaughnsfield	St. James	1216
Cambridge	St. James	4595
Flamstead	St. James	1510
Catadupa	St. James	2493
Mocho	St. James	547
Garlands	St. James	534
Retrieve	St. James	515
Niagara	St. James	710
Stonehenge	St. James	1457

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Name	Parish	Population
Arcadia	St. James	370
Maldon	St. James	1626
Mason Hall	St. Mary	866
Mango Valley	St. Mary	762
Bonnygate	St. Mary	2632
Lucky Hill	St. Mary	1210
Woodpark	St. Mary	1857
Guys Hill	St. Mary	884
Epsom	St. Mary	962
Annotto Bay	St. Mary	5669
Woodside	St. Mary	960
Broadgate	St. Mary	1210
Flint River	St. Mary	1010
Enfield	St. Mary	2665
Baxter Mountain	St. Mary	466
Friendship Gap	St. Mary	328
Brainerd	St. Mary	1570
Hagley Gap	St. Thomas	1666
Cedar Valley	St. Thomas	522
Johnson Mountain	St. Thomas	349

Name	Parish	Population
Rowlandsfield	St. Thomas	911
Mount Lebanus	St. Thomas	1430
Ramble	St. Thomas	781
Jones Pen	St. Thomas	1649
Spring Bank	St. Thomas	307
Wheelerfield	St. Thomas	974
Sunning Hill	St. Thomas	539
Llandewey	St. Thomas	513
Font Hill	St. Thomas	954
Pamphret	St. Thomas	526
Rio Bueno	Trelawny	1600
Samuels Prospect	Trelawny	901
Brampton	Trelawny	411
Stewart Town	Trelawny	993
Alps	Trelawny	478
Ulster Spring	Trelawny	1803
Wilson's Run	Trelawny	859
Joe Hut	Trelawny	532

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Appendix 2

Worked Example

Consider a 700 MHz LTE network in which a 10 MHz carrier is implemented across 2400 cells. The average traffic volume carried by the 700 MHz carrier is estimated to be 420.8 Terabyte/week. What is the spectrum efficiency in bps/Hz/Cell?

LTE Carriers (MHz)	Carrier Bandwidth (MHz)	# of cells implemented	Traffic Volume (TB/Week)	Spectral Efficiency (bps/Hz/cell)
700	10	2400	420.8	?

Solution:

Assumptions:

- *800 Base Stations*
- *The total number of cells = 800 * 3 = 2400, assuming three cells/base station*
- *Frequency reuse of 1*
- *Total traffic volume per week = 420.8 Terabyte/week over the 700 MHz carrier.*

The first step is to determine the traffic volume in bps.

To do this, we need to convert the traffic volume from Terabytes per week (TB/wk.) to Terabit per week (Tbit/wk.) using equation 1 below

$$Terabits/week = Terabytes/week * 8$$ ……equation 1

Tbit/wk. = TB/wk. * 8

Therefore,

$$Traffic\ Volume\ (Terabits/week) = 420.8 * 8 = 3366.4\ Terabits/week$$

We then need to convert Terabits/week to Terabits/day

$$Terabits/day = Terabits/week/7$$ …… equation 2

Therefore,

$$Traffic\ Volume\ (terabits/day) = 3366.4/7 = 480.9\ terabits/day$$

Now, based on measurements of typical network accepted by the industry, the peak traffic volume in any day is 1/3 the total traffic.

Then,

Traffic volume (terabits/day) (peak) = 480.9/3 = 160.30 terabits/day

Next, we calculate the Traffic volume in bits/day using equation 3 below.

$$bits/day = terabits/day \ * 10\text{^}12 \ldots equation\ 3$$

Therefore,

Traffic Volume (bps/day) = 160.3 * 10^{12} = 1.6 x 10^{14} bps/day

Finally, we calculate the Traffic Volume in bps using equation 4 below:

$$Traffic\ Volume\ (bps) = \frac{traffic\ volume\ (bits/day)}{24 * 60 * 60} \ldots\ldots equation\ 4$$

That is,

Traffic volume (bps) = 1.6 x 10^{14}/86400 = 1855379189 bps

Now that we have the traffic volume in bps, we can now determine the spectral efficiency in bps/Hz/cell, using equation 5 below:

$$Spectral\ Efficiency\ (bps/Hz/cell) = \frac{traffic\ volume\ (bps)}{bandwidth\ (Hz)/No.of\ cells} \ldots\ldots equation\ 5$$

where,

- bandwidth is in Hz
- No. of 700 MHz cells implemented

Therefore,

Spectral Efficiency (bps/Hz/cell) = 1855379189/10,000,000/2400 = 0.07 bps/Hz/cell

This means the calculated Spectral Efficiency is below the desired objective of at least within 85% of 2.4 bps/Hz/cell and therefore zero would be awarded.

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Appendix 3 Illustrative Scenario

Assume that there are two incumbents in the telecoms market, Incumbent 1 and Incumbent 2. Currently, Incumbent 1 holds 24 MHz, Incumbent 2 holds 20 MHz and there is an additional 22 MHz of spectrum which is unassigned in the 700MHz band.

Incumbent 2 has requested an additional assignment of 3 MHz of spectrum in the 700 MHz frequency band.

It has also been determined that a total of 32,000 numbers were ported (14,000 from Incumbent 1 to Incumbent 2 and 18,000 from Incumbent 2 to Incumbent 1) during the last six months. At the end of the period, there were 3,000,000 telecoms subscribers.

In what follows, we describe how the competition component of the request would be evaluated by the Spectrum Management Authority.

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A. Evaluation of *Contestability* Criterion

1. The first step is to calculate the total assignable spectrum within the band requested.

Based on the above, the total assignable spectrum is $66\ MHz\ (= 22 + 24 + 20)$.

2. The next step would be to calculate the share of the unassigned spectrum as well as the share of the spectrum assigned to each Incumbent *if the amount requested was granted*.

$$s_0 = \frac{(22-3)}{66} \times 100 = 28.8\%,$$

$$s_1 = \frac{24}{66} \times 100 = 36.4\%,$$

$$s_2 = \frac{(20+3)}{66} \times 100 = 34.8\%$$

3. Based on the above, we note that the smallest share among Incumbents would be 34.8% (i.e., $\min\{s_1, s_2\} = 34.8\%$), while the largest share among Incumbents is 36.4% (i.e., $\max\{s_1, s_2\} = 36.4\%$).

4. The final step is to assign the points for *contestability* using Table 1. A total of (0/6) point is allotted for contestability since during the post assignment period, the amount of spectrum that would be available for a future entrant would be less than the amount assigned to any Incumbent, i.e., $s_0 < min\{s_1, s_2, \dots, s_n\}$. See the table below.

Post Assignment Share	Points given
$s_0 \geq max\{s_1, s_2, \dots, s_n\}$	6
$min\{s_1, s_2, \dots, s_n\} \leq s_0 < max\{s_1, s_2, \dots, s_n\}$	3
$s_0 < min\{s_1, s_2, \dots, s_n\}$	0

B. Evaluation of *Competitiveness* Criterion

1. The first step is to calculate the share of spectrum assigned to each Incumbent based on current market holdings (prior) and the market share of holdings *if the amount requested was granted* (post).

I (prior)	I (post)
$\bar{s}_1 = \frac{24}{(24+20)} \times 100 = 54.5\%,$	$\bar{s}_1 = \frac{24}{(24+20+3)} \times 100 = 51.1\%,$
$\bar{s}_2 = \frac{20}{(24+20)} \times 100 = 45.5\%$	$\bar{s}_2 = \frac{(20+3)}{(24+20+3)} \times 100 = 48.9\%$

2. The next step is to calculate the Competitiveness Index in the period prior to and post assignment- after which, we calculate the change in this Index. Based on shares calculated in step 1 above, we determined that:

$$I(prior) = \frac{10{,}000}{2(54.5^2 + 45.5^2)} = 0.9918$$

$$I(post) = \frac{10{,}000}{2(51.1^2 + 48.9^2)} = 0.9995$$

$$\Delta = 0.9918 - 0.9995 = -0.0077$$

3. The final step is to assign points for *competitiveness* using Table 3. A total of (10/10) points are allotted for the *competitiveness* criterion since the market would be highly competitive in the post assignment period (as well as fact that the change in the Index would be less than 0.010). See the table below.

		Post Assignment Competitive Index		
		$Index < 0.750$	$0.750 \leq Index \leq 0.850$	$0.850 < Index \leq 1.000$
Change (Δ)	$\Delta < 0.010$	10	10	10
	$0.010 \leq \Delta < 0.020$	3	8	10
	$0.020 \leq \Delta < 0.030$	2	7	10
	$0.030 \leq \Delta < 0.040$	1	6	10
	$0.040 \leq \Delta < 0.050$	0	5	10
	$0.050 \leq \Delta < 0.060$	0	4	10
	$\Delta \geq 0.060$	0	3	10

C. Evaluation of *Consumer Behaviour* Criterion

Share of switching = $\frac{32{,}000}{3{,}000{,}000} \times 100$=1.06%.

Therefore, a total of 0 points is assigned to this criterion.

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APPENDIX 4

EVALUATION CRITERIA	Weight	Points	Actual Score
A.) Efficient Use of the Spectrum	**40**	**300**	
- **Population Coverage and Minimum ↓Data Rate**		75	
- **Cell Spectral Efficiency (CSE)**		87.5	
- **Consideration of Alternatives**		75	
TOTAL		**237.5**	
Actual Score = (Points /Maximum Points Available) * Weighting		40* (237.5/300)	**31.6**
B.) Competitive Analysis	**30**	**30**	
- **Contestability**			
Contestability Index: Points are awarded based on the change in this index (Δ) as a result of the requested assignment as follows: **Post Assignment Share** $s_0 \geq \max\{s_1, s_2, \dots, s_n\}$ $min\{s_1, s_2, \dots, s_n\} \leq s_0 < \max\{s_1, s_2, \dots, s_n\}$ $s_0 < \min\{s_1, s_2, \dots, s_n\}$		**6** 3 0	**3**
Rapid Entry Potential **Entry Potential** Telecom licence granted License requested but decision pending No requests for license/License denied		**9** 5 0	**9**
- **Competitiveness**		**10**	

Points awarded based on post-assignment competition Index (PACI):

		Post Assignment Competitive Index		
		Index < 0.750	0.750 ≤ *Index* ≤ 0.850	0.850 < *Index* ≤ 1.000
Change (Δ)	Δ< 0.010	10	10	10
	0.010 ≤ Δ< 0.020	3	8	10
	0.020 ≤ Δ< 0.030	2	7	10
	0.030 ≤ Δ< 0.040	1	6	10
	0.040 ≤ Δ< 0.050	0	5	10
	0.050 ≤ Δ< 0.060	0	4	10
	Δ≥ 0.060	0	3	10

		6	**6**
• **Consumer Behaviour**		**5**	
Bases on the number of mobile numbers ported during the most recent 6 month period as a share of the number of subscriptions. ○ If the share exceeds 10% ○ If this share is between 5% and 10%, ○ If this share is less than 5%,		**5** **3** **0**	**3**
	30		**21**
C.) Public Interest	**30**	**200%**	
- Expansion of coverage in unserved and or underserved areas as listed in Appendix 1 - **Improved coverage quality**		75 80	
TOTAL	30	**155**	
Actual Score = (Points /Maximum Points Available) * Weighting	30	30* (155/200)	**23.25**
OVERALL SCORE ACHIEVED A+B+C (31.6+21+23.25)	**100**		**75.85**

This applicant would be recommended for the additional spectrum