



# Development of Spectrum Pricing Fee Structures

Final Report

April 30, 2020

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# Executive Summary

The Spectrum Management Authority (“SMA” or “the Client”) engaged Engine Room Limited (“the Consultant”) to develop spectrum fee structures for frequency bands as specified in the Terms of Reference. Our recommendations follow.

## Mobile Service

Band	Price per MHz per population (US\$)	Price per MHz (US\$)
700 MHz	0.024	69,600
850 MHz	0.013	38,280
900 MHz	0.012	34,800
1800 MHz	0.010	27,840
1900 MHz	0.012	34,800
AWS	0.017	48,720

## Fixed Service

Parameter	Point to Point	Point to Multipoint
Base Fee	Values per MHz are <ul style="list-style-type: none"> <li>• \$20,000 above 0 MHz</li> <li>• \$15,000 above 50 MHz</li> <li>• \$10,000 above 100 MHz</li> </ul>	\$350,000 per MHz
Bandwidth factor	Bandwidth	Bandwidth
Frequency Band factor	Values are <ul style="list-style-type: none"> <li>• 1.80 below 4.2 GHz</li> <li>• 1.60 for 5.925 – 7.125 GHz</li> <li>• 1.40 for 7.110 – 7.725 GHz</li> <li>• 1.20 for 7.725 – 8.500 GHz</li> <li>• 1.00 for 10.150 – 10.650 GHz</li> <li>• 0.80 for 10.700 – 11.700 GHz</li> <li>• 0.60 for 12.750 – 15.350 GHz</li> <li>• 0.40 for 17.700 – 23.600 GHz</li> <li>• 0.20 for above 24.250 GHz</li> </ul>	Values are <ul style="list-style-type: none"> <li>• 1.80 below 4.2 GHz</li> <li>• 1.60 for 5.925 – 7.125 GHz</li> <li>• 1.40 for 7.110 – 7.725 GHz</li> <li>• 1.20 for 7.725 – 8.500 GHz</li> <li>• 1.00 for 10.150 – 10.650 GHz</li> <li>• 0.80 for 10.700 – 11.700 GHz</li> <li>• 0.60 for 12.750 – 15.350 GHz</li> <li>• 0.40 for 17.700 – 23.600 GHz</li> <li>• 0.20 for above 24.250 GHz</li> </ul>
Zone factor	Values are <ul style="list-style-type: none"> <li>• 0.10 for Zone 1</li> <li>• 0.06 for Zone 2</li> <li>• 0.04 for Zone 3</li> </ul>	Values are <ul style="list-style-type: none"> <li>• 0.10 for urban service</li> <li>• 0.06 for island wide service</li> <li>• 0.04 for rural only service</li> </ul>
Network Type factor	Values are <ul style="list-style-type: none"> <li>• 1.00 for Commercial networks</li> <li>• 0.50 for Private networks</li> </ul>	Values are <ul style="list-style-type: none"> <li>• 1.00 for Commercial networks</li> <li>• 0.50 for Private networks</li> </ul>

Exclusivity factor	Values are <ul style="list-style-type: none"> <li>• 1.00 for Exclusive use</li> <li>• 0.50 for Shared use</li> </ul>	Values are <ul style="list-style-type: none"> <li>• 1.00 for Exclusive use</li> <li>• 0.50 for Shared use</li> </ul>
License Tenure factor	Values are <ul style="list-style-type: none"> <li>• 1.00 for 5 years</li> <li>• 1.70 for 10 years</li> <li>• 2.20 for 15 years</li> </ul>	Values are <ul style="list-style-type: none"> <li>• 1.00 for 5 years</li> <li>• 1.70 for 10 years</li> <li>• 2.20 for 15 years</li> </ul>
Efficiency factor	Values are <ul style="list-style-type: none"> <li>• 1.00 for Category 1</li> <li>• 0.75 for Category 2</li> </ul>	Values are <ul style="list-style-type: none"> <li>• 1.00 for Category 1</li> <li>• 0.75 for Category 2</li> </ul>
Inflation factor	Values are as published by the Statistical Institute of Jamaica	Values are as published by the Statistical Institute of Jamaica

**Fixed Satellite Service**

Number of VSAT terminals	Annual Spectrum Fee (J\$)
Up to 30	200,000
More than 30	6,500 per terminal

Earth Station	Annual Spectrum Fee (J\$)
Emergency	50,000
Commercial	500,000

**Regulatory Fees**

Between 2016/2017 and 2019/2020, reliance on a capital grant transfer increased from 8% to 18% of budgeted income. In 2020/2021, this is forecast to increase to 27%. Options to address the shortfall include:

Reduce budgeted expenditure	<input type="checkbox"/> This limits the SMA’s planned activities over multiple financial periods
Continue to finance using capital grant transfer	<input type="checkbox"/> This is necessarily a temporary strategy as funds are finite
Increase regulatory fees by a minimum of 40%	<input type="checkbox"/> A significant increase in fees is normally problematic, but is particularly sensitive in the period of economic uncertainty associated with global pandemic
Absorb a minimum of 15% of spectrum license fees	<input type="checkbox"/> This is a policy decision outside the scope of this project
A combination	<input type="checkbox"/> This is a policy decision outside the scope of this project

# Section 1 – Background

The Spectrum Management Authority (“SMA” or “the Client”) engaged Engine Room Limited (“the Consultant”) to develop spectrum fee structures for the following frequency bands allocated for the listed services in ITU Region 2:

- Mobile Service (MS): 700 MHz, 850 MHz, 900 MHz, 1800 MHz, 1900 MHz and 1700/2100 MHz (AWS)
  
- Fixed Service(FS):
  - A. Point to Point: 5GHz, 6 GHz, 7 GHz, 8 GHz, 11 GHz, 13 GHz, 15 GHz, 18 GHz and 23 GHz B.
  - Point to Multipoint: 5 GHz, 2.5/2.6 GHz and 3.5 GHz<sup>1</sup>
  
- Fixed Satellite Service (FSS):
  - A. C-Band: 3.625-4.2 GHz (space to earth), 5.850-6.425 GHz (earth to space)
  - B. Ku-Band:12-18 GHz
  - C. Ka-Band: 18-30 GHz (earth to space), 26-40 GHz (space to earth)

This project builds on technical assistance received from the International Telecommunication Union Regional Office to assist in the re-development of the National Spectrum Licence Fees Framework. We consider recent and likely future technology and market changes that may affect demand for spectrum in bands used by fixed links.

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<sup>1</sup> In subsequent discussions with the client, we have mutually agreed to include 2.3GHz and 10GHz.

## Section 2 – Mobile Service

### General Literature Review

During the data collection stage of our project, we reviewed multiple benchmarking reports with emphasis on exercises conducted in the United Kingdom and The Bahamas. We incorporated the UK analysis because of our intention to base our pricing model on international best practice, in line with the project’s Terms of References. We incorporated the Bahamian analysis due to its exceptional applicability as an example of a pricing exercise within the region with objectives loosely in line with those of our current project.

### Case Study: The Bahamas

The Utilities Regulation and Competition Authority (“URCA”) commissioned a benchmarking report, with the main objective of developing a fee schedule that promotes optimal spectrum use. The study’s starting point was to benchmark values using auction prices from neighbouring Caribbean countries. However, due to limited Caribbean auction data, URCA expanded its sample beyond the region. Ultimately, URCA benchmarked spectrum values in The Bahamas against countries in the Caribbean, Central America and Europe, while controlling for differences in population, exchange rate and time.

*Table 2.1: Characteristics of benchmark countries – Caribbean countries*

Country	GDP per capita, PPP (Current US\$)	Population Density (People per sq. km)	Mobile Penetration (%)
The Bahamas	32,217	39	99
Antigua & Barbuda	20,656	219	N/a
Barbados	16,607	667	123
Jamaica	8,307	271	101
Puerto Rico	36,208	360	110
Trinidad & Tobago	32,831	271	140
Turks & Caicos	19,542	40	N/a
U.S. Virgin Islands	-	306	N/a

Source: World Bank Development Indicators

Where necessary, the analysis included European spectrum bands considered as comparable in value to the ones under analysis in The Bahamas. We summarize the Bahamian bands and the corresponding bands in Europe below.

*Table 2.2: Harmonized Frequency Bands for Mobile Services in Europe and the Americas*

Europe		Bahamas	
Band Identifier	Frequencies	Band Identifier	Frequencies
450 MHz	450-457/460-467 MHz		

800 MHz	791-821/832-862 MHz	700 MHz	698-716/728-746 MHz 746-757/776-787 MHz 716-728 MHz
900 MHz	880-915/925-960 MHz	850 MHz	824-849/869-894 MHz
1800 MHz	1710-1785/1805-1880 MHz	1900 MHz	1850-1910/1930-1990 MHz
2100 MHz	1920-1980/2110-2170 MHz 1900-1920 MHz 2010-2025 MHz	AWS	1710-1755/2110-2155 MHz 2000-2020/2180-2200 MHz
2.3 GHz	2300-2400 MHz	2.3 GHz	2305-2314/2350-2360 MHz
2.6 GHz	2.50-2.69 GHz	2.5 GHz	2496-2690 MHz

Source: URCA

URCA's findings included the average value and range for each band as follows:

*Table 2.3: Annual Fee Benchmarks by Frequency Band (US\$/MHz/Pop)*

Frequency Band	Low	High	Average
700	0.0369	0.1173	0.0684
800	0.0428	0.0428	0.0428
850	0.0316	0.0925	0.0625
900	0.0065	0.1401	0.0543
1800	0.0026	0.1401	0.0580
1900	0.0311	0.1831	0.0775
2100	0.0065	0.0637	0.0378
AWS	0.0107	0.0144	0.0120

Source: URCA

From these findings, URCA's recommended prices were:

*Table 2.4: Recommended Annual Fees*

Band Grouping	Overall Average (US\$/MHz/Pop)	Recommended (US\$/MHz/Pop)	Recommended (US\$/MHz)
Sub 1GHz	0.0570	0.04	14,900
1 – 2.1GHz	0.0463	0.02	7,400
Above 2.1 GHz	0.0059	0.002	700

Source: URCA

#### Case Study: United Kingdom

Ofcom undertook a revision of annual licence fees for the 900MHz and 1800 MHz bands in order to reflect their full market values, as directed by the UK government. To guide this revision, Ofcom commissioned an examination of the market value of spectrum in other jurisdictions.

Due to the limited number of competitive auctions for 900MHz and 1800Mz in the UK, the study included price information from jurisdictions in Europe and North America.

*Table 2.5 Characteristics of benchmark countries*

Country	GDP per capita (Current US\$)	Population Density (People per sq. km)	Mobile Penetration (%)
UK	37,161	259	130
Italy	33,005	207	158
Germany	39,284	235	140
France	35,677	119	104
Spain	33,275	93	125
USA	49,295	34	103

Source: World Bank Development Indicators

Where necessary, the analysis accounted for differences in frequency allocation by ITU zone by including other spectrum bands that may be of comparable value. The specified bands and the comparable bands in Europe and the USA are:

*Table 2.6: Comparable Frequency Bands for Mobile Services in Europe and the USA*

UK	Europe	USA
900 MHz	800 MHz	700 MHz
1800 MHz	2.1 GHz 2.6 GHz	2.1 GHz 2.6 GHz

Source: Ofcom

Ofcom's findings included the range for each band in GBP as follows:

*Table 2.7: Benchmark fees*

Frequency Band	Spectrum Award benchmarks	Renewal fee benchmarks	Spectrum Trade benchmarks
800 MHz	0.42 – 0.74	0.23 – 0.63	1.10 – 3.55
900 MHz	0.35 – 0.46		
1800 MHz	0.21 – 0.42	0.12 – 0.25	0.21 – 0.53
2.GHz	0.27 – 0.54	0.19	

Source: Ofcom



## Analysis

To establish the market value of Jamaican spectrum in the listed bands, we make use of a wide range of evidence from other jurisdictions, with particular emphasis on:

- Prices paid in spectrum auctions; and
- Studies on spectrum value by consultants, regulators, academics, etc.

We primarily base our findings on our analysis of data from auctions of radio spectrum in the listed bands and in comparable frequency bands, then cross-check our findings with results from similar studies conducted in other jurisdictions.

It is widely established that spectrum prices set through an effective and competitive auction process should provide the clearest indication of market value. For that reason, we rely on auction outcomes to guide our pricing exercise. We use spectrum awards data from the Policy Tracker (PT) database, which includes information from 62 countries worldwide. We also use country-specific economic and demographic data from the World Bank's World Development Indicators (WDI) database and from the Economist Intelligence Unit (EIU) database.

- We account for differences in license duration by converting all prices into the equivalent value for a 15-year licence tenure.
- We account for currency differences and for inflation by using prices expressed in United States dollars in 2019 terms from the PT database.
- We account for levels of affluence by using Gross Domestic Product (at Purchasing Power Parity) per capita from the WDI database.
- We account for the changing market circumstances by excluding auction prices that are more than 10 years old.
- We analyse all prices on a "per MHz per capita" and on a "per MHz per unit of GDP per capita, PPP" basis for comparison across jurisdictions.

We look at available spectrum award data across a number of mobile frequency bands, with a preference for benchmarking against countries with similar characteristics to Jamaica e.g. population density, GDP per capita and mobile penetration. We assign the greatest significance to spectrum prices in neighbouring Caribbean countries. However, as there is limited Caribbean auction data, we expand our analysis to include comparable non-Caribbean countries within the ITU Region 2. Even with this expansion, auction data remains limited. Therefore, we also consider spectrum prices in a wider sample of countries within the Americas.

*Table 2.8: Economic and Demographic Factors of Benchmarking Countries in the Americas*

Country	GDP p. capita, PPP US\$ (2019)	Population (Million)	Population density (People per km <sup>2</sup> )	Mobile Penetration (%)
Argentina				
Brazil	8,921	209.5	25	99
Chile	15,923	18.7	25	134
Colombia	6,668	49.6	45	130
Honduras	2,500	9.6	86	79
Jamaica	5,354	2.9	271	101
Mexico	9,673	126.2	65	93
Peru	6,941	32.0	25	124
Uruguay	17,278	3.4	20	150

Source: World Bank Development Indicators

We also look at auction values recorded in jurisdictions outside the Americas. When contemplating countries outside of ITU Zone 2, we consider the frequency bands used within the zone that are comparable to Zone 2 frequency bands.

We observe the following average price for each frequency band by region.

*Table 2.9: Price per MHz per Population by Region (US\$/MHz/Population)*

	Americas	Africa, Middle East	Asia, Asia Pacific	Europe
700 MHz	0.03	-	0.10	0.05 – 0.06
850 MHz	-	-	0.10	-
900 MHz	-	-	0.11	0.05-0.06
1800 MHz	-	0.04	0.07	0.02
1900 MHz	0.007	0.003	0.04	0.02
AWS	0.03	-	-	-

To start the Jamaican pricing table, we:

- Select the average spectrum price from the Americas as a base; and
- Apply a factor to adjust for the average wealth differential between Jamaica and the countries included in the regional sample.

*Table 2.10: Estimated Jamaican Price per MHz per Population (US\$/MHz/Population)*

Band	Price per MHz per population - Americas (US\$)	Proposed Price per MHz per population - Jamaica (US\$)
700 MHz	0.03	0.024
850 MHz		
900 MHz		
1800 MHz		
1900 MHz	0.007	0.006
AWS		

To complete the Jamaican pricing table, we rely on the price relativities observed from the auction data overall and observed from publicly available auction statistics provided by the Organization for Economic and Cooperative Development.

*Table 2.11: Relative Prices by Band*

Band	Relative Price
700 MHz – 900 MHz	100%
1800 MHz – 1900 MHz	45%
AWS	100%
Above 2.1 GHz	15%

We confirm that these price relativities are largely compatible with those from the Bahamian and UK studies.

*Table 2.12: Reconciliation of Relative Prices by Band*

Band	Results of Jamaica Study	Results of Bahamian Study	Results of UK Study <sup>2</sup>
700 MHz – 900 MHz	100%	100%	100%
1 – 2.1 GHz <sup>3</sup>	45%	40%	Auction: 55%-100%
AWS	100%		Renewal: 43%
Above 2.1 GHz	15%	10%	

Source: URCA

<sup>2</sup> Midpoint of range

<sup>3</sup> For The Bahamas, this band includes AWS frequencies. For Jamaica, this band does not include AWS frequencies; these are reported in the line below.

As a final step, we smooth our results. Based on these findings, our recommendations are as summarized below.

*Table 2.13: Recommendations*

Band	Price per MHz per population (US\$)	Price per MHz (US\$)
700 MHz	0.024	69,600
850 MHz	0.013	38,280
900 MHz	0.012	34,800
1800 MHz	0.010	27,840
1900 MHz	0.012	34,800
AWS	0.017	48,720

### Concluding Remarks

We provide preliminary remarks on the following bands allocated for 5G in Region 2:

- 24.25 – 27.5 GHz
- 37 – 43.5 GHz
- 47.2 – 48.2 GHz; and □ 66 – 71 GHz.

This project will conclude before 5G auctions anticipated in India and Brazil this year. These auctions will potentially yield pricing data that is applicable to a developing economy such as Jamaica. The full impact of the global pandemic on the timing, operation and results of these (and indeed, other) 5G auctions is still unclear. We note that at the time of writing, at least one other jurisdiction<sup>4</sup> has officially postponed its 5G spectrum auction.

As a starting point, we present the United States’ most recent 5G auction results.

*Table 2.14: 5G Auction Results (United States of America)*

Band	Price per MHz per Population
24 GHz	0.009112
28 GHz	0.0113
MN blocks: 37.6 – 38.6 GHz and 38.6 – 40 GHz	0.009613
P blocks: 47 GHz	0.001099

Source: Federal Communications Commission

<sup>4</sup> <https://www.reuters.com/article/us-health-france-5g/frances-telecom-regulator-postpones-5g-auction-due-to-coronavirus-idUSKBN21K2M0>

Applying a GDP per capita relativity factor as a rough proxy for wealth differential between Jamaica and the US yields a price estimate of US\$0.001 per MHz per population. However, these results are only approximate and will certainly be obsolete by the conclusion of the Brazilian 5G auction.

Table 2.15 shows the prices paid for C-Band spectrum in 5G-relevant auctions in the past 5 years. The average C-band price is \$0.12 per MHz per population.

*Table 2.15: 5G Auction Results (International)*

Prices paid for C-Band Spectrum, \$/MHz/Pop	Countries		
Less than \$0.05	Czech Rep.	Hungary	Romania
	Finland	Latvia	Slovakia
	Ireland	Norway	Spain
\$0.05 - \$0.10	Austria Hong Kong (10/2019) Latvia (09/2019)		
\$0.10 - \$0.20	Germany Hong Kong (11/2019) Rep. of Korea United Kingdom		
\$0.20 - \$0.30	Australia		
Greater than \$0.30	Italy Taiwan		

## Section 3 – Fixed Service: Point to Point

### General Literature Review

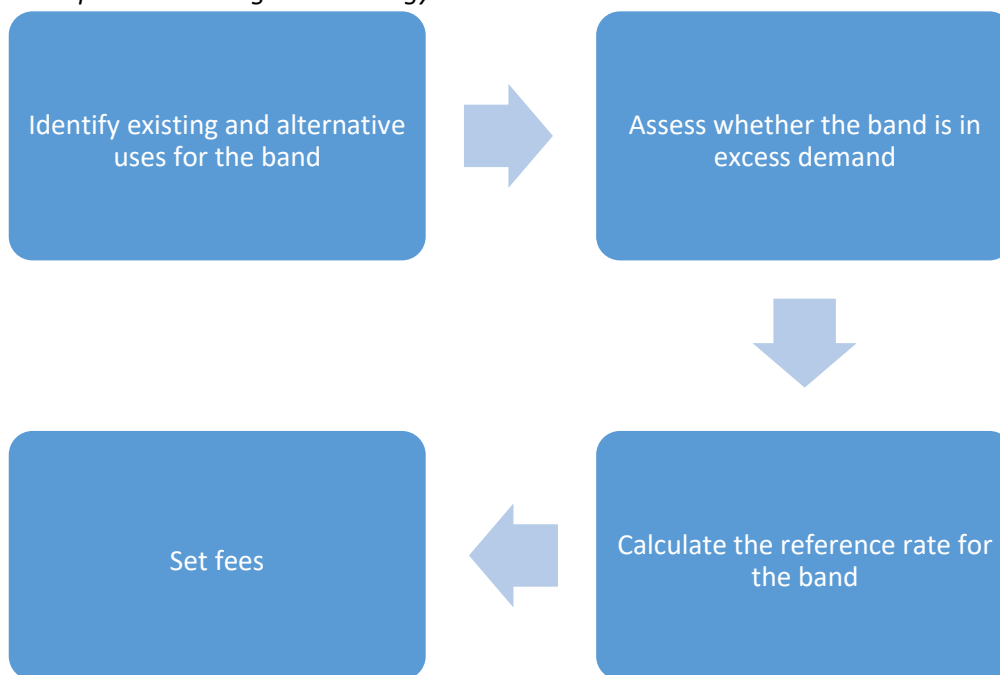
During the data collection stage of our project, we reviewed analyses related to repricing efforts for fixed service. Again, we used elements of analysis conducted in the UK because of our intention to base our pricing model on international best practice, in line with the project's Terms of References.

### Case Study: United Kingdom

We rely on published documentation including Ofcom's 2005 and 2015 review of fees for fixed links and permanent earth stations.

In the following figure, we summarize Ofcom's methodology:

*Figure 3.1: Spectrum Pricing Methodology*



Ofcom's analysis is summarized below.

*Table 3.1: Estimated values per link per 2x1 MHz and current fees*

Band	Implied Cost (GBP)	Current Fee (GBP)
1.4 GHz	124	88
3.6-3.8 GHz	1095	88
3.8-4.2 GHz	124	88
6 & 7.5 GHz	124	65
10 GHz	42	38
13 & 15 GHz	42	38
18 GHz	29	26
23, 25 & 28 GHz	~3	23-26
32 GHz	~3	23
38 GHz	~3	23
40 GHz & above	~3	15

Source: Ofcom

#### Analysis

The subject of this portion of the study is a range of bands between 2.3 GHz and 23 GHz that can be used by fixed point-to-point links. The following table lists the bands under consideration and indicates which of them are shared with other applications.

*Table 3.2: Fixed Service Bands*

Band	Current Use	Potential Alternative Use
2.5/2.6 GHz	Fixed: PtMP	Fixed-Satellite, Mobile, Broadcasting-Satellite
3.5 GHz	Fixed: PtMP	Mobile except Aeronautical Mobile, Fixed Satellite
5 GHz 5.150 – 5.350 GHz 5.470 – 5.725 GHz 5.725 – 5.850 GHz	Fixed: PtP and PtMP PtP and PtMP PtP and PtMP	Mobile, Radiolocation Mobile, Radiolocation Radiolocation
6 GHz	Fixed: PtP	Fixed-Satellite, Mobile
7 GHz	Fixed: PtP	Mobile, Space Research
8 GHz	Fixed: PtP	Mobile, Meteorological-Satellite, Fixed-Satellite, Earth Exploration-Satellite
11 GHz	Fixed: PtP and PtMP	Mobile except Aeronautical Mobile, Fixed Satellite
13 GHz	Fixed: PtP	Mobile, Fixed-Satellite, Space Research
15 GHz	Fixed: PtP	Fixed-Satellite, Mobile except Aeronautical Mobile, Mobile-Satellite, Space Research
18 GHz	Fixed: PtP	Fixed-Satellite, Mobile, Broadcasting-Satellite, Space Research, Earth Exploration-Satellite

23 GHz	Fixed: PtP	Standard frequency and time signal-satellite, MobileSatellite, Fixed-Satellite, Mobile, Radio Astronomy, Inter-Satellite
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Source: Spectrum Management Authority

To assess whether there is likely to be excess demand in the bands, we explore alternative uses that are deployable in the next 5-7 years. In the Jamaican context, we note the following:

- 5G is at an early stage of development and its impact is still uncertain.
- Our discussions with the Client indicate there are no items in their organizational strategic plan that are expected to impact excess demand within these bands.
- Our discussions with the Client indicate that there are no expected changes related to any international harmonization of these bands for use as mobile broadband in the next 5 years.

We found no published Jamaican data measuring excess demand by frequency band. However, we refer to international mobile network trends which suggest that excess demand is likely for lower frequency bands, but is less likely in bands above 20GHz.

We observe that there are certain fixed service bands that have the potential for use as mobile service. There is auction data that could be used to give an indication of the value of the band for mobile use. We present in the following table their estimated value according to auction results from the PT database, along with spectrum values derived from similar exercises conducted in other jurisdictions.

*Table 3.3: Price per MHz per Population by Region (US\$/MHz/Population)*

	Americas	Canada	USA	Africa, Middle East	Asia, Asia Pacific	Europe
4.9 GHz	-	-	-	-	0.0063	-
24 GHz	-	-	0.0010	-	-	-
26 GHz	-	-	-	-	-	0.0003

The auction data for these bands suggests that the opportunity cost of spectrum in the 23 GHz band is approximately J\$30,000 – J\$60,000.

We also consider the base fees (rounded to the nearest US\$100) for a sample of international jurisdictions.

Country	Base Fee (Equivalent US\$)
Pakistan	US\$100
South Africa	US\$100
United Kingdom	US\$100 – US\$500



We recommend that the Client consider:

- Setting the base fee at a level compatible with the estimated value for alternative use (as summarized in Table 3.3) and estimates provided by regulators in other jurisdictions (as summarized in Table 3.4); and
- Transitioning to a base fee per MHz that is more consistent for small and large users. (Currently, the base fee is \$100,000 per MHz for a 1MHz band, but is less than \$20,000 per MHz for bandwidths greater than 100MHz.)

*Table 3.5: Estimated value per MHz<sup>5</sup>*

Base Fee	<input type="checkbox"/> \$20,000 above 0 MHz <input type="checkbox"/> \$15,000 above 50 MHz <input type="checkbox"/> \$10,000 above 100 MHz
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We review the following algorithm used to calculate fixed wireless fees:

Annual Spectrum Licence Fee = Base Fee x Bandwidth factor (BW) x Frequency Band factor (BD) x Zone factor (Z) x Network Type factor (P) x Exclusivity factor (E) x License Tenure factor (T)

*Table 3.6: Current Formula*

Parameter	Value/Range
Base Fee	Varies between J\$100,000 and J\$2,000,000
Bandwidth factor	Bandwidth/3.5, rounded up

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<sup>5</sup> This base fee includes an adjustment by a factor of 2/3.5 to account for revisions to the bandwidth factor and network type factor.

Frequency Band factor	<p>Values are</p> <ul style="list-style-type: none"> <li>• 1.80 below 4.2 GHz</li> <li>• 1.60 for 5.925 – 7.125 GHz</li> <li>• 1.40 for 7.110 – 7.725 GHz</li> <li>• 1.20 for 7.725 – 8.500 GHz</li> <li>• 1.00 for 10.150 – 10.650 GHz</li> <li>• 0.80 for 10.700 – 11.700 GHz</li> <li>• 0.60 for 12.750 – 15.350 GHz</li> <li>• 0.40 for 17.700 – 23.600 GHz</li> <li>• 0.20 for above 24.250 GHz</li> </ul>
Zone factor	<p>Values are</p> <ul style="list-style-type: none"> <li>□ 0.10 for Zone 1</li> </ul>
	<ul style="list-style-type: none"> <li>• 0.06 for Zone 2</li> <li>• 0.04 for Zone 3</li> </ul>
Network Type factor	<p>Values are</p> <ul style="list-style-type: none"> <li>• 1.00 for Private networks</li> <li>• 2.00 for Commercial networks</li> </ul>
Exclusivity factor	<p>Values are</p> <ul style="list-style-type: none"> <li>• 1.00 for Exclusive use</li> <li>• 0.50 for Shared use</li> </ul>
License Tenure factor	<p>Values are</p> <ul style="list-style-type: none"> <li>• 1.00 for 5 years</li> <li>• 1.80 for 10 years</li> <li>• 2.60 for 15 years</li> </ul>

Throughout, we refer to guidance from Ofcom which states: “The algorithm is not (and cannot be) based on a precise set of engineering and/or economic relationships but rather is intended to provide appropriate incentives for efficient spectrum use.”

*Base Fee*

We recommend the following base fee per MHz:

- \$20,000 above 0 MHz
- \$15,000 above 50 MHz
- \$10,000 above 100 MHz

*Bandwidth Factor*

We recommend setting the bandwidth factor equal to the bandwidth amount.

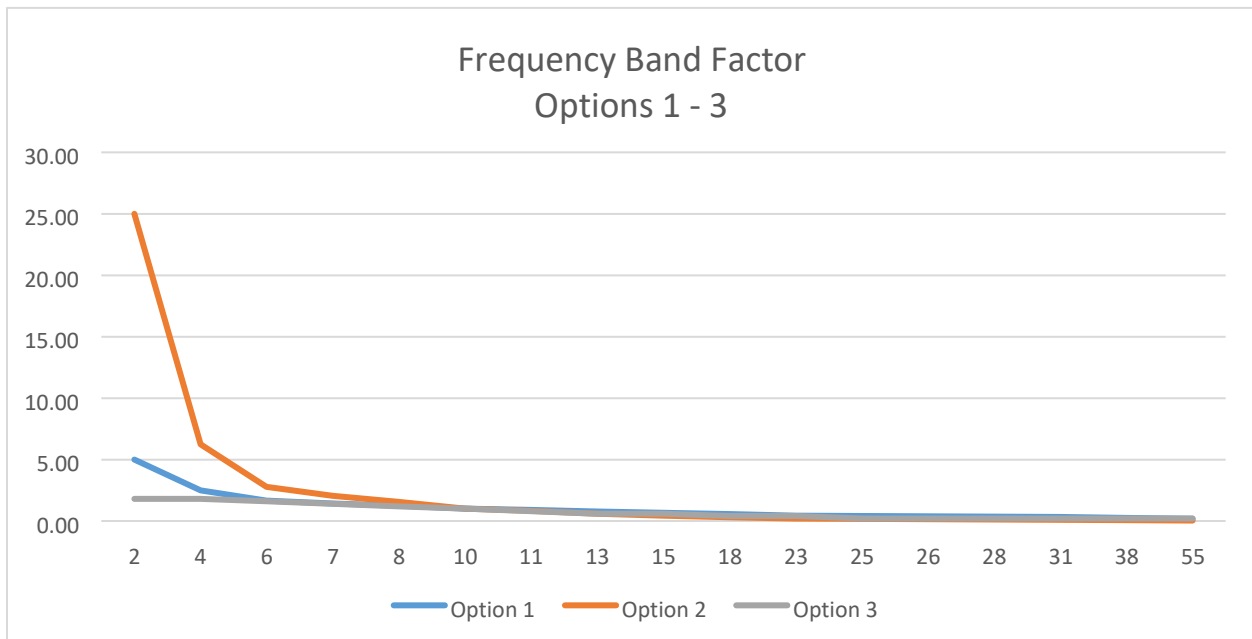
### Frequency Band Factor

We investigate three options:

- Option 1: Set the frequency band factor based on the reciprocal function to reflect the longer transmission range of lower frequency bands;
- Option 2: Set the frequency band factor based on the reciprocal of squared frequency to reflect the relationship between the capture of signal by a receiver and frequency; and
- Option 3: Keep the current frequency band factor.

The current factor lies between Options 1 and 2 for higher bands, but is significantly below both options for bands below 4 GHz. After discussions with the SMA about the appropriateness of this cap for frequencies below 4GHz, we recommend making no change to the associated factors.

Chart 3.1: Frequency Band Factor



### Zone Factor

Ofcom's pricing algorithm would assign a higher pricing factor if a link started or ended in a congested zone (defined based on the number of links in a grid square). These congested zones were mostly urban locations. However, in Ofcom's latest pricing algorithm documentation, this factor was removed.

As there is still significant interest in promoting infrastructure development outside the urban centres in Kingston, St. Andrew, St. Catherine and St. James, we do not recommend the elimination of this factor from the Jamaican pricing algorithm. However, we recommend that the Client consider a simplification to two zones – urban and non-urban. Further, we recommend that the Client consider applying the higher pricing factor if the link either starts or ends in Zone 1. In this case, the lower factor would apply

only if the link both starts and ends in Zone 2. However, we raise no objection to maintaining the current factors as long as the calculation is administratively simple to apply.

*Table 3.7: Zone Factors*

Zone	Current Factor	Recommended Factor
Zone 1	0.10	0.10
Zone 2	0.06	0.06
Zone 3	0.04	0.04

#### *Network Type Factor*

We recommend recalibrating this factor to clarify that a 50% discount has been applied to Private networks. The base fee was adjusted so that the recommended change, after accounting for the change in base fee, is zero.

*Table 3.8: Network Type Factors*

Network Type	Current Factor	Recommended Factor
Commercial	2.00	1.00
Private	1.00	0.50

#### *Exclusivity Factor*

This factor remains in line with the 50% discount applied by Ofcom to an additional link operating cochannel and cross-polar over the same path as an existing assigned link. *Table 3.9: Exclusivity Factors*

Exclusivity	Current Factor	Recommended Factor
Private	1.00	1.00
Shared	0.50	0.50

#### *License Tenure Factor*

*Table 3.10: Tenure Factors*

Tenure	Current Factor	Recommended Factor
5 years	1.00	1.00
10 years	1.80	1.70
15 years	2.60	2.20

#### *Additional Factors*

Before including additional factors, it is necessary to check that the factors can be captured in the assignment and licensing process.

### *Modulation Factor*

We concur with Ofcom’s approach, which is: “Users are already encouraged to use the minimum amount of bandwidth through the existing bandwidth factor in the fees formula e.g. this incentive will ensure that higher more spectrally efficient modulation states will be used where possible. We therefore do not propose to modify the algorithm to include a modulation factor.”

### *Link length Factor*

We concur with Ofcom’s approach, which is: “We consider that this factor is not required as the frequency band factor in the fee algorithm already provides an incentive for operators to select higher bands for shorter links.”

### *Efficiency Factor*

We recommend the addition of a factor that provides an incentive for the use of more efficient point to point technologies. The definition of the criteria that a licensee must meet to apply for the Category 2 is subject to the SMA. We opine that the introduction of this factor promotes responsiveness of the pricing methodology to technological developments within the industry. *Table 3.11: Efficiency Factor*

Efficiency	Current Factor	Recommended Factor
Category 1	Not applicable	1.00
Category 2	Not applicable	0.75

### *Inflation Factor*

We recommend that the fee is updated each year by the Consumer Price Index.

Table 3.12: Recommendations

Parameter	Current Value/Range	Proposed Value/Range
Base Fee	Varies between \$100,000 and \$2,000,000	Values per MHz are <ul style="list-style-type: none"> <li>• \$20,000 above 0 MHz</li> <li>• \$15,000 above 50 MHz</li> <li>• \$10,000 above 100 MHz</li> </ul>
Bandwidth factor	Bandwidth/3.5, rounded up	Bandwidth
Frequency Band factor	Values are <ul style="list-style-type: none"> <li>• 1.80 below 4.2 GHz</li> <li>• 1.60 for 5.925 – 7.125 GHz</li> <li>• 1.40 for 7.110 – 7.725 GHz</li> <li>• 1.20 for 7.725 – 8.500 GHz</li> <li>• 1.00 for 10.150 – 10.650 GHz</li> <li>• 0.80 for 10.700 – 11.700 GHz</li> <li>• 0.60 for 12.750 – 15.350 GHz</li> <li>• 0.40 for 17.700 – 23.600 GHz</li> <li>• 0.20 for above 24.250 GHz</li> </ul>	Values are <ul style="list-style-type: none"> <li>• 1.80 below 4.2 GHz</li> <li>• 1.60 for 5.925 – 7.125 GHz</li> <li>• 1.40 for 7.110 – 7.725 GHz</li> <li>• 1.20 for 7.725 – 8.500 GHz</li> <li>• 1.00 for 10.150 – 10.650 GHz</li> <li>• 0.80 for 10.700 – 11.700 GHz</li> <li>• 0.60 for 12.750 – 15.350 GHz</li> <li>• 0.40 for 17.700 – 23.600 GHz</li> <li>• 0.20 for above 24.250 GHz</li> </ul>
Zone factor	Values are <ul style="list-style-type: none"> <li>• 0.10 for Zone 1</li> <li>• 0.06 for Zone 2</li> <li>• 0.04 for Zone 3</li> </ul>	Values are <ul style="list-style-type: none"> <li>• 0.10 for Zone 1</li> <li>• 0.06 for Zone 2</li> <li>• 0.04 for Zone 3</li> </ul>
Network Type factor	Values are <ul style="list-style-type: none"> <li>• 1.00 for Private networks</li> <li>• 2.00 for Commercial networks</li> </ul>	Values are <ul style="list-style-type: none"> <li>• 0.50 for Private networks</li> <li>• 1.00 for Commercial networks</li> </ul>
Exclusivity factor	Values are <ul style="list-style-type: none"> <li>• 1.00 for Exclusive use</li> <li>• 0.50 for Shared use</li> </ul>	Values are <ul style="list-style-type: none"> <li>• 1.00 for Exclusive use</li> <li>• 0.50 for Shared use</li> </ul>
License Tenure factor	Values are <ul style="list-style-type: none"> <li>• 1.00 for 5 years</li> <li>• 1.80 for 10 years</li> <li>• 2.60 for 15 years</li> </ul>	Values are <ul style="list-style-type: none"> <li>• 1.00 for 5 years</li> <li>• 1.70 for 10 years</li> <li>• 2.20 for 15 years</li> </ul>
Efficiency factor	N/A	Values are <ul style="list-style-type: none"> <li>• 1.00 for Category 1</li> <li>• 0.75 for Category 2</li> </ul>
Inflation factor	N/A	Values are as published by the Statistical Institute of Jamaica

## Section 4 – Fixed Service: Point to Multipoint

### Analysis

The subject of this portion of the study is a range of bands between 2.3 GHz and 10 GHz that can be used by fixed point-to-multipoint links.

We observe that there are certain fixed service bands that have the potential for use as mobile service. There is auction data that could be used to give an indication of the value of the band for mobile use. We present in the following table their estimated value according to auction results from the PT database, along with spectrum values derived from similar exercises conducted in other jurisdictions.

*Table 4.1: Price per MHz per Population by Region (US\$/MHz/Population)*

	Americas	Canada	USA	Africa, Middle East	Asia, Asia Pacific	Europe
2.3 GHz	-	-	-	-	0.0063	-
2.6 GHz	0.0024	-	0.0010	-	-	-
3.5 GHz	-	-	-	-	-	0.0003

The auction data for these bands suggests that the opportunity cost of spectrum in the 2.6 GHz band is approximately J\$400,000.

We recommend a base fee of J\$350,000 per MHz.<sup>6</sup>

We review the following algorithm used to calculate fixed wireless fees:

Annual Spectrum Licence Fee = Base Fee x Bandwidth factor (BW) x Frequency Band factor (BD) x Zone factor (Z) x Network Type factor (P) x Exclusivity factor (E) x License Tenure factor (T)

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<sup>6</sup> This base fee includes an adjustment by a factor of 5/3.5 to account for revisions to the zone factor, bandwidth factor and network type factor.

Table 4.2: Current Formula

Parameter	Value/Range											
Base Fee	For bands using 5 MHz channel plans											
	<table border="1"> <thead> <tr> <th>Bandwidth</th> <th>Base Fee (J\$ million)</th> </tr> </thead> <tbody> <tr> <td>2×5</td> <td>2</td> </tr> <tr> <td>2×10</td> <td>4</td> </tr> <tr> <td>2×15</td> <td>6</td> </tr> <tr> <td>2×20</td> <td>8</td> </tr> <tr> <td>2×25</td> <td>10</td> </tr> </tbody> </table>	Bandwidth	Base Fee (J\$ million)	2×5	2	2×10	4	2×15	6	2×20	8	2×25
Bandwidth	Base Fee (J\$ million)											
2×5	2											
2×10	4											
2×15	6											
2×20	8											
2×25	10											
	channel plans											
	<p>For bands using 3.5 MHz</p> <table border="1"> <thead> <tr> <th>Bandwidth</th> <th>Base Fee (J\$ million)</th> </tr> </thead> <tbody> <tr> <td>2×3.5</td> <td>2</td> </tr> <tr> <td>2×7</td> <td>4</td> </tr> <tr> <td>2×14</td> <td>6</td> </tr> <tr> <td>2×28</td> <td>8</td> </tr> <tr> <td>2×56</td> <td>10</td> </tr> </tbody> </table>	Bandwidth	Base Fee (J\$ million)	2×3.5	2	2×7	4	2×14	6	2×28	8	2×56
Bandwidth	Base Fee (J\$ million)											
2×3.5	2											
2×7	4											
2×14	6											
2×28	8											
2×56	10											
Bandwidth factor	Bandwidth/3.5, rounded up											
Frequency Band factor	<p>Values are</p> <ul style="list-style-type: none"> <li>• 1.80 below 4.2 GHz</li> <li>• 1.60 for 5.925 – 7.125 GHz</li> <li>• 1.40 for 7.110 – 7.725 GHz</li> <li>• 1.20 for 7.725 – 8.500 GHz</li> <li>• 1.00 for 10.150 – 10.650 GHz</li> <li>• 0.80 for 10.700 – 11.700 GHz</li> <li>• 0.60 for 12.750 – 15.350 GHz</li> <li>• 0.40 for 17.700 – 23.600 GHz</li> <li>• 0.20 for above 24.250 GHz</li> </ul>											
Zone factor	<p>Values are</p> <ul style="list-style-type: none"> <li>• 0.10 for rural only services</li> <li>• 0.20 for island wide services</li> <li>• 0.25 for urban services</li> </ul>											
Network Type factor	<p>Values are</p> <ul style="list-style-type: none"> <li>• 1.00 for Private networks</li> <li>• 2.00 for Commercial networks</li> </ul>											
Exclusivity factor	<p>Values are</p> <ul style="list-style-type: none"> <li>• 1.00 for Exclusive use</li> <li>• 0.50 for Shared use</li> </ul>											
License Tenure factor	<p>Values are</p> <ul style="list-style-type: none"> <li>• 1.00 for 5 years</li> <li>• 1.80 for 10 years</li> <li>• 2.60 for 15 years</li> </ul>											



### Base Fee

We recommend a base fee of J\$350,000 per MHz.

### Bandwidth Factor

We recommend setting the bandwidth factor equal to the bandwidth amount.

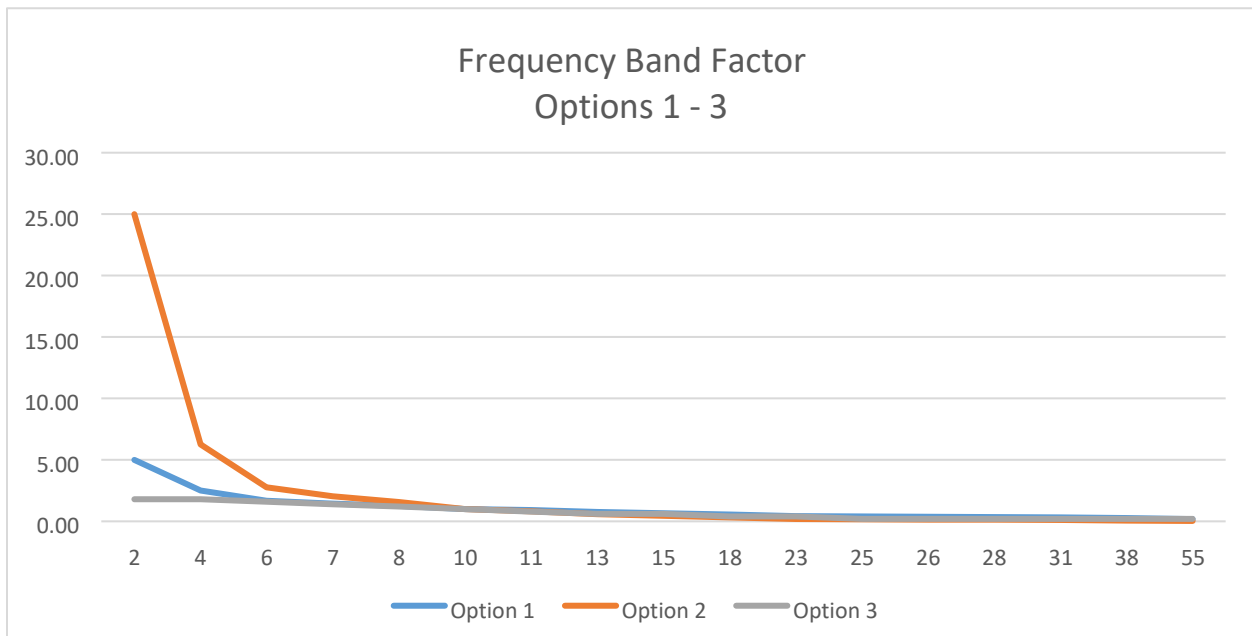
### Frequency Band Factor

We investigate three options:

- Option 1: Set the frequency band factor based on the reciprocal function to reflect the longer transmission range of lower frequency bands;
- Option 2: Set the frequency band factor based on the reciprocal of squared frequency to reflect the relationship between the capture of signal by a receiver and frequency; and
- Option 3: Keep the current frequency band factor.

The current factor lies between Options 1 and 2 for higher bands, but is significantly below both options for bands below 4 GHz. After discussions with the SMA about the appropriateness of this cap for frequencies below 4GHz, we recommend making no change to the associated factors.

Chart 4.1: Frequency Band Factor



### *Zone Factor*

The SMA has clarified that these zone factors are different from those used in the point to point pricing as, in this case, the type of service (i.e. rural, urban or island-wide) rather than the path (i.e. the location of the start and end point of each link.)

*Table 4.3: Zone Factors*

Zone	Current Factor	Recommended Factor
Zone 1	0.25	0.10
Zone 2	0.20	0.06
Zone 3	0.10	0.04

### *Network Type Factor*

The recommended change, after accounting for the change in base fee, is zero.

*Table 4.4: Network Type Factors*

Network Type	Current Factor	Recommended Factor
Commercial	2.00	1.00
Private	1.00	0.50

### *Exclusivity Factor*

*Table 4.5: Exclusivity Factors*

Exclusivity	Current Factor	Recommended Factor
Private	1.00	1.00
Shared	0.50	0.50

### *License Tenure Factor*

*Table 4.6: Tenure Factors*

Tenure	Current Factor	Recommended Factor
5 years	1.00	1.00
10 years	1.80	1.70
15 years	2.60	2.20

Before including additional factors, it is necessary to check that the factors can be captured in the assignment and licensing process.

*Modulation Factor*

We concur with Ofcom’s approach, which is: “Users are already encouraged to use the minimum amount of bandwidth through the existing bandwidth factor in the fees formula e.g. this incentive will ensure that higher more spectrally efficient modulation states will be used where possible. We therefore do not propose to modify the algorithm to include a modulation factor.”

*Link length Factor*

We concur with Ofcom’s approach, which is: “We consider that this factor is not required as the frequency band factor in the fee algorithm already provides an incentive for operators to select higher bands for shorter links.”

*Efficiency Factor*

We recommend the addition of a factor that provides an incentive for the use of more efficient point to point technologies. The definition of the criteria that a licensee must meet to apply for the Category 2 is subject to the SMA. We opine that the introduction of this factor promotes responsiveness of the pricing methodology to technological developments within the industry. *Table 4.7: Efficiency Factor*

Efficiency	Current Factor	Recommended Factor
Category 1	Not applicable	1.00
Category 2	Not applicable	0.75

*Inflation Factor*

We recommend that the fee is updated each year by the Consumer Price Index.

*Table 4.8: Recommendations*

Parameter	Current Value/Range	Proposed Value/Range
Base Fee	For bands using 5 MHz channel plans	
	Bandwidth	Base Fee (J\$ million)
	2×5	2
	2×10	4
	2×15	6
	2×20	8
	2×25	10
	For bands using 3.5 MHz channel plans	
	Bandwidth	Base Fee (J\$ million)
	2×3.5	2
		\$350,000 per MHz

	<table border="1"> <tbody> <tr> <td>2x7</td> <td>4</td> </tr> <tr> <td>2x14</td> <td>6</td> </tr> <tr> <td>2x28</td> <td>8</td> </tr> <tr> <td>2x56</td> <td>10</td> </tr> </tbody> </table>	2x7	4	2x14	6	2x28	8	2x56	10	
2x7	4									
2x14	6									
2x28	8									
2x56	10									
Bandwidth factor	Bandwidth/3.5, rounded up	Bandwidth								
Frequency Band factor	<p>Values are</p> <ul style="list-style-type: none"> <li>• 1.80 below 4.2 GHz</li> <li>• 1.60 for 5.925 – 7.125 GHz</li> <li>• 1.40 for 7.110 – 7.725 GHz</li> <li>• 1.20 for 7.725 – 8.500 GHz</li> <li>• 1.00 for 10.150 – 10.650 GHz</li> <li>• 0.80 for 10.700 – 11.700 GHz</li> <li>• 0.60 for 12.750 – 15.350 GHz</li> <li>• 0.40 for 17.700 – 23.600 GHz</li> <li>• 0.20 for above 24.250 GHz</li> </ul>	<p>Values are</p> <ul style="list-style-type: none"> <li>• 1.80 below 4.2 GHz</li> <li>• 1.60 for 5.925 – 7.125 GHz</li> <li>• 1.40 for 7.110 – 7.725 GHz</li> <li>• 1.20 for 7.725 – 8.500 GHz</li> <li>• 1.00 for 10.150 – 10.650 GHz</li> <li>• 0.80 for 10.700 – 11.700 GHz</li> <li>• 0.60 for 12.750 – 15.350 GHz</li> <li>• 0.40 for 17.700 – 23.600 GHz</li> <li>• 0.20 for above 24.250 GHz</li> </ul>								
Zone factor	<p>Values are</p> <ul style="list-style-type: none"> <li>• 0.25 for urban services</li> <li>• 0.20 for island wide services</li> <li>• 0.10 for rural only services</li> </ul>	<p>Values are</p> <ul style="list-style-type: none"> <li>• 0.10 for urban services</li> <li>• 0.06 for island wide services</li> <li>• 0.04 for rural only services</li> </ul>								
Network Type factor	<p>Values are</p> <ul style="list-style-type: none"> <li>• 1.00 for Private networks</li> <li>• 2.00 for Commercial networks</li> </ul>	<p>Values are</p> <ul style="list-style-type: none"> <li>• 0.50 for Private networks</li> <li>• 1.00 for Commercial networks</li> </ul>								
Exclusivity factor	<p>Values are</p> <ul style="list-style-type: none"> <li>• 1.00 for Exclusive use</li> <li>• 0.50 for Shared use</li> </ul>	<p>Values are</p> <ul style="list-style-type: none"> <li>• 1.00 for Exclusive use</li> <li>• 0.50 for Shared use</li> </ul>								
License Tenure factor	<p>Values are</p> <ul style="list-style-type: none"> <li>• 1.00 for 5 years</li> <li>• 1.80 for 10 years</li> <li>• 2.60 for 15 years</li> </ul>	<p>Values are</p> <ul style="list-style-type: none"> <li>• 1.00 for 5 years</li> <li>• 1.70 for 10 years</li> <li>• 2.20 for 15 years</li> </ul>								
Efficiency factor	N/A	<p>Values are</p> <ul style="list-style-type: none"> <li>• 1.00 for Category 1</li> <li>• 0.75 for Category 2</li> </ul>								
Inflation factor	N/A	As published by the Statistical Institute of Jamaica								

## Section 5 – Fixed Satellite Service

### Very Small Aperture Terminals

Table 5.1 summarizes the VSAT spectrum fees charged by the largest (by population) English-speaking countries in the Caribbean region.

*Table 5.1: Caribbean VSAT Spectrum Fees*

Country	Annual VSAT Fee (Approximate US\$ Equivalent)
Jamaica	US\$3,700
Bahamas	US\$500 per system
Barbados	Private VSAT Network/Operator: \$1,500 per VSAT Commercial VSAT Network/Operator: 1% of AGTO plus \$150 per VSAT Interactive VSAT Terminal: \$1,500 per VSAT VSAT Terminal for Radio, Determination & Related Services: \$75 per VSAT VSAT (Internet Application): Greater of 1% of AGTO or \$10,000 VSAT Terminal for Space Research & Related Services: \$750 per VSAT VSAT for Amateur Satellite Services: \$75 per VSAT VSAT (Downlink for Broadcast Reception only): \$500 per VSAT
Belize	US\$25,000
Guyana	US\$1,720
Trinidad & Tobago	US\$22 per kHz

Source: Regulator websites

Table 5.2 summarizes annual spectrum fees for fixed satellite service for a sample of countries outside the Caribbean region.

*Table 5.2: International Fixed Satellite Spectrum Fees*

Country	Licence	Annual Fee (C\$ per MHz per year)
Canada	Satellite	120
UK	Satellite	\$74
US	GSO Satellite	\$121
	NGSO Satellite	\$151
Mexico	Orbital Slot	\$850
Brazil	Brazil Satellite	\$74
	Foreign Satellite	\$37

Source: Regulator websites

Based on the patterns we observe in this sample, we recommend:

- Reducing Jamaica’s spectrum fee to a level that is closer to the low/middle end of the range; □  
Expanding the fee structure to accommodate VSAT networks, in addition to single terminals; and □ Keeping the new fee structure as simple as possible.

Our proposal is a 2-tiered system as follows:

Table 5.3: VSAT Spectrum Fees

Number of terminals	Annual Spectrum Fee (J\$)
Up to 30	\$200,000
More than 30	\$6,500 per terminal

We caution that the introduction of a two-tiered system may cause additional administrative cost (e.g. associated with compliance monitoring and enforcement).

#### Earth Stations

In the previous sections of this report, we adopted elements of best practice from comparable pricing studies. As we did for the mobile and fixed service categories, we reviewed the pricing methodology used in the UK. In particular, we considered applying an adapted version of the pricing algorithm that applies to Permanent Earth Stations in the UK because of:

- The parallels between SMA’s and Ofcom’s pricing algorithms for other frequency bands;
- Our intention to base our pricing model on international best practice, in line with the project’s Terms of References; and
- The general usefulness and applicability of Ofcom’s research to other portions of this project.

Ofcom’s pricing algorithm is:

Annual Spectrum Licence Fee =

$$\sum_{bands} [\beta \times BF_{band} \times \sqrt{\sum_{paths\ band} (P_{path} \times BW_{path})}]$$

Where:

$\beta$  = reference fee

$P_{path}$  = peak power delivered into the antenna for each transmission path

$BW_{path}$  = transmit authorised bandwidth for each transmission path

$BF_{band}$  = band factor that changes inversely with band from 0.60 to 2.33 as summarized below

*Table 5.4: Band Factors*

Band	Band Factor
< 5 GHz	2.33
5 – 10 GHz	1.72
10 – 16 GHz	1.00
16 – 24 GHz	0.70
> 24 GHz	0.60

Source: Ofcom

In spite of the arguments above supporting increased alignment between pricing policies in Jamaica and the United Kingdom, we do not recommend its adoption at this time. We believe that moving to this algorithm from the current flat fee structure would increase administrative cost, reduce transparency and increase complexity, with limited added benefit.

Table 5.5 summarizes the earth station spectrum fees charged by the largest (by population) English speaking countries in the Caribbean region.

*Table 5.5: Caribbean Earth Station Spectrum Fees*

Country	Annual Earth Station Fee (Approximate US\$ Equivalent)
Jamaica	US\$7,400
Bahamas	US\$4,500
Barbados	-
Belize	US\$50,000
Guyana	US\$1,720
Trinidad & Tobago	US\$220 per kHz

Source: Regulator websites

Based on the patterns we observe in this sample, we recommend:

- Reducing Jamaica’s spectrum fee to a level that is closer to the low/middle end of the range; and
- Keeping the fee structure as simple as possible.

We recommend that the Client continue to apply a flat fee structure as follows:

*Table 5.6: Earth Station Spectrum Fees*

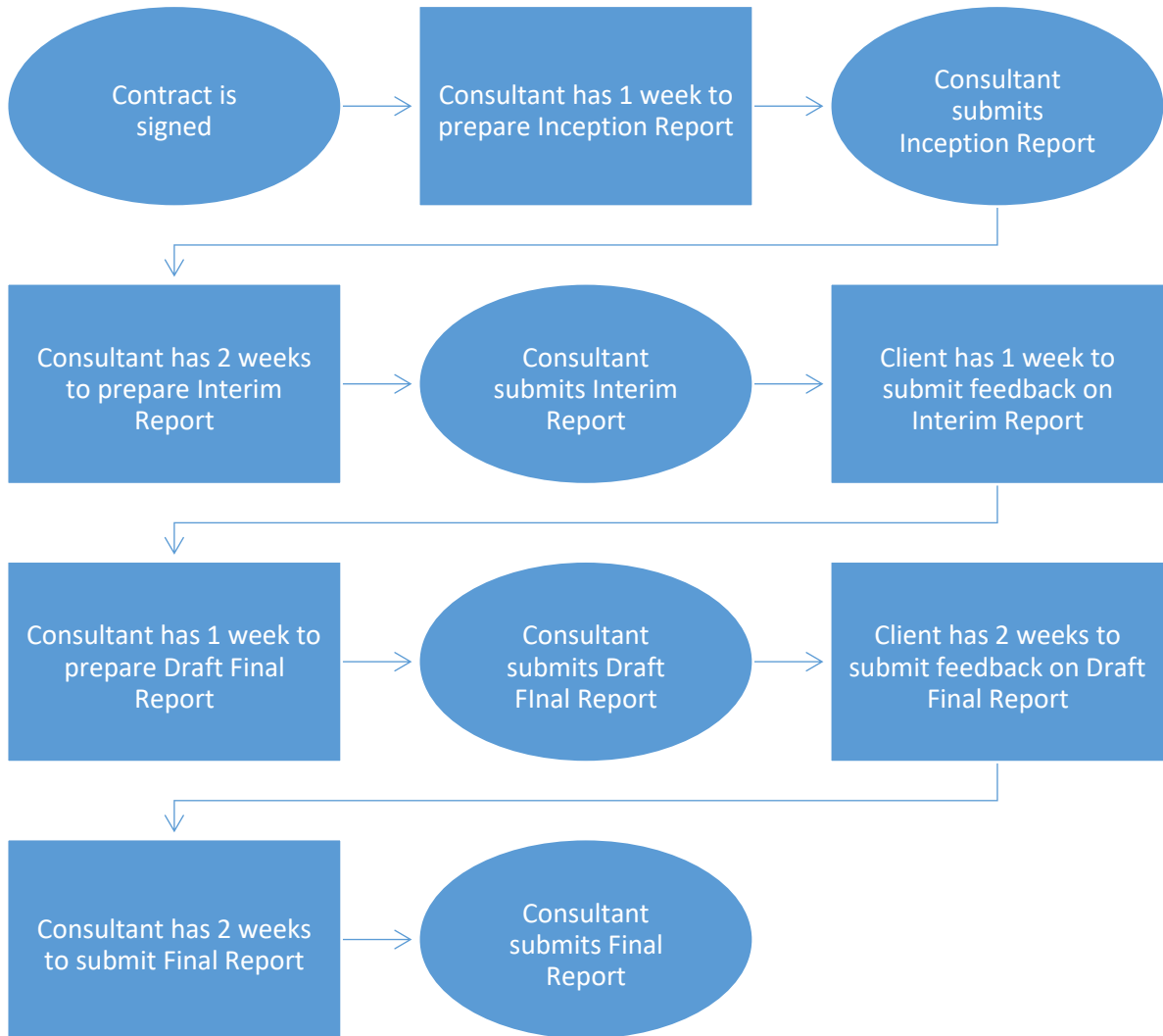
Earth Station	Annual Spectrum Fee (J\$)
Emergency	50,000
Commercial	500,000

# Appendix A: Detailed Methodology

Detailed Methodology	
Stage 1 – Defining scope	<ul style="list-style-type: none"> <li>▪ Initialize scope in accordance with the Terms of Reference</li> <li>▪ Refine scoping through consultations with the Client.</li> <li>▪ Formulate and communicate a project plan.</li> <li>▪ Collect information about the goals and objectives of key stakeholders</li> </ul>
Stage 2 – Collecting data	<ul style="list-style-type: none"> <li>▪ Gather background information through research including a technical review of applicable legislation, national development strategies, programmes and policies.</li> <li>▪ Where available, gather existing data from the client, key stakeholders and public sources.</li> <li>▪ Redefine scope, if needed.</li> </ul>
Stage 3 – Building fee structure	<ul style="list-style-type: none"> <li>▪ Based on outcome of literature review, spectrum demand/scarcity, data availability and other factors, select appropriate spectrum pricing methodology for each frequency band.</li> <li>▪ Apply pricing methodology, with underpinning mathematical and economic theory, to model spectrum values based on pricing parameter inputs.</li> <li>▪ Collaborate with and incorporate feedback from the client.</li> </ul>
Stage 4 – Reporting results	<ul style="list-style-type: none"> <li>▪ Prepare reports in accordance with the TOR and any mutually agreed, subsequent amendments.</li> </ul> <p><u>Interim Report</u> This report will give an overview of the information obtained to date. The literature review shall be finalised. The main gaps on available information shall be presented along with proposals how the study will create information to fill these gaps.</p> <p><u>Draft Final Report</u> This report will give the results of the project as proposed by the Consultant.</p> <p><u>Final Report</u> This report will incorporate the Client’s comments on the Draft Final Report.</p>



# Appendix B: Work Plan



# Appendix C: Point to Point Comparison Table

Site Identifier	Band	Bandwidth	Zone	Network	Exclusive	Current	Proposed	Difference
Site 1	13	7	2	Commercial	Shared	7,200.00	3,528.00	-51%
Site 2	13	7	2	Commercial	Shared	7,200.00	3,528.00	-51%
Site 3	6	30	3	Private	Shared	69,120.00	57,600.00	-17%
Site 4	6	30	3	Private	Shared	69,120.00	57,600.00	-17%
Site 5	6	30	2	Private	Shared	103,680.00	86,400.00	-17%
Site 6	6	30	3	Private	Shared	69,120.00	57,600.00	-17%
Site 7	6	30	3	Private	Shared	69,120.00	57,600.00	-17%
Site 8	6	30	2	Private	Shared	103,680.00	86,400.00	-17%
Site 9	11	30	3	Private	Shared	34,560.00	28,800.00	-17%
Site 10	11	30	3	Private	Shared	34,560.00	28,800.00	-17%
Site 11	6	120	1	Commercial	Shared	2,240,000.00	2,304,000.00	3%
Site 12	6	120	2	Commercial	Shared	1,344,000.00	1,382,400.00	3%
Site 13	6	60	3	Commercial	Shared	460,800.00	345,600.00	-25%
Site 14	6	120	3	Commercial	Shared	896,000.00	921,600.00	3%
Site 15	6	60	3	Commercial	Shared	460,800.00	345,600.00	-25%
Site 16	6	60	1	Commercial	Shared	1,152,000.00	864,000.00	-25%
Site 17	6	30	3	Commercial	Shared	138,240.00	115,200.00	-17%
Site 18	6	60	2	Commercial	Shared	691,200.00	518,400.00	-25%
Site 19	6	60	2	Commercial	Shared	691,200.00	518,400.00	-25%
Site 20	6	60	2	Commercial	Shared	691,200.00	518,400.00	-25%
Site 21	6	60	1	Commercial	Shared	1,152,000.00	864,000.00	-25%
Site 22	6	120	3	Commercial	Shared	896,000.00	921,600.00	3%
Site 23	6	60	1	Commercial	Shared	1,152,000.00	864,000.00	-25%
Site 24	6	120	1	Commercial	Shared	2,240,000.00	2,304,000.00	3%
Site 25	6	60	2	Commercial	Shared	691,200.00	518,400.00	-25%
Site 26	6	60	1	Commercial	Shared	1,152,000.00	864,000.00	-25%
Site 27	6	60	1	Commercial	Shared	1,152,000.00	864,000.00	-25%
Site 28	6	120	2	Commercial	Shared	1,344,000.00	1,382,400.00	3%
Site 29	6	120	1	Commercial	Shared	2,240,000.00	2,304,000.00	3%
Site 30	6	120	2	Commercial	Shared	1,344,000.00	1,382,400.00	3%
Site 31	6	60	3	Commercial	Shared	460,800.00	345,600.00	-25%
Site 32	6	120	3	Commercial	Shared	896,000.00	921,600.00	3%
Site 33	6	60	3	Commercial	Shared	460,800.00	345,600.00	-25%
Site 34	6	60	1	Commercial	Shared	1,152,000.00	864,000.00	-25%
Site 35	6	60	2	Commercial	Shared	691,200.00	518,400.00	-25%
Site 36	6	60	1	Commercial	Shared	1,152,000.00	864,000.00	-25%

Site 37	6	60	1	Commercial	Shared	1,152,000.00	864,000.00	-25%
Site 38	6	120	3	Commercial	Shared	896,000.00	921,600.00	3%
Site 39	6	60	1	Commercial	Shared	1,152,000.00	864,000.00	-25%
Site 40	6	120	1	Commercial	Shared	2,240,000.00	2,304,000.00	3%
Site 41	6	60	2	Commercial	Shared	691,200.00	518,400.00	-25%
Site 42	6	60	2	Commercial	Shared	691,200.00	518,400.00	-25%
Site 43	6	60	1	Commercial	Shared	1,152,000.00	864,000.00	-25%
Site 44	6	120	2	Commercial	Shared	1,344,000.00	1,382,400.00	3%
Site 45	8	30	1	Commercial	Shared	259,200.00	216,000.00	-17%
Site 46	8	119	2	Commercial	Shared	979,200.00	1,019,592.00	4%
Site 47	8	119	2	Commercial	Shared	979,200.00	1,019,592.00	4%
Site 48	8	30	3	Commercial	Shared	103,680.00	86,400.00	-17%
Site 49	8	30	3	Commercial	Shared	103,680.00	86,400.00	-17%
Site 50	8	30	2	Commercial	Shared	155,520.00	129,600.00	-17%
Site 51	8	30	1	Commercial	Shared	259,200.00	216,000.00	-17%
Site 52	8	59	1	Commercial	Shared	816,000.00	626,580.00	-23%
Site 53	8	30	3	Commercial	Shared	103,680.00	86,400.00	-17%
Site 54	8	119	2	Commercial	Shared	979,200.00	1,019,592.00	4%
Site 55	8	30	2	Commercial	Shared	155,520.00	129,600.00	-17%
Site 56	8	30	2	Commercial	Shared	155,520.00	129,600.00	-17%
Site 57	8	30	2	Commercial	Shared	155,520.00	129,600.00	-17%
Site 58	8	30	2	Commercial	Shared	155,520.00	129,600.00	-17%
Site 59	8	30	1	Commercial	Shared	259,200.00	216,000.00	-17%
Site 60	8	148	2	Commercial	Shared	1,238,400.00	1,577,088.00	27%
Site 61	8	59	1	Commercial	Shared	816,000.00	626,580.00	-23%
Site 62	8	59	3	Commercial	Shared	326,400.00	250,632.00	-23%
Site 63	8	30	3	Commercial	Shared	103,680.00	86,400.00	-17%
Site 64	8	59	3	Commercial	Shared	326,400.00	250,632.00	-23%
Site 65	8	119	3	Commercial	Shared	652,800.00	679,728.00	4%
Site 66	8	59	1	Commercial	Shared	816,000.00	626,580.00	-23%
Site 67	8	59	3	Commercial	Shared	326,400.00	250,632.00	-23%
Site 68	8	30	2	Commercial	Shared	155,520.00	129,600.00	-17%
Site 69	8	59	2	Commercial	Shared	489,600.00	375,948.00	-23%
Site 70	8	59	1	Commercial	Shared	816,000.00	626,580.00	-23%
Site 71	8	59	3	Commercial	Shared	326,400.00	250,632.00	-23%
Site 72	8	59	3	Commercial	Shared	326,400.00	250,632.00	-23%
Site 73	8	119	1	Commercial	Shared	1,632,000.00	1,699,320.00	4%
Site 74	8	119	2	Commercial	Shared	979,200.00	1,019,592.00	4%
Site 75	8	59	3	Commercial	Shared	326,400.00	250,632.00	-23%
Site 76	8	59	3	Commercial	Shared	326,400.00	250,632.00	-23%
Site 77	8	30	2	Commercial	Shared	155,520.00	129,600.00	-17%

Site 78	8	30	2	Commercial	Shared	155,520.00	129,600.00	-17%
Site 79	8	148	1	Commercial	Shared	2,064,000.00	2,628,480.00	27%
Site 80	8	119	2	Commercial	Shared	979,200.00	1,019,592.00	4%
Site 81	8	30	1	Commercial	Shared	259,200.00	216,000.00	-17%
Site 82	8	119	2	Commercial	Shared	979,200.00	1,019,592.00	4%
Site 83	8	30	2	Commercial	Shared	155,520.00	129,600.00	-17%
Site 84	8	30	1	Commercial	Shared	259,200.00	216,000.00	-17%
Site 85	8	30	3	Commercial	Shared	103,680.00	86,400.00	-17%
Site 86	8	30	2	Commercial	Shared	155,520.00	129,600.00	-17%
Site 87	8	30	3	Commercial	Shared	103,680.00	86,400.00	-17%
Site 88	8	59	2	Commercial	Shared	489,600.00	375,948.00	-23%
Site 89	8	30	1	Commercial	Shared	259,200.00	216,000.00	-17%
Site 90	8	30	1	Commercial	Shared	259,200.00	216,000.00	-17%
Site 91	8	30	2	Commercial	Shared	155,520.00	129,600.00	-17%
Site 92	8	30	2	Commercial	Shared	155,520.00	129,600.00	-17%
Site 93	8	30	2	Commercial	Shared	155,520.00	129,600.00	-17%
Site 94	8	30	2	Commercial	Shared	155,520.00	129,600.00	-17%
Site 95	8	59	1	Commercial	Shared	816,000.00	626,580.00	-23%
Site 96	8	59	1	Commercial	Shared	816,000.00	626,580.00	-23%
Site 97	8	30	3	Commercial	Shared	103,680.00	86,400.00	-17%
Site 98	8	59	3	Commercial	Shared	326,400.00	250,632.00	-23%
Site 99	8	119	3	Commercial	Shared	652,800.00	679,728.00	4%
Site 100	8	59	2	Commercial	Shared	489,600.00	375,948.00	-23%
Site 101	8	59	3	Commercial	Shared	326,400.00	250,632.00	-23%
Site 102	8	30	2	Commercial	Shared	155,520.00	129,600.00	-17%
Site 103	8	59	2	Commercial	Shared	489,600.00	375,948.00	-23%
Site 104	8	59	1	Commercial	Shared	816,000.00	626,580.00	-23%
Site 105	8	59	3	Commercial	Shared	326,400.00	250,632.00	-23%
Site 106	8	59	3	Commercial	Shared	326,400.00	250,632.00	-23%
Site 107	8	119	2	Commercial	Shared	979,200.00	1,019,592.00	4%
Site 108	8	119	2	Commercial	Shared	979,200.00	1,019,592.00	4%
Site 109	10	28	1	Commercial	Shared	192,000.00	156,800.00	-18%
Site 110	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 111	10	56	1	Commercial	Shared	640,000.00	470,400.00	-27%
Site 112	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 113	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 114	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 115	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 116	10	56	1	Commercial	Shared	640,000.00	470,400.00	-27%
Site 117	10	56	2	Commercial	Shared	384,000.00	282,240.00	-27%
Site 118	10	112	2	Commercial	Shared	768,000.00	752,640.00	-2%

Site 119	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 120	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 121	10	56	1	Commercial	Shared	640,000.00	470,400.00	-27%
Site 122	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 123	10	56	2	Commercial	Shared	384,000.00	282,240.00	-27%
Site 124	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 125	10	56	2	Commercial	Shared	384,000.00	282,240.00	-27%
Site 126	10	56	2	Commercial	Shared	384,000.00	282,240.00	-27%
Site 127	10	112	1	Commercial	Shared	1,280,000.00	1,254,400.00	-2%
Site 128	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 129	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 130	10	56	2	Commercial	Shared	384,000.00	282,240.00	-27%
Site 131	10	56	2	Commercial	Shared	384,000.00	282,240.00	-27%
Site 132	10	28	1	Commercial	Shared	192,000.00	156,800.00	-18%
Site 133	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 134	10	56	1	Commercial	Shared	640,000.00	470,400.00	-27%
Site 135	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 136	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 137	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 138	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 139	10	56	1	Commercial	Shared	640,000.00	470,400.00	-27%
Site 140	10	56	2	Commercial	Shared	384,000.00	282,240.00	-27%
Site 141	10	112	2	Commercial	Shared	768,000.00	752,640.00	-2%
Site 142	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 143	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 144	10	56	1	Commercial	Shared	640,000.00	470,400.00	-27%
Site 145	10	56	2	Commercial	Shared	384,000.00	282,240.00	-27%
Site 146	10	56	2	Commercial	Shared	384,000.00	282,240.00	-27%
Site 147	10	56	2	Commercial	Shared	384,000.00	282,240.00	-27%
Site 148	10	112	1	Commercial	Shared	1,280,000.00	1,254,400.00	-2%
Site 149	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 150	10	56	3	Commercial	Shared	256,000.00	188,160.00	-27%
Site 151	10	56	2	Commercial	Shared	384,000.00	282,240.00	-27%
Site 152	11	60	2	Commercial	Shared	345,600.00	259,200.00	-25%
Site 153	11	60	3	Commercial	Shared	230,400.00	172,800.00	-25%
Site 154	11	120	3	Commercial	Shared	448,000.00	460,800.00	3%
Site 155	11	120	3	Commercial	Shared	448,000.00	460,800.00	3%
Site 156	11	40	1	Commercial	Shared	307,200.00	256,000.00	-17%
Site 157	11	40	2	Commercial	Shared	184,320.00	153,600.00	-17%
Site 158	11	60	2	Commercial	Shared	345,600.00	259,200.00	-25%
Site 159	11	40	3	Commercial	Shared	122,880.00	102,400.00	-17%

Site 160	11	60	3	Commercial	Shared	230,400.00	172,800.00	-25%
Site 161	11	120	2	Commercial	Shared	672,000.00	691,200.00	3%
Site 162	11	120	2	Commercial	Shared	672,000.00	691,200.00	3%
Site 163	11	40	1	Commercial	Shared	307,200.00	256,000.00	-17%
Site 164	11	120	3	Commercial	Shared	448,000.00	460,800.00	3%
Site 165	11	60	3	Commercial	Shared	230,400.00	172,800.00	-25%
Site 166	11	60	3	Commercial	Shared	230,400.00	172,800.00	-25%
Site 167	11	40	1	Commercial	Shared	307,200.00	256,000.00	-17%
Site 168	11	40	3	Commercial	Shared	122,880.00	102,400.00	-17%
Site 169	11	120	3	Commercial	Shared	448,000.00	460,800.00	3%
Site 170	11	60	2	Commercial	Shared	345,600.00	259,200.00	-25%
Site 171	11	60	3	Commercial	Shared	230,400.00	172,800.00	-25%
Site 172	11	30	1	Commercial	Shared	172,800.00	144,000.00	-17%
Site 173	11	60	2	Commercial	Shared	345,600.00	259,200.00	-25%
Site 174	11	60	3	Commercial	Shared	230,400.00	172,800.00	-25%
Site 175	11	120	1	Commercial	Shared	1,120,000.00	1,152,000.00	3%
Site 176	11	40	1	Commercial	Shared	307,200.00	256,000.00	-17%
Site 177	11	40	2	Commercial	Shared	184,320.00	153,600.00	-17%
Site 178	11	60	2	Commercial	Shared	345,600.00	259,200.00	-25%
Site 179	11	60	3	Commercial	Shared	230,400.00	172,800.00	-25%
Site 180	11	120	2	Commercial	Shared	672,000.00	691,200.00	3%
Site 181	11	40	1	Commercial	Shared	307,200.00	256,000.00	-17%
Site 182	11	60	1	Commercial	Shared	576,000.00	432,000.00	-25%
Site 183	11	60	3	Commercial	Shared	230,400.00	172,800.00	-25%
Site 184	11	40	1	Commercial	Shared	307,200.00	256,000.00	-17%
Site 185	11	40	3	Commercial	Shared	122,880.00	102,400.00	-17%
Site 186	11	120	1	Commercial	Shared	1,120,000.00	1,152,000.00	3%
Site 187	11	60	2	Commercial	Shared	345,600.00	259,200.00	-25%
Site 188	11	30	1	Commercial	Shared	172,800.00	144,000.00	-17%
Site 189	13	56	1	Commercial	Shared	384,000.00	282,240.00	-27%
Site 190	13	56	2	Commercial	Shared	230,400.00	169,344.00	-27%
Site 191	8	59.5	2	Commercial	Shared	489,600.00	382,347.00	-22%
Site 192	8	59.5	2	Commercial	Shared	489,600.00	382,347.00	-22%
Site 193	8	59.5	2	Commercial	Shared	489,600.00	382,347.00	-22%
Site 194	11	80	1	Commercial	Shared	736,000.00	768,000.00	4%
Site 195	11	60	2	Commercial	Shared	345,600.00	259,200.00	-25%
Site 196	11	80	2	Commercial	Shared	441,600.00	460,800.00	4%
Site 197	11	80	1	Commercial	Shared	736,000.00	768,000.00	4%
Site 198	11	60	2	Commercial	Shared	345,600.00	259,200.00	-25%
Site 199	11	80	2	Commercial	Shared	441,600.00	460,800.00	4%
Site 200	13	56	1	Commercial	Shared	384,000.00	282,240.00	-27%

Site 201	13	56	2	Commercial	Shared	230,400.00	169,344.00	-27%
Site 202	13	56	2	Commercial	Shared	230,400.00	169,344.00	-27%
Site 203	13	56	2	Commercial	Shared	230,400.00	169,344.00	-27%
Site 204	13	56	1	Commercial	Shared	384,000.00	282,240.00	-27%
Site 205	13	56	2	Commercial	Shared	230,400.00	169,344.00	-27%
Site 206	13	56	2	Commercial	Shared	230,400.00	169,344.00	-27%
Site 207	18	27.5	1	Commercial	Shared	115,200.00	90,750.00	-21%
Site 208	18	27.5	2	Commercial	Shared	69,120.00	54,450.00	-21%
Site 209	18	27.5	2	Commercial	Shared	69,120.00	54,450.00	-21%
Site 210	18	55	2	Commercial	Shared	207,360.00	163,350.00	-21%
Site 211	18	55	1	Commercial	Shared	345,600.00	272,250.00	-21%
Site 212	18	55	1	Commercial	Shared	345,600.00	272,250.00	-21%
Site 213	18	27.5	2	Commercial	Shared	69,120.00	54,450.00	-21%
Site 214	18	27.5	2	Commercial	Shared	69,120.00	54,450.00	-21%
Site 215	18	55	2	Commercial	Shared	207,360.00	163,350.00	-21%
						106,712,640.00	94,007,235.00	-12%

# Appendix D: Point to Multipoint Comparison Table

Example	Band	Bandwidth	Zone	Network	Exclusive	Current	Proposed	Difference
Example 1	2.5	2x5	1	Commercial	Shared	540,000.00	630,000.00	17%
Example 2	2.5	2x10	1	Commercial	Shared	2,160,000.00	2,520,000.00	17%
Example 3	2.5	2x15	1	Commercial	Shared	4,860,000.00	5,670,000.00	17%
Example 4	2.5	2x20	1	Commercial	Shared	8,640,000.00	10,080,000.00	17%
Example 5	2.5	2x25	1	Commercial	Shared	13,500,000.00	15,750,000.00	17%
Example 6	2.5	2x3.5	1	Commercial	Shared	360,000.00	308,700.00	-14%
Example 7	2.5	2x7	1	Commercial	Shared	1,440,000.00	1,234,800.00	-14%
Example 8	2.5	2x14	1	Commercial	Shared	4,320,000.00	4,939,200.00	14%
Example 9	2.5	2x28	1	Commercial	Shared	11,520,000.00	19,756,800.00	72%
Example 10	2.5	2x56	1	Commercial	Shared	28,800,000.00	79,027,200.00	174%
Example 11	2.5	2x5	2	Commercial	Shared	432,000.00	378,000.00	-13%
Example 12	2.5	2x10	2	Commercial	Shared	1,728,000.00	1,512,000.00	-13%
Example 13	2.5	2x15	2	Commercial	Shared	3,888,000.00	3,402,000.00	-13%
Example 14	2.5	2x20	2	Commercial	Shared	6,912,000.00	6,048,000.00	-13%
Example 15	2.5	2x25	2	Commercial	Shared	10,800,000.00	9,450,000.00	-13%
Example 16	2.5	2x3.5	2	Commercial	Shared	288,000.00	185,220.00	-36%
Example 17	2.5	2x7	2	Commercial	Shared	1,152,000.00	740,880.00	-36%
Example 18	2.5	2x14	2	Commercial	Shared	3,456,000.00	2,963,520.00	-14%
Example 19	2.5	2x28	2	Commercial	Shared	9,216,000.00	11,854,080.00	29%
Example 20	2.5	2x56	2	Commercial	Shared	23,040,000.00	47,416,320.00	106%
Example 21	2.5	2x5	3	Commercial	Shared	216,000.00	252,000.00	17%
Example 22	2.5	2x10	3	Commercial	Shared	864,000.00	1,008,000.00	17%
Example 23	2.5	2x15	3	Commercial	Shared	1,944,000.00	2,268,000.00	17%
Example 24	2.5	2x20	3	Commercial	Shared	3,456,000.00	4,032,000.00	17%
Example 25	2.5	2x25	3	Commercial	Shared	5,400,000.00	6,300,000.00	17%
Example 26	2.5	2x3.5	3	Commercial	Shared	144,000.00	123,480.00	-14%
Example 27	2.5	2x7	3	Commercial	Shared	576,000.00	493,920.00	-14%
Example 28	2.5	2x14	3	Commercial	Shared	1,728,000.00	1,975,680.00	14%
Example 29	2.5	2x28	3	Commercial	Shared	4,608,000.00	7,902,720.00	72%
Example 30	2.5	2x56	3	Commercial	Shared	11,520,000.00	31,610,880.00	174%
Example 31	2.5	2x5	1	Private	Shared	270,000.00	315,000.00	17%
Example 32	2.5	2x10	1	Private	Shared	1,080,000.00	1,260,000.00	17%
Example 33	2.5	2x15	1	Private	Shared	2,430,000.00	2,835,000.00	17%
Example 34	2.5	2x20	1	Private	Shared	4,320,000.00	5,040,000.00	17%
Example 35	2.5	2x25	1	Private	Shared	6,750,000.00	7,875,000.00	17%



Example 36	2.5	2x3.5	1	Private	Shared	180,000.00	154,350.00	-14%
Example 37	2.5	2x7	1	Private	Shared	720,000.00	617,400.00	-14%
Example 38	2.5	2x14	1	Private	Shared	2,160,000.00	2,469,600.00	14%
Example 39	2.5	2x28	1	Private	Shared	5,760,000.00	9,878,400.00	72%
Example 40	2.5	2x56	1	Private	Shared	14,400,000.00	39,513,600.00	174%
Example 41	2.5	2x5	2	Private	Shared	216,000.00	189,000.00	-13%
Example 42	2.5	2x10	2	Private	Shared	864,000.00	756,000.00	-13%
Example 43	2.5	2x15	2	Private	Shared	1,944,000.00	1,701,000.00	-13%
Example 44	2.5	2x20	2	Private	Shared	3,456,000.00	3,024,000.00	-13%
Example 45	2.5	2x25	2	Private	Shared	5,400,000.00	4,725,000.00	-13%
Example 46	2.5	2x3.5	2	Private	Shared	144,000.00	92,610.00	-36%
Example 47	2.5	2x7	2	Private	Shared	576,000.00	370,440.00	-36%
Example 48	2.5	2x14	2	Private	Shared	1,728,000.00	1,481,760.00	-14%
Example 49	2.5	2x28	2	Private	Shared	4,608,000.00	5,927,040.00	29%
Example 50	2.5	2x56	2	Private	Shared	11,520,000.00	23,708,160.00	106%
Example 51	2.5	2x5	3	Private	Shared	108,000.00	126,000.00	17%
Example 52	2.5	2x10	3	Private	Shared	432,000.00	504,000.00	17%
Example 53	2.5	2x15	3	Private	Shared	972,000.00	1,134,000.00	17%
Example 54	2.5	2x20	3	Private	Shared	1,728,000.00	2,016,000.00	17%
Example 55	2.5	2x25	3	Private	Shared	2,700,000.00	3,150,000.00	17%
Example 56	2.5	2x3.5	3	Private	Shared	72,000.00	61,740.00	-14%
Example 57	2.5	2x7	3	Private	Shared	288,000.00	246,960.00	-14%
Example 58	2.5	2x14	3	Private	Shared	864,000.00	987,840.00	14%
Example 59	2.5	2x28	3	Private	Shared	2,304,000.00	3,951,360.00	72%
Example 60	2.5	2x56	3	Private	Shared	5,760,000.00	15,805,440.00	174%
Example 61	3.5	2x5	1	Commercial	Shared	540,000.00	630,000.00	17%
Example 62	3.5	2x10	1	Commercial	Shared	2,160,000.00	2,520,000.00	17%
Example 63	3.5	2x15	1	Commercial	Shared	4,860,000.00	5,670,000.00	17%
Example 64	3.5	2x20	1	Commercial	Shared	8,640,000.00	10,080,000.00	17%
Example 65	3.5	2x25	1	Commercial	Shared	13,500,000.00	15,750,000.00	17%
Example 66	3.5	2x3.5	1	Commercial	Shared	360,000.00	308,700.00	-14%
Example 67	3.5	2x7	1	Commercial	Shared	1,440,000.00	1,234,800.00	-14%
Example 68	3.5	2x14	1	Commercial	Shared	4,320,000.00	4,939,200.00	14%
Example 69	3.5	2x28	1	Commercial	Shared	11,520,000.00	19,756,800.00	72%
Example 70	3.5	2x56	1	Commercial	Shared	28,800,000.00	79,027,200.00	174%
Example 71	3.5	2x5	2	Commercial	Shared	432,000.00	378,000.00	-13%
Example 72	3.5	2x10	2	Commercial	Shared	1,728,000.00	1,512,000.00	-13%
Example 73	3.5	2x15	2	Commercial	Shared	3,888,000.00	3,402,000.00	-13%
Example 74	3.5	2x20	2	Commercial	Shared	6,912,000.00	6,048,000.00	-13%
Example 75	3.5	2x25	2	Commercial	Shared	10,800,000.00	9,450,000.00	-13%
Example 76	3.5	2x3.5	2	Commercial	Shared	288,000.00	185,220.00	-36%
Example 77	3.5	2x7	2	Commercial	Shared	1,152,000.00	740,880.00	-36%
Example 78	3.5	2x14	2	Commercial	Shared	3,456,000.00	2,963,520.00	-14%

Example 79	3.5	2x28	2	Commercial	Shared	9,216,000.00	11,854,080.00	29%
Example 80	3.5	2x56	2	Commercial	Shared	23,040,000.00	47,416,320.00	106%
Example 81	3.5	2x5	3	Commercial	Shared	216,000.00	252,000.00	17%
Example 82	3.5	2x10	3	Commercial	Shared	864,000.00	1,008,000.00	17%
Example 83	3.5	2x15	3	Commercial	Shared	1,944,000.00	2,268,000.00	17%
Example 84	3.5	2x20	3	Commercial	Shared	3,456,000.00	4,032,000.00	17%
Example 85	3.5	2x25	3	Commercial	Shared	5,400,000.00	6,300,000.00	17%
Example 86	3.5	2x3.5	3	Commercial	Shared	144,000.00	123,480.00	-14%
Example 87	3.5	2x7	3	Commercial	Shared	576,000.00	493,920.00	-14%
Example 88	3.5	2x14	3	Commercial	Shared	1,728,000.00	1,975,680.00	14%
Example 89	3.5	2x28	3	Commercial	Shared	4,608,000.00	7,902,720.00	72%
Example 90	3.5	2x56	3	Commercial	Shared	11,520,000.00	31,610,880.00	174%
Example 91	3.5	2x5	1	Private	Shared	270,000.00	315,000.00	17%
Example 92	3.5	2x10	1	Private	Shared	1,080,000.00	1,260,000.00	17%
Example 93	3.5	2x15	1	Private	Shared	2,430,000.00	2,835,000.00	17%
Example 94	3.5	2x20	1	Private	Shared	4,320,000.00	5,040,000.00	17%
Example 95	3.5	2x25	1	Private	Shared	6,750,000.00	7,875,000.00	17%
Example 96	3.5	2x3.5	1	Private	Shared	180,000.00	154,350.00	-14%
Example 97	3.5	2x7	1	Private	Shared	720,000.00	617,400.00	-14%
Example 98	3.5	2x14	1	Private	Shared	2,160,000.00	2,469,600.00	14%
Example 99	3.5	2x28	1	Private	Shared	5,760,000.00	9,878,400.00	72%
Example 100	3.5	2x56	1	Private	Shared	14,400,000.00	39,513,600.00	174%
Example 101	3.5	2x5	2	Private	Shared	216,000.00	189,000.00	-13%
Example 102	3.5	2x10	2	Private	Shared	864,000.00	756,000.00	-13%
Example 103	3.5	2x15	2	Private	Shared	1,944,000.00	1,701,000.00	-13%
Example 104	3.5	2x20	2	Private	Shared	3,456,000.00	3,024,000.00	-13%
Example 105	3.5	2x25	2	Private	Shared	5,400,000.00	4,725,000.00	-13%
Example 106	3.5	2x3.5	2	Private	Shared	144,000.00	92,610.00	-36%
Example 107	3.5	2x7	2	Private	Shared	576,000.00	370,440.00	-36%
Example 108	3.5	2x14	2	Private	Shared	1,728,000.00	1,481,760.00	-14%
Example 109	3.5	2x28	2	Private	Shared	4,608,000.00	5,927,040.00	29%
Example 110	3.5	2x56	2	Private	Shared	11,520,000.00	23,708,160.00	106%
Example 111	3.5	2x5	3	Private	Shared	108,000.00	126,000.00	17%
Example 112	3.5	2x10	3	Private	Shared	432,000.00	504,000.00	17%
Example 113	3.5	2x15	3	Private	Shared	972,000.00	1,134,000.00	17%
Example 114	3.5	2x20	3	Private	Shared	1,728,000.00	2,016,000.00	17%
Example 115	3.5	2x25	3	Private	Shared	2,700,000.00	3,150,000.00	17%
Example 116	3.5	2x3.5	3	Private	Shared	72,000.00	61,740.00	-14%
Example 117	3.5	2x7	3	Private	Shared	288,000.00	246,960.00	-14%
Example 118	3.5	2x14	3	Private	Shared	864,000.00	987,840.00	14%
Example 119	3.5	2x28	3	Private	Shared	2,304,000.00	3,951,360.00	72%
Example 120	3.5	2x56	3	Private	Shared	5,760,000.00	15,805,440.00	174%
Example 121	5	2x5	1	Commercial	Shared	540,000.00	630,000.00	17%

Example 122	5	2x10	1	Commercial	Shared	2,160,000.00	2,520,000.00	17%
Example 123	5	2x15	1	Commercial	Shared	4,860,000.00	5,670,000.00	17%
Example 124	5	2x20	1	Commercial	Shared	8,640,000.00	10,080,000.00	17%
Example 125	5	2x25	1	Commercial	Shared	13,500,000.00	15,750,000.00	17%
Example 126	5	2x3.5	1	Commercial	Shared	360,000.00	308,700.00	-14%
Example 127	5	2x7	1	Commercial	Shared	1,440,000.00	1,234,800.00	-14%
Example 128	5	2x14	1	Commercial	Shared	4,320,000.00	4,939,200.00	14%
Example 129	5	2x28	1	Commercial	Shared	11,520,000.00	19,756,800.00	72%
Example 130	5	2x56	1	Commercial	Shared	28,800,000.00	79,027,200.00	174%
Example 131	5	2x5	2	Commercial	Shared	432,000.00	378,000.00	-13%
Example 132	5	2x10	2	Commercial	Shared	1,728,000.00	1,512,000.00	-13%
Example 133	5	2x15	2	Commercial	Shared	3,888,000.00	3,402,000.00	-13%
Example 134	5	2x20	2	Commercial	Shared	6,912,000.00	6,048,000.00	-13%
Example 135	5	2x25	2	Commercial	Shared	10,800,000.00	9,450,000.00	-13%
Example 136	5	2x3.5	2	Commercial	Shared	288,000.00	185,220.00	-36%
Example 137	5	2x7	2	Commercial	Shared	1,152,000.00	740,880.00	-36%
Example 138	5	2x14	2	Commercial	Shared	3,456,000.00	2,963,520.00	-14%
Example 139	5	2x28	2	Commercial	Shared	9,216,000.00	11,854,080.00	29%
Example 140	5	2x56	2	Commercial	Shared	23,040,000.00	47,416,320.00	106%
Example 141	5	2x5	3	Commercial	Shared	216,000.00	252,000.00	17%
Example 142	5	2x10	3	Commercial	Shared	864,000.00	1,008,000.00	17%
Example 143	5	2x15	3	Commercial	Shared	1,944,000.00	2,268,000.00	17%
Example 144	5	2x20	3	Commercial	Shared	3,456,000.00	4,032,000.00	17%
Example 145	5	2x25	3	Commercial	Shared	5,400,000.00	6,300,000.00	17%
Example 146	5	2x3.5	3	Commercial	Shared	144,000.00	123,480.00	-14%
Example 147	5	2x7	3	Commercial	Shared	576,000.00	493,920.00	-14%
Example 148	5	2x14	3	Commercial	Shared	1,728,000.00	1,975,680.00	14%
Example 149	5	2x28	3	Commercial	Shared	4,608,000.00	7,902,720.00	72%
Example 150	5	2x56	3	Commercial	Shared	11,520,000.00	31,610,880.00	174%
Example 151	5	2x5	1	Private	Shared	270,000.00	315,000.00	17%
Example 152	5	2x10	1	Private	Shared	1,080,000.00	1,260,000.00	17%
Example 153	5	2x15	1	Private	Shared	2,430,000.00	2,835,000.00	17%
Example 154	5	2x20	1	Private	Shared	4,320,000.00	5,040,000.00	17%
Example 155	5	2x25	1	Private	Shared	6,750,000.00	7,875,000.00	17%
Example 156	5	2x3.5	1	Private	Shared	180,000.00	154,350.00	-14%
Example 157	5	2x7	1	Private	Shared	720,000.00	617,400.00	-14%
Example 158	5	2x14	1	Private	Shared	2,160,000.00	2,469,600.00	14%
Example 159	5	2x28	1	Private	Shared	5,760,000.00	9,878,400.00	72%
Example 160	5	2x56	1	Private	Shared	14,400,000.00	39,513,600.00	174%
Example 161	5	2x5	2	Private	Shared	216,000.00	189,000.00	-13%
Example 162	5	2x10	2	Private	Shared	864,000.00	756,000.00	-13%
Example 163	5	2x15	2	Private	Shared	1,944,000.00	1,701,000.00	-13%
Example 164	5	2x20	2	Private	Shared	3,456,000.00	3,024,000.00	-13%

Example 165	5	2x25	2	Private	Shared	5,400,000.00	4,725,000.00	-13%
Example 166	5	2x3.5	2	Private	Shared	144,000.00	92,610.00	-36%
Example 167	5	2x7	2	Private	Shared	576,000.00	370,440.00	-36%
Example 168	5	2x14	2	Private	Shared	1,728,000.00	1,481,760.00	-14%
Example 169	5	2x28	2	Private	Shared	4,608,000.00	5,927,040.00	29%
Example 170	5	2x56	2	Private	Shared	11,520,000.00	23,708,160.00	106%
Example 171	5	2x5	3	Private	Shared	108,000.00	126,000.00	17%
Example 172	5	2x10	3	Private	Shared	432,000.00	504,000.00	17%
Example 173	5	2x15	3	Private	Shared	972,000.00	1,134,000.00	17%
Example 174	5	2x20	3	Private	Shared	1,728,000.00	2,016,000.00	17%
Example 175	5	2x25	3	Private	Shared	2,700,000.00	3,150,000.00	17%
Example 176	5	2x3.5	3	Private	Shared	72,000.00	61,740.00	-14%
Example 177	5	2x7	3	Private	Shared	288,000.00	246,960.00	-14%
Example 178	5	2x14	3	Private	Shared	864,000.00	987,840.00	14%
Example 179	5	2x28	3	Private	Shared	2,304,000.00	3,951,360.00	72%
Example 180	5	2x56	3	Private	Shared	5,760,000.00	15,805,440.00	174%
Example 181	10	2x5	1	Commercial	Shared	300,000.00	350,000.00	17%
Example 182	10	2x10	1	Commercial	Shared	1,200,000.00	1,400,000.00	17%
Example 183	10	2x15	1	Commercial	Shared	2,700,000.00	3,150,000.00	17%
Example 184	10	2x20	1	Commercial	Shared	4,800,000.00	5,600,000.00	17%
Example 185	10	2x25	1	Commercial	Shared	7,500,000.00	8,750,000.00	17%
Example 186	10	2x3.5	1	Commercial	Shared	200,000.00	171,500.00	-14%
Example 187	10	2x7	1	Commercial	Shared	800,000.00	686,000.00	-14%
Example 188	10	2x14	1	Commercial	Shared	2,400,000.00	2,744,000.00	14%
Example 189	10	2x28	1	Commercial	Shared	6,400,000.00	10,976,000.00	72%
Example 190	10	2x56	1	Commercial	Shared	16,000,000.00	43,904,000.00	174%
Example 191	10	2x5	2	Commercial	Shared	240,000.00	210,000.00	-13%
Example 192	10	2x10	2	Commercial	Shared	960,000.00	840,000.00	-13%
Example 193	10	2x15	2	Commercial	Shared	2,160,000.00	1,890,000.00	-13%
Example 194	10	2x20	2	Commercial	Shared	3,840,000.00	3,360,000.00	-13%
Example 195	10	2x25	2	Commercial	Shared	6,000,000.00	5,250,000.00	-13%
Example 196	10	2x3.5	2	Commercial	Shared	160,000.00	102,900.00	-36%
Example 197	10	2x7	2	Commercial	Shared	640,000.00	411,600.00	-36%
Example 198	10	2x14	2	Commercial	Shared	1,920,000.00	1,646,400.00	-14%
Example 199	10	2x28	2	Commercial	Shared	5,120,000.00	6,585,600.00	29%
Example 200	10	2x56	2	Commercial	Shared	12,800,000.00	26,342,400.00	106%
Example 201	10	2x5	3	Commercial	Shared	120,000.00	140,000.00	17%
Example 202	10	2x10	3	Commercial	Shared	480,000.00	560,000.00	17%
Example 203	10	2x15	3	Commercial	Shared	1,080,000.00	1,260,000.00	17%
Example 204	10	2x20	3	Commercial	Shared	1,920,000.00	2,240,000.00	17%
Example 205	10	2x25	3	Commercial	Shared	3,000,000.00	3,500,000.00	17%
Example 206	10	2x3.5	3	Commercial	Shared	80,000.00	68,600.00	-14%
Example 207	10	2x7	3	Commercial	Shared	320,000.00	274,400.00	-14%

Example 208	10	2x14	3	Commercial	Shared	960,000.00	1,097,600.00	14%
Example 209	10	2x28	3	Commercial	Shared	2,560,000.00	4,390,400.00	72%
Example 210	10	2x56	3	Commercial	Shared	6,400,000.00	17,561,600.00	174%
Example 211	10	2x5	1	Private	Shared	150,000.00	175,000.00	17%
Example 212	10	2x10	1	Private	Shared	600,000.00	700,000.00	17%
Example 213	10	2x15	1	Private	Shared	1,350,000.00	1,575,000.00	17%
Example 214	10	2x20	1	Private	Shared	2,400,000.00	2,800,000.00	17%
Example 215	10	2x25	1	Private	Shared	3,750,000.00	4,375,000.00	17%
Example 216	10	2x3.5	1	Private	Shared	100,000.00	85,750.00	-14%
Example 217	10	2x7	1	Private	Shared	400,000.00	343,000.00	-14%
Example 218	10	2x14	1	Private	Shared	1,200,000.00	1,372,000.00	14%
Example 219	10	2x28	1	Private	Shared	3,200,000.00	5,488,000.00	72%
Example 220	10	2x56	1	Private	Shared	8,000,000.00	21,952,000.00	174%
Example 221	10	2x5	2	Private	Shared	120,000.00	105,000.00	-13%
Example 222	10	2x10	2	Private	Shared	480,000.00	420,000.00	-13%
Example 223	10	2x15	2	Private	Shared	1,080,000.00	945,000.00	-13%
Example 224	10	2x20	2	Private	Shared	1,920,000.00	1,680,000.00	-13%
Example 225	10	2x25	2	Private	Shared	3,000,000.00	2,625,000.00	-13%
Example 226	10	2x3.5	2	Private	Shared	80,000.00	51,450.00	-36%
Example 227	10	2x7	2	Private	Shared	320,000.00	205,800.00	-36%
Example 228	10	2x14	2	Private	Shared	960,000.00	823,200.00	-14%
Example 229	10	2x28	2	Private	Shared	2,560,000.00	3,292,800.00	29%
Example 230	10	2x56	2	Private	Shared	6,400,000.00	13,171,200.00	106%
Example 231	10	2x5	3	Private	Shared	60,000.00	70,000.00	17%
Example 232	10	2x10	3	Private	Shared	240,000.00	280,000.00	17%
Example 233	10	2x15	3	Private	Shared	540,000.00	630,000.00	17%
Example 234	10	2x20	3	Private	Shared	960,000.00	1,120,000.00	17%
Example 235	10	2x25	3	Private	Shared	1,500,000.00	1,750,000.00	17%
Example 236	10	2x3.5	3	Private	Shared	40,000.00	34,300.00	-14%
Example 237	10	2x7	3	Private	Shared	160,000.00	137,200.00	-14%
Example 238	10	2x14	3	Private	Shared	480,000.00	548,800.00	14%
Example 239	10	2x28	3	Private	Shared	1,280,000.00	2,195,200.00	72%
Example 240	10	2x56	3	Private	Shared	3,200,000.00	8,780,800.00	174%

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