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Fixed Terrestrial Services Band Plan 2018 for Eswatini

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1 Introduction

1.1 Background

Fixed services are widely used by Communications services providers for backhaul, broadcasting, and other large-scale data transmissions. They can be thought of as the backbone of the digital economy and ensuring efficient use of fixed service bands can help achieve the growth of the Communications sector for the Kingdom of Eswatini.

In the country, the management and use of radio frequency spectrum resources is guided by the Electronic Communication Act, 2013 and the Electronic Communications (Radio Communications and Frequency Spectrum) Regulations, 2016. The National Frequency Allocation Plan (NFAP) further provides a clear structure on the allocation of spectrum resources to different services. The current NFAP identifies a number of spectrum bands which can be used for Terrestrial fixed services systems in Eswatini.

Currently there is an extensive use of the Fixed services bands for point to point fixed links and also for point to multipoint fixed links. This use is however not controlled in a proper way as there are some bands which have already been fully assigned, whereas some bands have not been utilized at all. A further analysis of the services deployed in the Fixed services band identified that there are bands which are utilized but the utilization is not based on the recommended channelling arrangements which are proposed in ITU recommendations and also in the Harmonised Radio Frequency Channelling Arrangements for Terrestrial Fixed and Mobile Systems in the Southern African Development Community (SADC). The Commission recognises that there is a legal and regulatory requirement to propose band channelling arrangements for the different services in accordance with national priorities and the national frequency allocation plan (NFAP), therefore, in accordance with the tenants of the Electronic Communications Act, 2013, the proposed channelling plan for Fixed Services bands is based on technological neutrality, meaning that the Commission desires to promote the use of radio frequency spectrum resources to achieve the much desired socio-economic transformation of the country.

1.2 Intention of the Commission

The Commission, in accordance with the Electronic Communications Act 2013 [Act No. 09 of 2013] and the Electronic Communications (Radio Communications and Frequency Spectrum) Regulations), 2016, intends to publish a band plan for Terrestrial Fixed Services bands which gives channelling structure for currently assigned spectrum and also recommend steps to be taken in order to ensure that all assignments are according to the proposed band plan.

The Electronic Communications (Radio Communications and Frequency Spectrum) Regulations 2016 state the following requirements in relation to radio frequency spectrum band plans:

5. *(1) The Commission may in accordance with section 34 of the Act, prepare a national frequency allocation plan.*

(2) The National Frequency Allocation plan shall fall under the Radio Frequency Plan and shall be detailed and provide a description of how a band is allocated.

(3) Radio Frequency Spectrum Band Plans shall specify the purposes for which bands may be used, arising from Government policy initiatives or public demand.

(4) Radio Frequency Spectrum band plans may specify or propose –

(a) detailed frequency channelling arrangements;

(b) technical and other requirements; or

(c) principles or assignment and implementation for the detailed allocation of the radio frequency spectrum between types of services.

(5) Radio Frequency Band Plans shall be subject to consultation.

The document presents the following decisions and plans for the different Terrestrial Fixed Services bands:

1.2.1 2GHz Band

The proposed channelling arrangement for this band is the band 2025 – 2110 MHz paired with 2200 – 2290 MHz as presented in the SADC channel arrangement and in Annex 1 to ITU-R Recommendation F.1098. This arrangement provides for 6 full-duplex channels of 14 MHz paired, with a transmitter-receiver duplex spacing of 175 MHz. Current assignments in this band, Eswatini Posts and Telecommunications Corporation (EPTC) shall be realigned to conform to this channelling arrangements. The channelling arrangement is as follows:

Table 1: Channelling Arrangement in 2GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency
1	2032.5	1'	2207.5
2	2046.5	2'	2221.5
3	2060.5	3'	2235.5
4	2074.5	4'	2249.5
5	2088.5	5'	2263.5
6	2102.5	6'	2277.5

1.2.2 4GHz Band

The channelling arrangement for the 4GHz band is on the band 3600 – 4200 MHz and as presented in section 6 of Annex 1 to ITU-R Recommendation F.635. In this channel arrangement there are 9 full-duplex channels of 30 MHz paired, with a transmitter-receiver duplex spacing of 320 MHz. The current assignments in this band, EPTC, shall be realigned to conform to this channelling arrangement. There is also an assignment for SWACAA which is for a VSAT terminal that shall require reassignment in the same band. The channelling arrangement is as follows:

Table 2: Channelling Arrangement in 4GHz Band

Channel Nr	Centre Frequency	Channel Nr	Centre Frequency
1	3 620	1'	3 940
2	3 650	2'	3 970
3	3 680	3'	4 000
4	3 710	4'	4 030
5	3 740	5'	4 060
6	3 770	6'	4 090
7	3 800	7'	4 120
8	3 830	8'	4 150
9	3 860	9'	4 180

1.2.3 5GHz Band

The 5GHz band is allocated for Government Use according to the National Frequency Allocation Plan 2017. The Channelling arrangement is as presented in Annex 1 of ITU-R Recommendation F.1099 where there are 7 full-duplex channels of 40 MHz paired, with a transmitter-receiver duplex spacing of 300 MHz. The channelling arrangement is as follows:

Table 3: Channelling Arrangement in 5GHz Band

Channel Nr	Centre Frequency	Channel Nr	Centre Frequency
1	4 430	1'	4 730
2	4 470	2'	4 770
3	4 510	3'	4 810
4	4 540	4'	4 850
5	4 590	5'	4 890
6	4 630	6'	4 930
7	4 670	7'	4 970

1.2.4 Lower 6GHz Band

The channel arrangement in this band is as presented in ITU-R Recommendation F 383 where there are 8 full-duplex channels of 29.65 MHz paired, with a transmitter-receiver duplex spacing of 252.04MHz. The channelling arrangement is as follows:

Table 4: Channelling Arrangement in 4GHz Band

Channel Nr	Centre Frequency	Channel Nr	Centre Frequency
1	5 945.20	1'	6 197.24
2	5 974.85	2'	6 226.89
3	6 004.50	3'	6 256.54
4	6 034.15	4'	6 286.19
5	6 063.80	5'	6 315.84
6	6 093.45	6'	6 345.49
7	6 123.10	7'	6 375.14
8	6 152.75	8'	6 404.79

1.2.5 Upper 6GHz Band

The channelling arrangement in the Upper 6GHz band is in the band 6 425 – 7 125 MHz and is as presented in ITU-R Recommendation F.384. This band has been designated for high and medium capacity fixed systems using 40 MHz and 20 MHz respectively. The high capacity channel arrangement allows for 8 full-duplex channels of 40 MHz paired, with a transmitter-receiver separation of 340MHz while the medium capacity channel arrangement allows for 16 full-duplex channels of 20 MHz paired, with a transmitter-receiver duplex spacing of 340MHz. The proposed channelling arrangements are as follows:

Table 5: Channelling Arrangement in Upper 6GHz Band based on 40MHz Bandwidth

Channel Nr	Centre Frequency	Channel Nr	Centre Frequency
1	6 460	1'	6 800
2	6 500	2'	6 840
3	6 540	3'	6 880
4	6 580	4'	6 920
5	6 620	5'	6 960
6	6 660	6'	7 000
7	6 700	7'	7 040
8	6 740	8'	7 080

Table 6: Channelling Arrangement in Upper 6GHz Band based on 20MHz Bandwidth

Channel Nr	Centre Frequency	Channel Nr	Centre Frequency
1	6 440	1'	6 780
2	6 460	2'	6 800
3	6 480	3'	6 820
4	6 500	4'	6 840
5	6 520	5'	6 860
6	6 540	6'	6 880
7	6 560	7'	6 900
8	6 580	8'	6 920
9	6 600	9'	6 940
10	6 620	10'	6 960
11	6 640	11'	6 980
12	6 660	12'	7 000
13	6 800	13'	7 020
14	6 700	14'	7 040
15	6 720	15'	7 060
16	6 740	16'	7 080

1.2.6 7 GHz Band

The channelling arrangement in the 7GHz band is in the band 7 110 – 7 750 MHz and is as presented in ITU-R Recommendation F.385 Annex 3 where there are 5 full-duplex channels of 28MHz paired, with a transmitter-receiver separation of 340MHz covering the lower part of the 7GHz band and 5 full-duplex channels of 28MHz paired, with a

transmitter-receiver separation of 168MHz covering the upper part of the band. The channelling arrangements are as follows:

Table 7: Channelling Arrangement in 7GHz Band

Channel Nr	Centre Frequency	Channel Nr	Centre Frequency
1l	7 121	1l'	7 317
2l	7 149	2l'	7 345
3l	7 177	3l'	7 373
4l	7 205	4l'	7 401
5l	7 233	5l'	7 429
1h	7 457	1h'	7 625
2h	7 485	2h'	7 653
3h	7 513	3h'	7 681
4h	7 541	4h'	7 709
5h	7 569	5h'	7 737

1.2.7 Lower 8GHz Band

The channelling arrangement in the lower 8GHz band is in the band 7 725 – 8 275 MHz and is as presented in ITU-R Recommendation F.386 Annex 6 where there are 8 full-duplex channels of 29.5MHz paired, with a transmitter-receiver separation of 311.32MHz. There are spectrum users (Swazi MTN and Eswatini Electricity Company) in this band who are using a different channelling arrangement to the one proposed, therefore their assignments have to be re-aligned with this channelling arrangement. The channelling arrangements are as follows:

Table 8: Channelling Arrangement in the lower 8GHz Band

Channel Nr	Centre Frequency	Channel Nr	Centre Frequency
1	7 747.70	1'	8 059.02
2	7 777.35	2'	8 088.67
3	7 807.00	3'	8 118.32
4	7 836.65	4'	8 147.97
5	7 866.30	5'	8 177.62
6	7 895.95	6'	8 207.27
7	7 925.60	7'	8 236.92
8	7 955.25	8'	8 266.57

1.2.8 Upper 8GHz Band

The channelling arrangement in the upper 8GHz band is in the band 8 275 – 8 500 MHz and is as presented in ITU-R Recommendation F.386 Annex 2. This band has been designated for medium and low capacity digital fixed wireless systems using 14 MHz and 7 MHz respectively. The medium capacity channel arrangement allows for 6 full-duplex channels of 14 MHz paired, with a transmitter-receiver separation of 119MHz while the low capacity channel arrangement allows for 12 full-duplex channels of 7 MHz paired,

with a transmitter-receiver duplex spacing of 126MHz. The channelling arrangements are as follows:

Table 9: Channelling Arrangement in the Upper 8GHz Band based on 14MHz Bandwidth

Channel Nr	Centre frequency	Channel Nr	Centre frequency
1	8293	1'	8412
2	8307	2'	8426
3	8321	3'	8440
4	8335	4'	8454
5	8349	5'	8468
6	8363	6'	8482

Table 10: Channelling Arrangement in the upper 8GHz Band based on 7MHz Bandwidth

Channel Nr	Centre frequency	Channel Nr	Centre frequency
1	8286	1'	8412
2	8293	2'	8419
3	8300	3'	8426
4	8307	4'	8433
5	8314	5'	8440
6	8321	6'	8447
7	8328	7'	8454
8	8335	8'	8461
9	8342	9'	8468
10	8349	10'	8475
11	8356	11'	8482
12	8363	12'	8489

1.2.9 10.5 GHz Band

The channelling arrangement in the 10.5GHz band is in the band 10.15 – 10.3 GHz paired with 10.5 – 10.65 GHz and is as presented in ITU-R Recommendation F.1568 Annex 2 where there are 5 full-duplex channels of **30MHz** paired, with a transmitter-receiver duplex spacing of 350MHz. The channelling arrangement is as follows:

Table 11: Channelling Arrangement in the 10.5GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency
1	10 165	1'	10 515
2	10 195	2'	10 545
3	10 225	3'	10 575
4	10 255	4'	10 605
5	10 285	5'	10 635

1.2.10 11 GHz Band

The channelling arrangement in the 11GHz band is in the band 10.7 – 11.7 GHz and is as presented in ITU-R Recommendation F.387 where there are 12 full-duplex channels of 40MHz paired, with a transmitter-receiver duplex spacing of 490MHz. The channelling arrangement is as follows:

Table 12: Channelling Arrangement in the 11GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency
1	10 735	1'	11 225
2	10 775	2'	11 265
3	10 815	3'	11 305
4	10 855	4'	11 345
5	10 895	5'	11 385
6	10 935	6'	11 425
7	10 975	7'	11 465
8	11 015	8'	11 505
9	11 055	9'	11 545
10	11 095	10'	11 585
11	11 135	11'	11 625
12	11 175	12'	11 665

1.2.11 13 GHz Band

The channelling arrangement in the 13GHz band is in the band 12.75 – 13.25 GHz and is as presented in ITU-R Recommendation F.497 where there are 8 full-duplex channels of 28MHz paired, with a transmitter-receiver duplex spacing of 266MHz. The channelling arrangement is as follows:

Table 13: Channelling Arrangement in the 13GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency
1	12 765	1'	13 031
2	12 793	2'	13 059
3	12 821	3'	13 087
4	12 849	4'	13 115
5	12 877	5'	13 143
6	12 905	6'	13 171
7	12 933	7'	13 199
8	12 961	8'	13 227

1.2.12 15 GHz Band

The channelling arrangement in the 13GHz band is in the band 14.5 – 15.35 GHz and is as presented in ITU-R Recommendation F.636 where there are 15 full-duplex channels of 28MHz paired, with a transmitter-receiver duplex spacing of 616MHz. The channelling arrangement is as follows:

Table 14: Channelling Arrangement in the 15GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency
1	14 515	1'	15 131
2	14 543	2'	15 159
3	14 571	3'	15 187
4	14 599	4'	15 215
5	14 627	5'	15 243
6	14 655	6'	15 271
7	14 683	7'	15 299
8	14 711	8'	15 327
9	14 739	9'	15 355
10	14 767	10'	15 383
11	14 795	11'	15 411
12	14 823	12'	15 439
13	14 851	13'	15 467
14	14 879	14'	15 495
15	14 907	15'	15 523

1.2.13 18 GHz Band

The channelling arrangement in the 18GHz band is in the band 17.7 – 19.7 GHz

and is as presented in ITU-R Recommendation F.595 Annex 1 where there are 131 full-duplex channels of 7.5 MHz paired, with a transmitter-receiver duplex spacing of 1010MHz. The channelling arrangement is as follows:

Table 15: Channelling Arrangement in the 18GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency
1	17710.0	1'	18720.0
2	17717.5	2'	18727.5
3	17725.0	3'	18735.0
4	17732.5	4'	18742.5
5	17740.0	5'	18750.0
6	17747.5	6'	18757.5
7	17755.0	7'	18765.0
8	17762.5	8'	18772.5
9	17770.0	9'	18780.0
10	17777.5	10'	18787.5
11	17785.0	11'	18795.0
12	17792.5	12'	18802.5
13	17800.0	13'	18810.0
14	17807.5	14'	18817.5
15	17815.0	15'	18825.0
16	17822.5	16'	18832.5
17	17830.0	17'	18840.0
18	17837.5	18'	18847.5
19	17845.0	19'	18855.0
20	17852.5	20'	18862.5
21	17860.0	21'	18870.0
22	17867.5	22'	18877.5
23	17875.0	23'	18885.0
24	17882.5	24'	18892.5
25	17890.0	25'	18900.0
26	17897.5	26'	18907.5
27	17905.0	27'	18915.0
28	17912.5	28'	18922.5
29	17920.0	29'	18930.0
30	17927.5	30'	18937.5
31	17935.0	31'	18945.0
32	17942.5	32'	18952.5
33	17950.0	33'	18960.0
34	17957.5	34'	18967.5
35	17965.0	35'	18975.0
36	17972.5	36'	18982.5
37	17980.0	37'	18990.0
38	17987.5	38'	18997.5
39	17995.0	39'	19005.0
40	18002.5	40'	19012.5
41	18010.0	41'	19020.0
42	18017.5	42'	19027.5
43	18025.0	43'	19035.0
44	18032.5	44'	19042.5
45	18040.0	45'	19050.0
46	18047.5	46'	19057.5

47	18055.0	47'	19065.0
48	18062.5	48'	19072.5
49	18070.0	49'	19080.0
50	18077.5	50'	19087.5
51	18085.0	51'	19095.0
52	18092.5	52'	19102.5
53	18100.0	53'	19110.0
54	18107.5	54'	19117.5
55	18115.0	55'	19125.0
56	18122.5	56'	19132.5
57	18130.0	57'	19140.0
58	18137.5	58'	19147.5
59	18145.0	59'	19155.0
60	18152.5	60'	19162.5
61	18160.0	61'	19170.0
62	18167.5	62'	19177.5
63	18175.0	63'	19185.0
64	18182.5	64'	19192.5
65	18190.0	65'	19200.0
66	18197.5	66'	19207.5
67	18205.0	67'	19215.0
68	18212.5	68'	19222.5
69	18220.0	69'	19230.0
70	18227.5	70'	19237.5
71	18235.0	71'	19245.0
72	18242.5	72'	19252.5
73	18250.0	73'	19260.0
74	18257.5	74'	19267.5
75	18265.0	75'	19275.0
76	18272.5	76'	19282.5
77	18280.0	77'	19290.0
78	18287.5	78'	19297.5
79	18295.0	79'	19305.0
80	18302.5	80'	19312.5
81	18310.0	81'	19320.0
82	18317.5	82'	19327.5
83	18325.0	83'	19335.0
84	18332.5	84'	19342.5
85	18340.0	85'	19350.0
86	18347.5	86'	19357.5
87	18355.0	87'	19365.0
88	18362.5	88'	19372.5
89	18370.0	89'	19380.0
90	18377.5	90'	19387.5
91	18385.0	91'	19395.0
92	18392.5	92'	19402.5
93	18400.0	93'	19410.0
94	18407.5	94'	19417.5
95	18415.0	95'	19425.0
96	18422.5	96'	19432.5
97	18430.0	97'	19440.0
98	18437.5	98'	19447.5
99	18445.0	99'	19455.0
100	18452.5	100'	19462.5

101	18460.0	101'	19470.0
102	18467.5	102'	19477.5
103	18475.0	103'	19485.0
104	18482.5	104'	19492.5
105	18490.0	105'	19500.0
106	18497.5	106'	19507.5
107	18505.0	107'	19515.0
108	18512.5	108'	19522.5
109	18520.0	109'	19530.0
110	18527.5	110'	19537.5
111	18535.0	111'	19545.0
112	18542.5	112'	19552.5
113	18550.0	113'	19560.0
114	18557.5	114'	19567.5
115	18565.0	115'	19575.0
116	18572.5	116'	19582.5
117	18580.0	117'	19590.0
118	18587.5	118'	19597.5
119	18595.0	119'	19605.0
120	18602.5	120'	19612.5
121	18610.0	121'	19620.0
122	18617.5	122'	19627.5
123	18625.0	123'	19635.0
124	18632.5	124'	19642.5
125	18640.0	125'	19650.0
126	18647.5	126'	19657.5
127	18655.0	127'	19665.0
128	18662.5	128'	19672.5
129	18670.0	129'	19680.0
130	18677.5	130'	19687.5
131	18685.0	131'	19695.0

1.2.14 23 GHz Band

The channelling arrangement in the 23GHz band is in the band 21.2 – 23.6 GHz and is as presented in ITU-R Recommendation F.637 Annex 1 where there are 10 full-duplex channels of 112 MHz paired, with a transmitter-receiver duplex spacing of 1232MHz. The channelling arrangement is as follows:

Table 16: Channelling Arrangement in the 23GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency
1	21 280	1'	22 512
2	21 392	2'	22 624
3	21 504	3'	22 736
4	21 616	4'	22 848
5	21 728	5'	22 960
6	21 840	6'	23 072
7	21 952	7'	23 184
8	22 064	8'	23 296
9	22 176	9'	23 408
10	22 288	10'	23 520

1.2.15 26 GHz Band

The channelling arrangement in the 26GHz band is in the band 24.5-26.5 GHz and is as presented in ITU-R Recommendation F.748 Annex 1 where there are 8 full-duplex channels of 112 MHz paired, with a transmitter-receiver duplex spacing of 1008MHz. The channelling arrangement is as follows:

Table 17: Channelling Arrangement in the 26GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency
1	24605	1'	25613
2	24717	2'	25725
3	24829	3'	25837
4	24941	4'	25949
5	25053	5'	26061
6	25165	6'	26173
7	25277	7'	26285
8	25389	8'	26397

1.2.16 28 GHz Band

The channelling arrangement in the 28GHz band is in the band 27.5-29.5 GHz and is as presented in ITU-R Recommendation F.748 Annex 2 where there are 8 full-duplex channels of 112 MHz paired, with a transmitter-receiver duplex spacing of 1008MHz. The channelling arrangement is as follows:

Table 18: Channelling Arrangement in the 28GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency
1	27604.5	1'	28612.5
2	27716.5	2'	28724.5
3	27828.5	3'	28836.5
4	27940.5	4'	28948.5
5	28052.5	5'	29060.5
6	28164.5	6'	29172.5
7	28276.5	7'	29284.5
8	28388.5	8'	29396.5

1.2.17 32 GHz Band

The channelling arrangement in the 32GHz band is in the band 31.8- 33.4 GHz and is as presented in ITU-R Recommendation F.1520 Annex 1 where there are 12 full-duplex channels of 56 MHz paired, with a transmitter-receiver duplex spacing of 812MHz. The channelling arrangement is as follows:

Table 19: Channelling Arrangement in the 32GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency
1	31 899	1'	32 711
2	31 955	2'	32 767
3	32 011	3'	32 823
4	32 067	4'	32 879
5	32 123	5'	32 935
6	32 179	6'	32 991
7	32 235	7'	33 047
8	32 291	8'	33 103
9	32 347	9'	33 159
10	32 403	10'	33 215
11	32 459	11'	33 271
12	32 515	12'	33 327

1.2.18 38 GHz Band

The channelling arrangement in the 38GHz band is in the band 37.0 – 39.5 GHz and is as presented in ITU-R Recommendation F.749 Annex 1 where there are 20 full-duplex channels of 56 MHz paired, with a transmitter-receiver duplex spacing of 1260MHz. The channelling arrangement is as follows:

Table 20: Channelling Arrangement in the 38GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency
1	37 086	1'	38 346
2	37 142	2'	38 402
3	37 198	3'	38 458
4	37 254	4'	38 514
5	37 310	5'	38 570
6	37 366	6'	38 626
7	37 422	7'	38 682
8	37 478	8'	38 738
9	37 534	9'	38 794
10	37 590	10'	38 850
11	37 646	11'	38 906
12	37 702	12'	38 962
13	37 758	13'	39 018
14	37 814	14'	39 074
15	37 870	15'	39 130
16	37 926	16'	39 186
17	37 982	17'	39 242
18	38 038	18'	39 298
19	38 094	19'	39 354
20	38 150	20'	39 410

2 Development of the Band Plan for Fixed Services Bands

2.1 Background

Following the successful development and publication of the Eswatini National Frequency Allocation Plan in 2017, the Commission developed the Eswatini National Radio Frequency Channelling Arrangements for Terrestrial Fixed Systems. The National Frequency Allocation Plan clearly highlights all frequency bands allocated to fixed wireless systems which this channelling plan seeks to specify the channel arrangements of each of those bands.

Eswatini, as a CRASA member state, adopted the frequency allocation plan (SADC FAP 2015) which was developed by CRASA with a view to harmonise, to the extent possible, not only the frequency allocations but also the radio-frequency channel arrangements in key PTP, PTMP and access frequency bands.

This document therefore addresses the harmonisation of radio frequency channel arrangements of key frequency bands. It however, does not address issues of frequency sharing and coordination, spectrum licensing, frequency migration or reframing.

2.2 Radio Frequency Channel Arrangements

In the case of fixed wireless systems (mainly PTP links), ITU-R Recommendation F.746 addresses three possible schemes for frequency channel arrangements as indicated in figure XX.

The main parameters are defined as:

XS = radio-frequency separation between the centre frequencies of adjacent radio-frequency channels on the same polarisation and in the same direction of transmission;

YS = radio-frequency separation between the centre frequencies of the go and return radio-frequency channels which are nearest to each other (innermost channels);

ZS = radio-frequency separation between the centre frequencies of the outermost radio-frequency channels and the edge of the frequency band (also known as guard-band). Where the upper and lower guard-band differ in size, these are referred to as Z_1S and Z_2S for the lower and upper separations respectively. Where the go and return frequency bands are not contiguous such that there are another allocation/s in the gap between the Tx and Rx band, ZS_i will be defined for the innermost edges of both sub-bands and will included in YS ;

DS = Tx/Rx duplex spacing defined as the radio---frequency separation between corresponding go and return channels within a given channel arrangement.

For more detail on these and other relevant parameters, Recommendation ITU---R F.746 should be consulted.

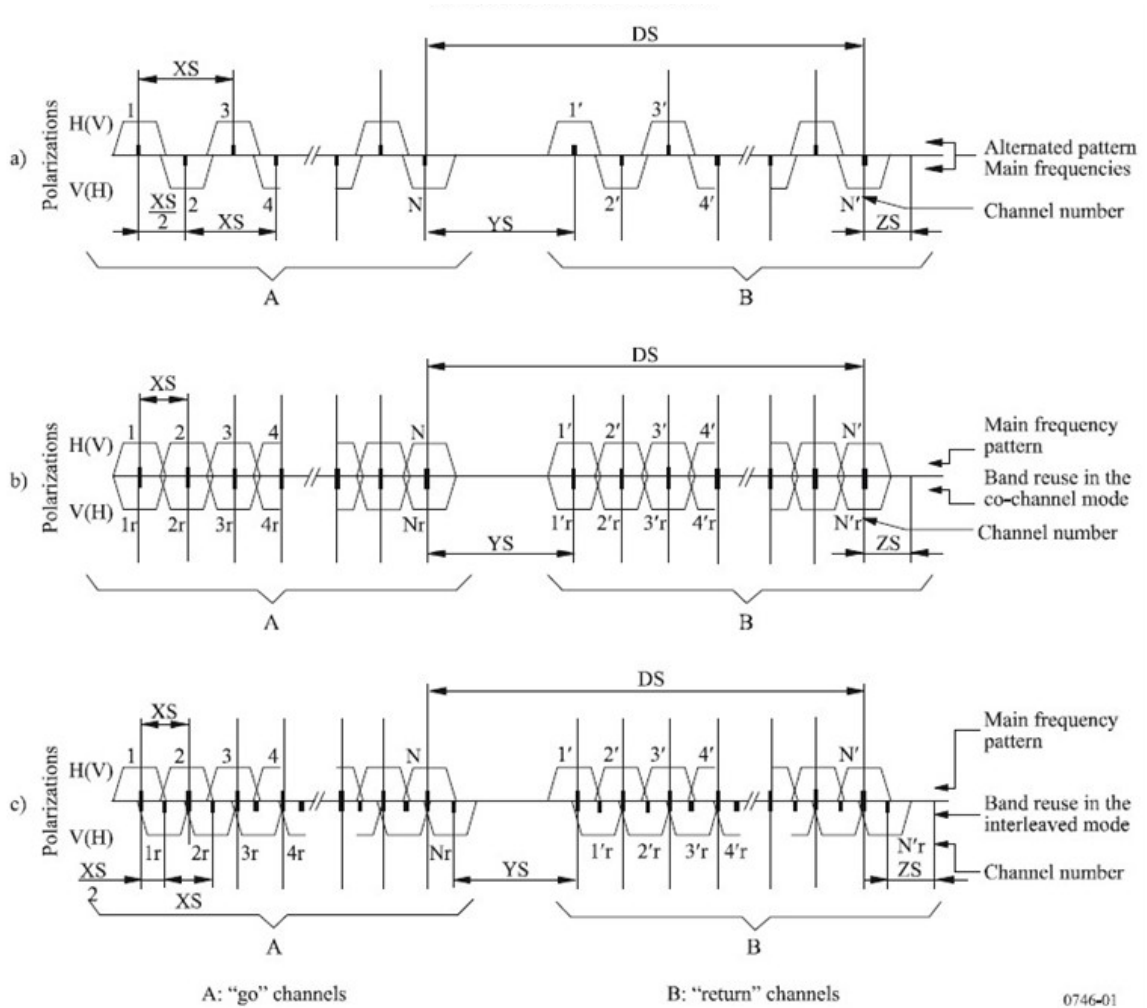


Figure 1: Radio Frequency channel arrangements for the three possible schemes considered in the band plan

2.3 List of Frequency bands and adopted Recommendations

The Eswatini National Frequency Allocation Plan 2017, which was developed in line with the SADC frequency allocation plan and the ITU Region 1 frequency allocation plan, specifies the following frequency bands as those earmarked for fixed services in Eswatini.

Table 21: List of Frequency bands and adopted recommendations

Section	Frequency Band	Frequency band	Bandwidth (MHz)	ITU-R Recommendation or Reports
5.1	2 GHz	2 025-2 110 MHz//2 200-2 290 MHz	85//90	ITU---R F.1098
5.2	4 GHz	3 600 – 4 200 MHz	600	ITU---R F.635, Annex 1
5.3	5 GHz	4 400 – 5 000 MHz	600	ITU---R F.1099, Annex 1
5.4	Lower 6 GHz	5 925 – 6 425 MHz	500	ITU---R F.383
5.5	Upper 6 GHz	6 425 – 7 110 MHz	685	ITU---R F.384
5.6	7 GHz	7 110 – 7 750 MHz	640	ITU---R F385, Annex 3
5.7	Lower 8 GHz	7 750 – 8 275 MHz	525	ITU---R F.386, Annex 6
5.8	Upper 8 GHz	8 275 – 8 500 MHz	225	ITU---R F.386, Annex 1
5.9	10.5 GHz	10.15-10.3 GHz//10.5-10.65 GHz	150 or 150	ITU---R F.1568, Annex 1
5.10	11 GHz	10.7 – 11.7 GHz	1000	ITU---R F.387
5.11	13 GHz	12.75 – 13.25 GHz	500	ITU---R F.497
5.12	15 GHz	14.5 – 15.35 GHz	850	ITU---R F.636
5.13	18 GHz	17.7 – 19.7 GHz	2000	ITU---R F.595, Annex 1
5.14	23 GHz	21.2-23.6 GHz or 22.0-23.6 GHz	2400 or 1600	ITU---R F.637, Annex 1 ITU---R F.637, Annex 3
5.15	26 GHz	24.5 – 26.5 GHz	2000	ITU---R F.748, Annex 1
5.16	28 GHz	27.5 – 29.5 GHz	2000	ITU---R F.748, Annex 2
5.17	32 GHz	31.8 – 33.4 GHz	1600	ITU---R F.1520, Annex 1
5.18	38 GHz	37.0 – 39.5 GHz	2500	ITU---R F.749, Annex 1

2.4 Channel Arrangements for Different Fixed Services Bands

This section reflects the preferred RF channel arrangement for Eswatini for each radio frequency band listed in table 21.

2.4.1 Channel Arrangement in the 2 GHz band.

Eswatini adopts the RF channel arrangement for the 2 GHz band (2025 – 2110 MHz paired with 2200 – 2290 MHz) as presented in the SADC channel arrangement and in Annex 1 to ITU-R Recommendation F.1098. The 2 GHz band has technical and economic advantages for low capacity digital systems including, for example, provisioning of fixed links operating over long distances. RF channel arrangement in Annex 1 of the Recommendation ITU-R F.1098 provides for 6 go and return channels of 14 MHz each and with a transmitter-receiver duplex spacing of 175 MHz. These channels can be further sub-divided into channels of 7 MHz, 3.5 MHz or 1.75 MHz, depending on the system capacity requirements.

Channelling plan development for band 2025-2110MHz

Channel Centre frequencies on either side (lower and upper) of band are obtained after substituting and computing in the following equations:

Let $F_n = F_0 - 136.5 + 14n$: Lower centre frequencies

$F_n' = F_0 + 38.5 + 14n$: Upper centre frequencies

F_n/F_n' : centre frequencies either side of band

F₀: centre frequency of band = **2155MHz**

n = 1, 2, 3, 4.....

Tx-Lower band	Centre gap(MHz)	Rx-Upper band	Duplex separation(MHz)
2025-2110	90	2200 to 2290	175

2.4.2 Channel Arrangement in the 4 GHz band

Eswatini reserved the 4 GHz band (3600 – 4200 MHz) for Fixed services and Fixed Satellite on a co-primary basis. The preferred RF channel arrangement for this band is as presented in section 6 of Annex 1 to ITU-R Recommendation F.635. In this channel arrangement there are 9 go and 9 return channels of 30 MHz each, with centre frequencies as follows:

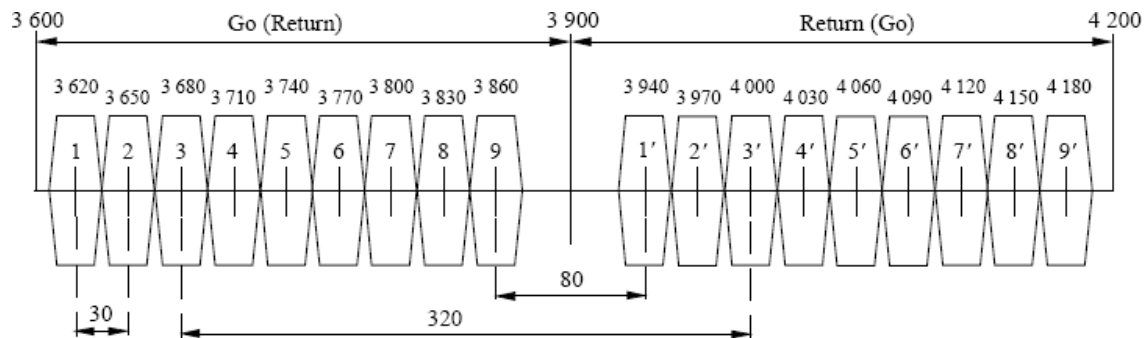
F_n: centre frequency of one RF channel in the go (return) part of the band (MHz)

F'_n: centre frequency of one RF channel in the return (go) part of the band (MHz)

F_n = 4 200 – 10 m, where **m** = 58, 55, 52, 49, 46, 43, 40, 37, 34

$$F'n = 4200 - 10m,$$

where $m = 26, 23, 20, 17, 14, 11, 8, 5, 2.$



2.4.4 Channel Arrangement in the 5 GHz band.

In Eswatini the 5 GHz band (4 400 – 5 000 MHz) is reserved for Government use and the preferred channel arrangement for this band is as presented in Annex 1 of ITU-R Recommendation F.1099. In this channel arrangement there are 7 go and 7 return channels of 40 MHz each, with centre frequencies as following;

Let F_0 be the frequency (MHz) of the centre of the band, **$F_0 = 4 700$ MHz,**

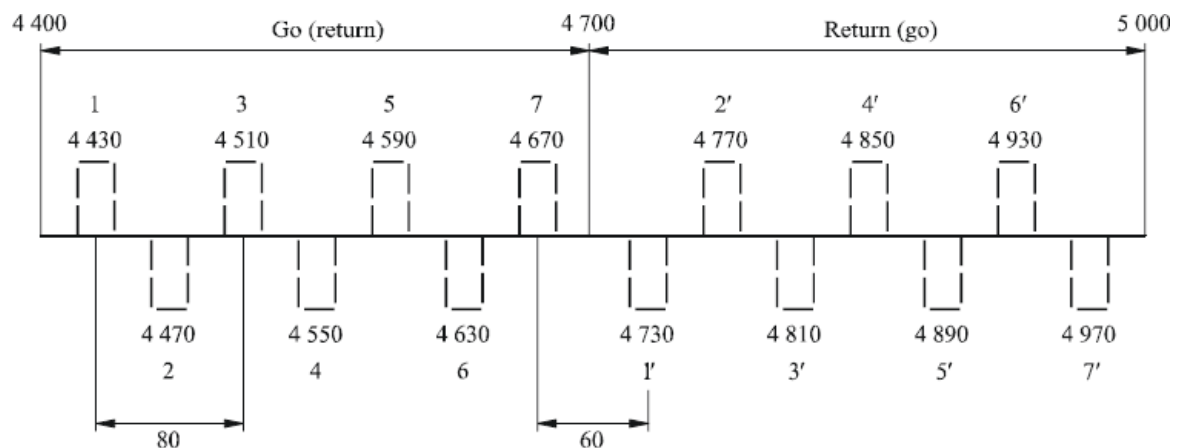
F_n be the centre frequency (MHz) of one RF channel in the lower half of the band,

$F'n$ be the centre frequency (MHz) of one RF channel in the upper half of the band,

$$F_n = F_0 - 310 + 40n$$

$$F'n = F_0 - 10 + 40n$$

where: $n = 1, 2, 3, 4, 5, 6$ or $7.$



2.4.6 Channel Arrangement in the Lower 6 GHz band.

The channel arrangement as presented in ITU-R Recommendation F 383 is the channel arrangement that Eswatini adopted for this band. In this channel arrangement there are 8 go and 8 return channels of 29.65 MHz each, with centre frequencies represented by the following relationship;

Let F_0 be the frequency (MHz) of the centre of the band of frequencies occupied

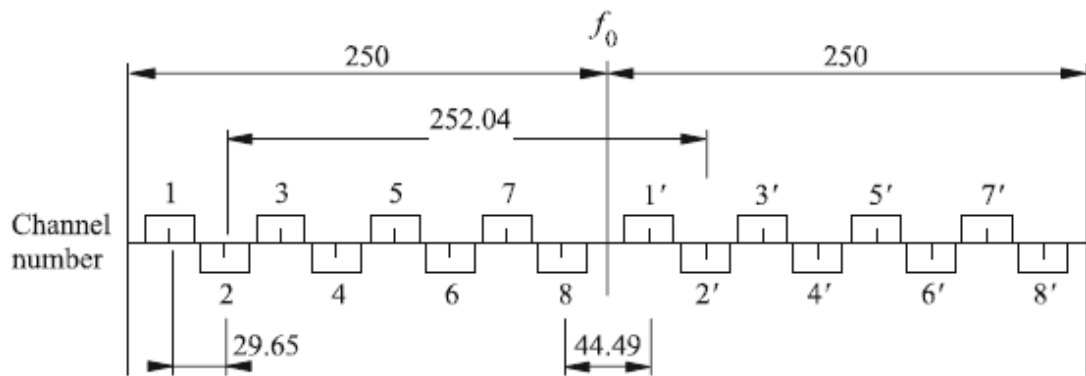
F_n be the centre frequency (MHz) of one RF channel in the lower half of the band

F'_n be the centre frequency (MHz) of one RF channel in the upper half of the band;

$$F_0 = 6\,175 \text{ MHz}$$

$$F_n = F_0 - 259.45 + 29.65n$$

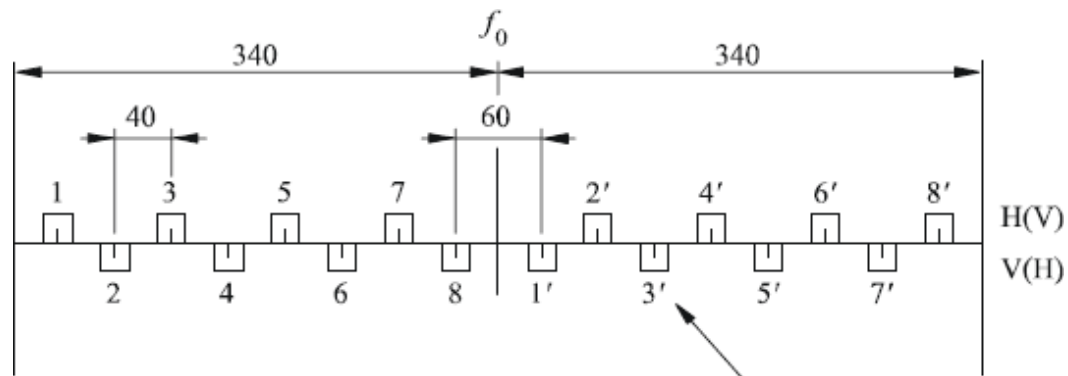
$$F'_n = F_0 - 7.41 + 29.65n, \quad \text{where: } n = 1, 2, 3, 4, 5, 6, 7 \text{ or } 8;$$



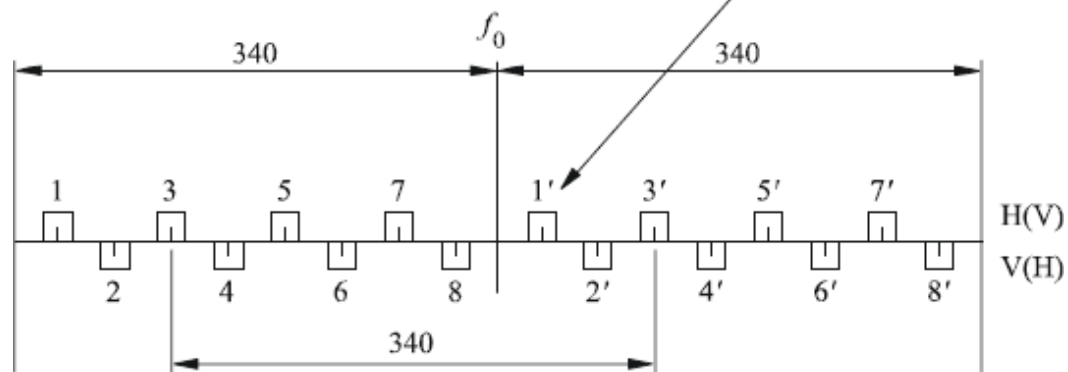
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2.4.7 Channel Arrangement in the Upper 6 GHz band.

The preferred Upper 6 GHz band (6 425 – 7 125 MHz) RF channel arrangement in Eswatini is as presented in ITU-R Recommendation F.384 which CRASA also adopted. This recommendation provides for channel arrangements for fixed wireless systems which may be used for high, medium and low capacity fixed systems. In Eswatini, this band has been developed for high and medium capacity fixed systems using 40 MHz and 20 MHz respectively. The high capacity channel arrangement allows for 8 go and 8 return channels of 40 MHz each while the medium capacity channel arrangement allows for 16 go and 16 return channels of 20 MHz each. The 40 MHz and 20 MHz channel arrangements shown in the following figures;



a) Channel arrangement for antennas with double polarization (Note 3)

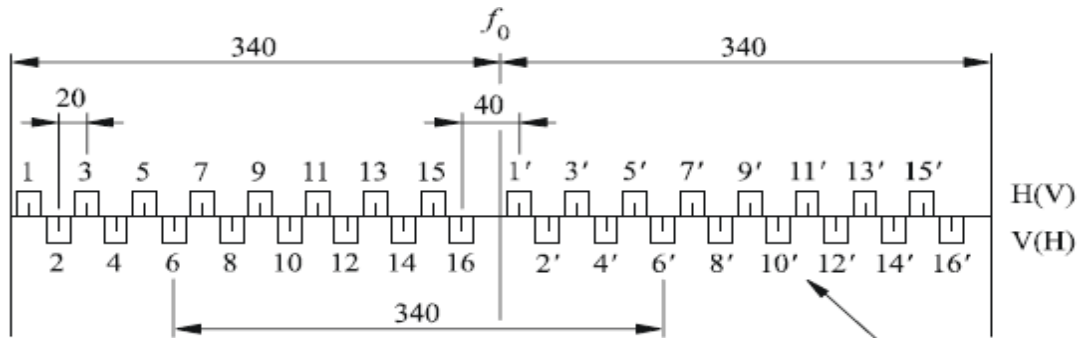


b) Channel arrangement for antennas with single polarization or common Tx/Rx antenna with double polarization (Note 3)

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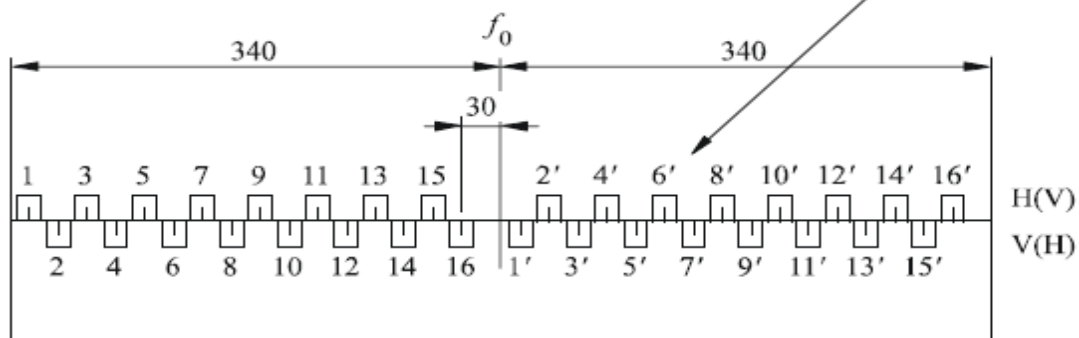
The figure above shows the channel arrangement for antenna with single and double polarizations. The RF channel centre frequencies for the U6 GHz band (based on 40 MHz channels) are represented by the following relationships;

- Let **F₀** be the frequency of the centre of the band of frequencies occupied (MHz),
F_n be the centre frequency of one RF channel in the lower half of the band (MHz),
F'_n be the centre frequency of one RF channel in the upper half of the band (MHz),
F₀ = 6 770 MHz
F_n = F₀ – 350 + 40n
F'_n = F₀ – 10 + 40n, where n = 1, 2, 3, 4, 5, 6, 7 or 8;



a) Channel arrangement for antennas with single polarization

Channel number



b) Channel arrangement for antennas with double polarization

The figure above also shows the channel arrangement for antenna with single and double polarizations. The RF channel centre frequencies for the U6 GHz band (based on 20 MHz channels) are represented by the following relationships;

Let F_0 be the frequency of the centre of the band of frequencies occupied (MHz),

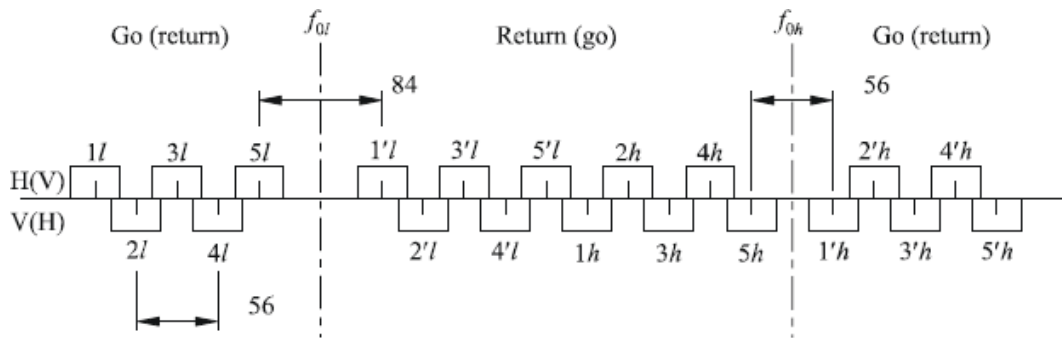
$$F_0 = 6770 \text{ MHz}$$

$$F_n = F_0 - 350 + 20n$$

$$F'_n = F_0 - 10 + 20n, \quad \text{where } n = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16;$$

2.4.8 Channel Arrangement in the 7 GHz band.

The preferred RF channel arrangement for the L7 and the U7 GHz bands (7 110 – 7 750 MHz) in Eswatini is as presented in ITU-R Recommendation F.385 Annex 3. This channel arrangement consists of a lower and upper part as depicted in the diagram below. The 7 GHz band can be used for medium and high capacity systems.



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The RF channel centre frequencies for the 7 GHz band (based on 28 MHz channels) are represented by the following relationships;

Let **F0l** be the frequency at the centre of the lower part of the band:

$$\mathbf{F0l = 7275 \text{ MHz,}}$$

F0h be the frequency at the centre of the higher part of the band:

$$\mathbf{F0h = 7597 \text{ MHz,}}$$

Fnl be the centre frequency of one RF channel in the lower half of the lower part of the band,

Fnl' be the centre frequency of one RF channel in the upper half of the lower part of the band,

Fnh be the centre frequency of one RF channel in the lower half of the higher part of the band,

Fnh' be the centre frequency of one RF channel in the upper half of the higher part of the band,

Then the frequencies (MHz) of the individual channels are expressed by the following relationships:

$$\mathbf{Fnl = F0l - 182 + 28 n}$$

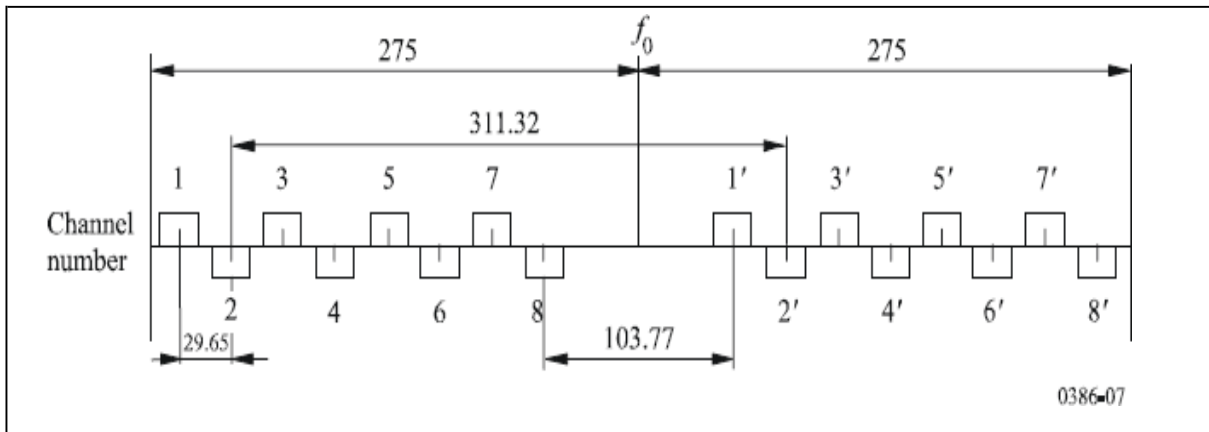
$$\mathbf{Fnl' = F0l + 14 + 28 n}$$

$$\mathbf{Fnh = F0h - 168 + 28 n}$$

$$\mathbf{Fnh' = F0h + 28 n \quad \text{where: } n = 1, 2, 3, 4, 5.}$$

2.4.9 Channel Arrangement in the Lower 8 GHz band.

The preferred Lower 8 GHz band (7 725 – 8 275 MHz) RF channel arrangement in Eswatini is as presented in Figure 7 of ITU-R Recommendation F.386 (Annex 6) which CRASA also adopted. This channel arrangement provides for 8 go and 8 return channels that can be used for digital systems up to 140 Mbit/s or SDH. A co-channel arrangement is also possible, using the same channel centre frequencies as indicated below.



The RF channel centre frequencies for the L8 GHz band (based on 29.65 MHz channels) are represented by the following relationships;

- Let **F0** be the frequency of the centre of the band of frequencies occupied (MHz),
Fn be the centre frequency of one RF channel in the lower half of this band (MHz),
F'n be the centre frequency of one RF channel in the upper half of this band (MHz),
F0 = 8000 MHz

then the frequencies (MHz) of the individual channels are expressed by the following relationships:

$$F_n = F_0 - 281.95 + 29.65 n$$

$$F'_n = F_0 + 29.37 + 29.65 n$$

where: **n = 1, 2, 3, 4, 5, 6, 7 or 8.**

2.4.10 Channel Arrangement in the Upper 8 GHz band.

The preferred Upper 8 GHz band (8 275 – 8 500 MHz) RF channel arrangement in Eswatini is as presented in Figure 2 of ITU-R Recommendation F.386 (Annex 2). This band can be used for medium and low capacity digital fixed wireless systems (34Mb/s and 8*2Mb/s) using 14MHz and 7MHz channels respectively.

The RF channel centre frequencies for the U8 GHz band are represented by the following relationships;

Let **F₀** be the frequency of the centre of the band of frequencies occupied
F_n be the centre frequency of one RF channel in the lower half of band
F'_n be the centre frequency of one RF channel in the upper half of band
F₀ = 8 387.5MHz

The following relationships are used to express the individual channels for systems with a capacity of 34Mb/s:

F_n = **F₀** - **108.5** + **14n** : Lower half of band

F_n = **F₀** + **108.5** + **14n** : Upper half of band

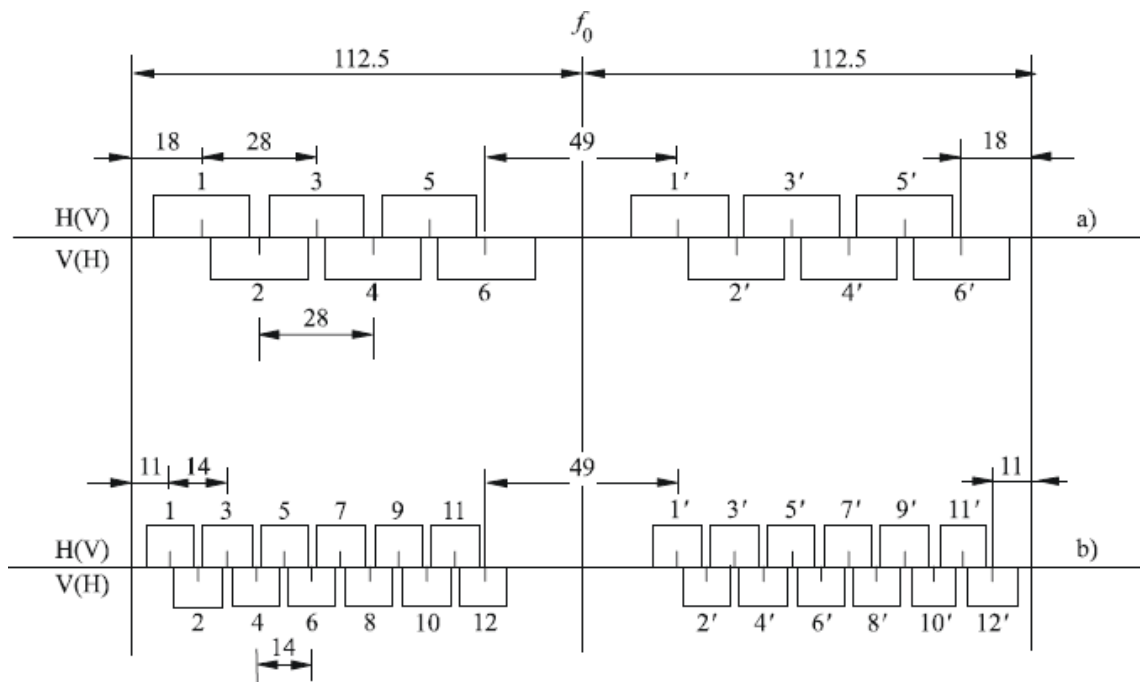
where **n** = 1, 2, 3, 4, 5 or 6.

Relationships for systems with a capacity of 8*2Mb/s:

F_n = **F₀** - **108.5** + **7n** : Lower half of band

F'_n = **F₀** + **17.5** + **14n** : Upper half of band

where **n**=1, 2, 3, 4, 5, 6,,12.



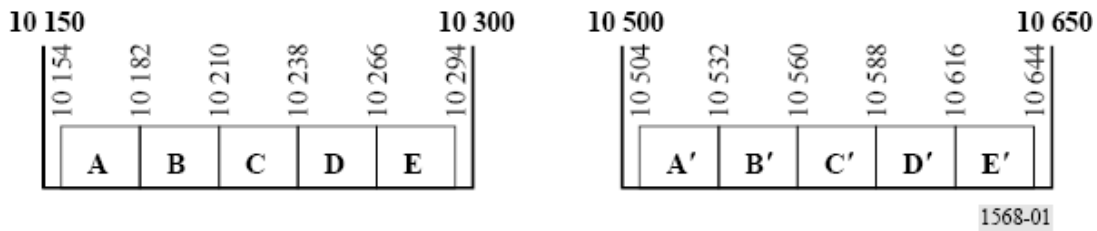
a) For systems with a capacity of 34 Mbit/s
 b) For systems with a capacity of 2 x 8 Mbit/s

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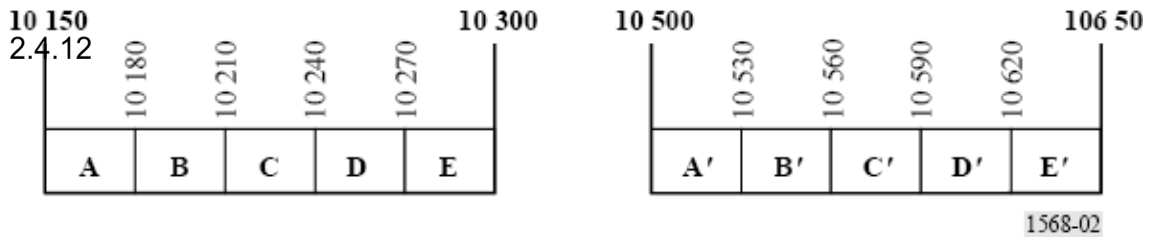
2.4.11 Channel Arrangement in the 10.5 GHz band.

The preferred RF channel arrangement in the 10.5 GHz band (10.15 – 10.3 GHz paired with 10.5 – 10.65 GHz) in Eswatini is as presented in Figure 1 and Figure 2 of ITU-R Recommendation F.1568 (Annex 1 and Annex 2). This channel arrangement provides two options to be used in this band, namely a 28 MHz plan and a 30 MHz plan which both provide 5 go and 5 return channels.

28 MHz block plan for the ranges 10.15-10.3/10.5-10.65 GHz
(Frequencies in MHz)



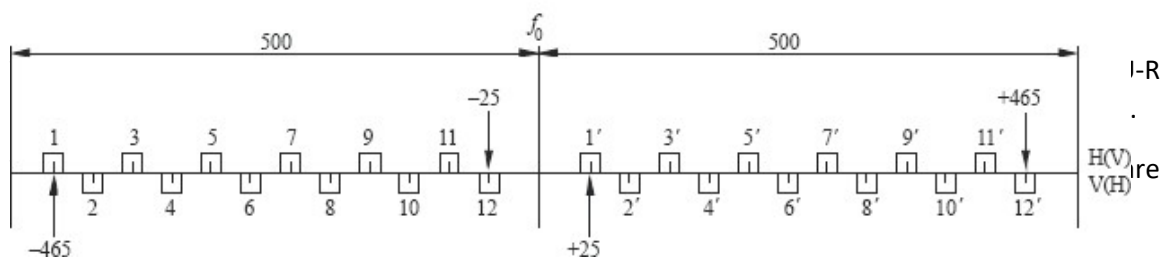
30 MHz block plan for the ranges 10.15-10.3/10.5-10.65 GHz
(Frequencies in MHz)



2.4.13 Channel Arrangement in the 11 GHz band.

The preferred RF channel arrangement in the 11 GHz band (10.7 – 11.7) in Eswatini is as presented in Figure 2 of ITU-R Recommendation F.387. This band may be used for low, medium and high capacity fixed service applications. This preferred channel arrangement allows for 12 go and 12 return channels based on 40MHz each. The centre frequency of the 11 GHz band is **F₀ = 11 200 MHz**.

**RF channel arrangement for high capacity FWSs operating
in the 11 GHz band according to recommends 1.2**
(All frequencies (MHz))



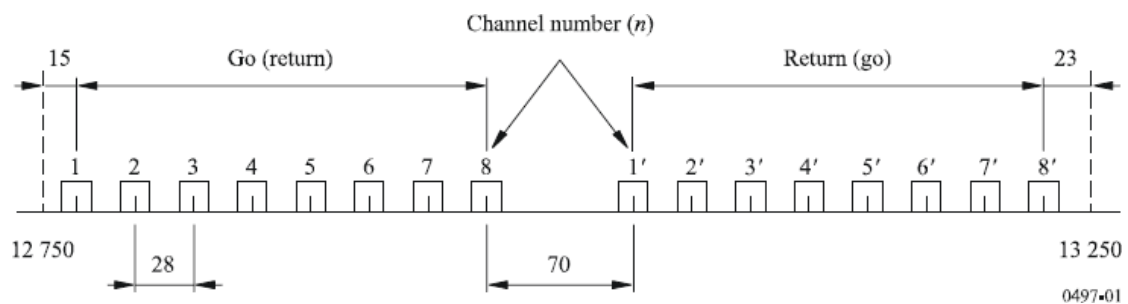
$F_n = F_0 - 505 + 40n$: lower half of the band

$F'_n = F_0 - 15 + 40n$: upper half of the band

where: $n = 1, 2, 3, \dots 12$.

2.4.14 Channel Arrangement in the 13 GHz band

The preferred RF channel arrangement for the 13 GHz band (12.75 – 13.25 GHz) in Eswatini is as presented in Figure 1 of ITU-R Recommendation F.497, which CRASA also adopted. This channel arrangement provides for 8 go and 8 return channels with a channel separation of 28 MHz that can be used for high capacity systems up to 140 Mbit/s or SDH. The centre frequency for the 13 GHz band plan is $F_0 = 12\ 996$ MHz.



The RF channel centre frequencies for the 13 GHz band (based on 40 MHz channels) are represented by the following relationships;

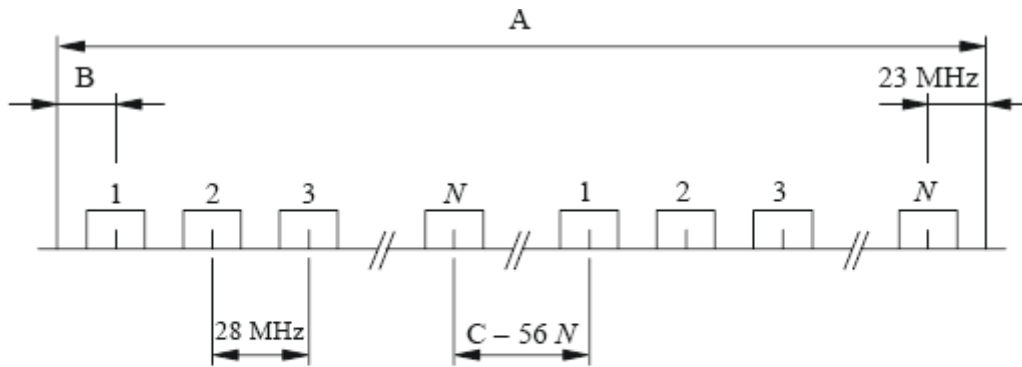
Let $F_n = F_0 - 259 + 28n$: Lower half centre frequencies

$F'_n = F_0 + 7 + 28n$: Upper half centre frequencies

where $n = 1, 2, 3, 4, 5, 6, 7$ or 8

2.4.15 Channel Arrangement in the 15 GHz band.

The preferred RF channel arrangement for medium capacity systems operating in the 15 GHz band (14.5 – 15.35 GHz) in Eswatini uses 28 MHz channel spacing and is as presented in Figure 1 of ITU-R Recommendation F.636. This channel arrangement provides for 15 go and 15 return channels of 28 MHz each and is depicted in the figure below.



(For the band 14.4-15.35 GHz: A = 950 MHz, B = 17 MHz, C = 966 MHz
 For the band 14.5-15.35 GHz: A = 850 MHz, B = 15 MHz, C = 868 MHz)

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The RF channel centre frequencies for the 15 GHz band (based on 28 MHz channels) are represented by the following relationships;

Let **F₀ = 11 701 MHz** : reference frequency in the 15 GHz band plan

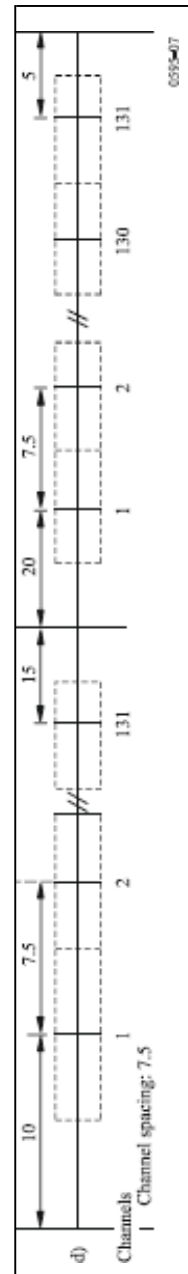
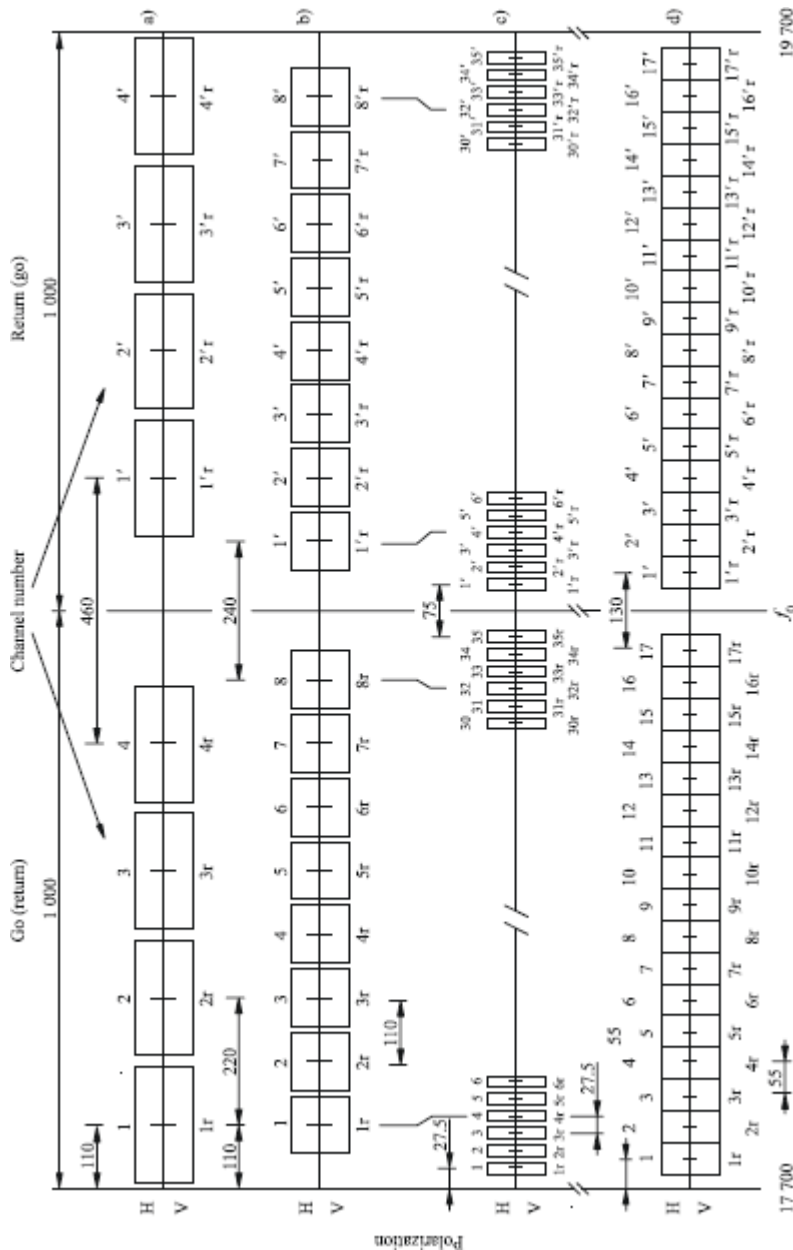
F_n = F₀ + 2 786 + 28n : Lower half centre frequencies

F'_n = F₀ + 3 626 + 28 (N - n) : Upper half centre frequencies

Where **n = 1,2,3,4..., N.** with **N ≤ 15**

2.4.16 Channel Arrangement in the 18 GHz band.

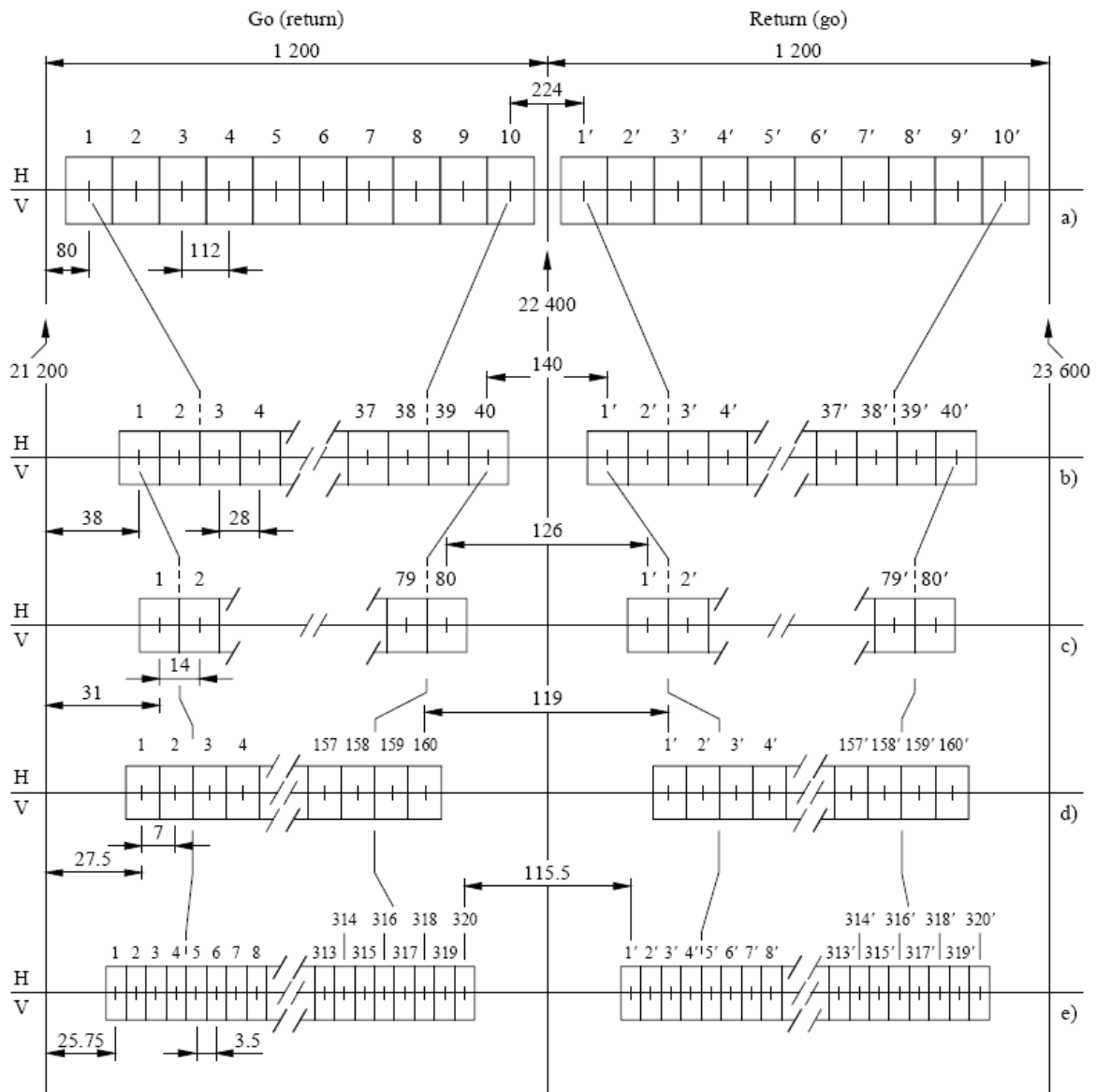
The preferred RF channel arrangement for low, medium and high capacity systems operating in the 18 GHz Band (17.7 – 19.7 GHz) in Eswatini is as presented in Figure 1 of ITU-R Recommendation F.595. This Recommendation provides for various channel spacing options including, amongst others, 220 MHz, 110 MHz, 55 MHz and 27.5 MHz. In Eswatini the 7.5 MHz channel spacing option has also been adopted to accommodate low capacity systems where such a channel arrangement provides for 131 duplex channels of 7.5 MHz each. The preferred channel arrangements are as indicated in the figure below.



2.4.17 Channel Arrangement in the 23 GHz band.

The preferred RF channel arrangement for the 23 GHz band in Eswatini is as presented in ITU-R Recommendation F.637. In this recommendation, there are two RF channel arrangement options which are based on Annex 1 and Annex3. Option 1 uses the frequency band 21.2 – 23.6 GHz and is based on Annex 1, whereas Option 2 uses the frequency band 22.0 – 23.6 GHz. In the case of Eswatini, option 1 is more applicable since there already exist some deployments below 22.0 GHz within this band.

In Option 1, the RF channel arrangement for low, medium and high capacity systems operating in the frequency band 21.2 – 23.6 GHz is as presented in Figure 1 of ITU-R Recommendation F.595. This recommendation provided for various channel spacing options including 112 MHz, 28 MHz, 14 MHz, 7 MHz and 3.5 MHz and is indicated in the figure below. The centre frequency for the 23 GHz band plan is **F₀ = 22 400 MHz** (Option 1).



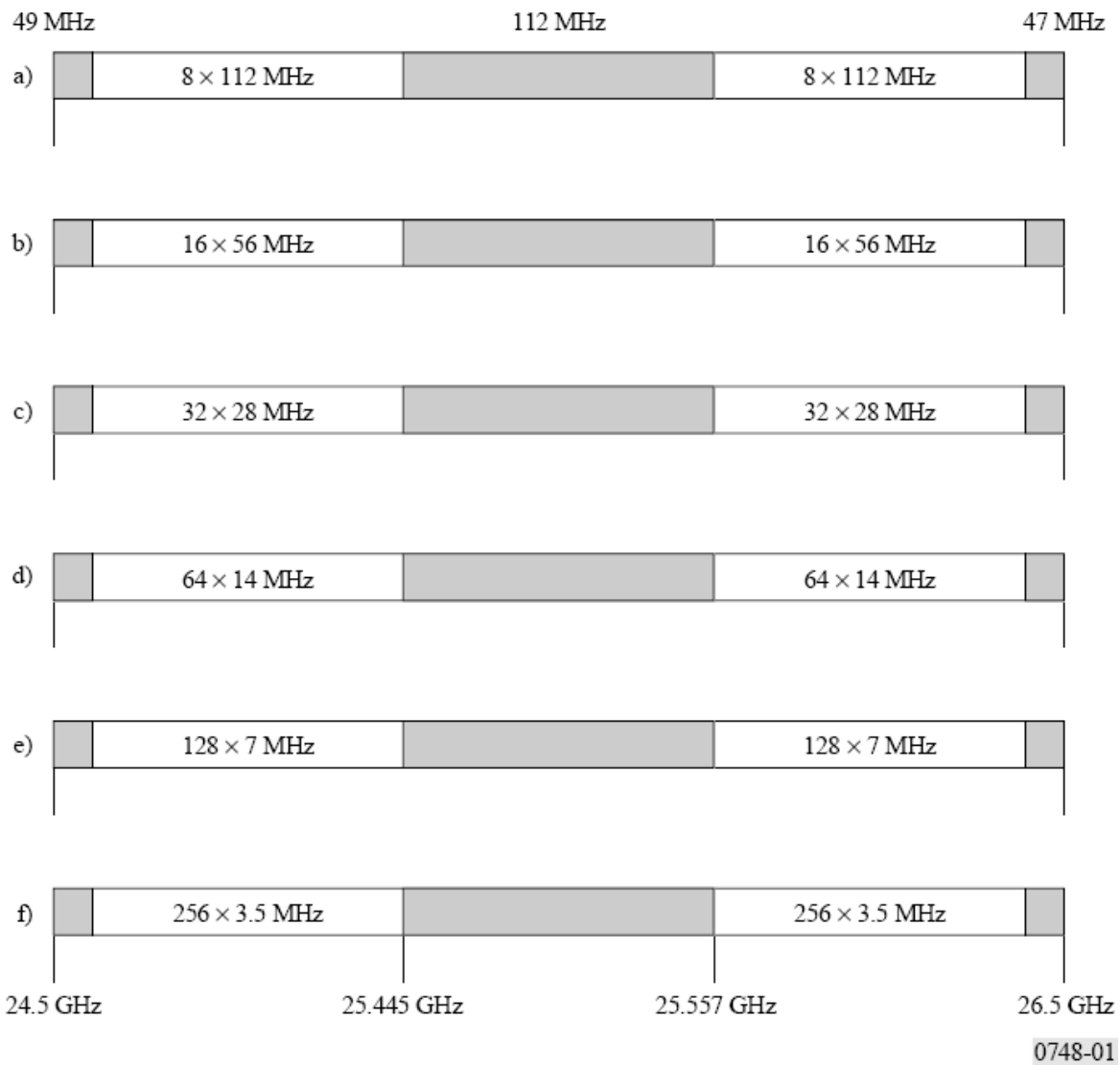
Note 1 - The RF channel arrangements of Fig. 1e) are derived by the use of carriers interleaved between those of the homogeneous pattern of recommends 2.

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2.4.18 Channel Arrangement in the 26 GHz band.

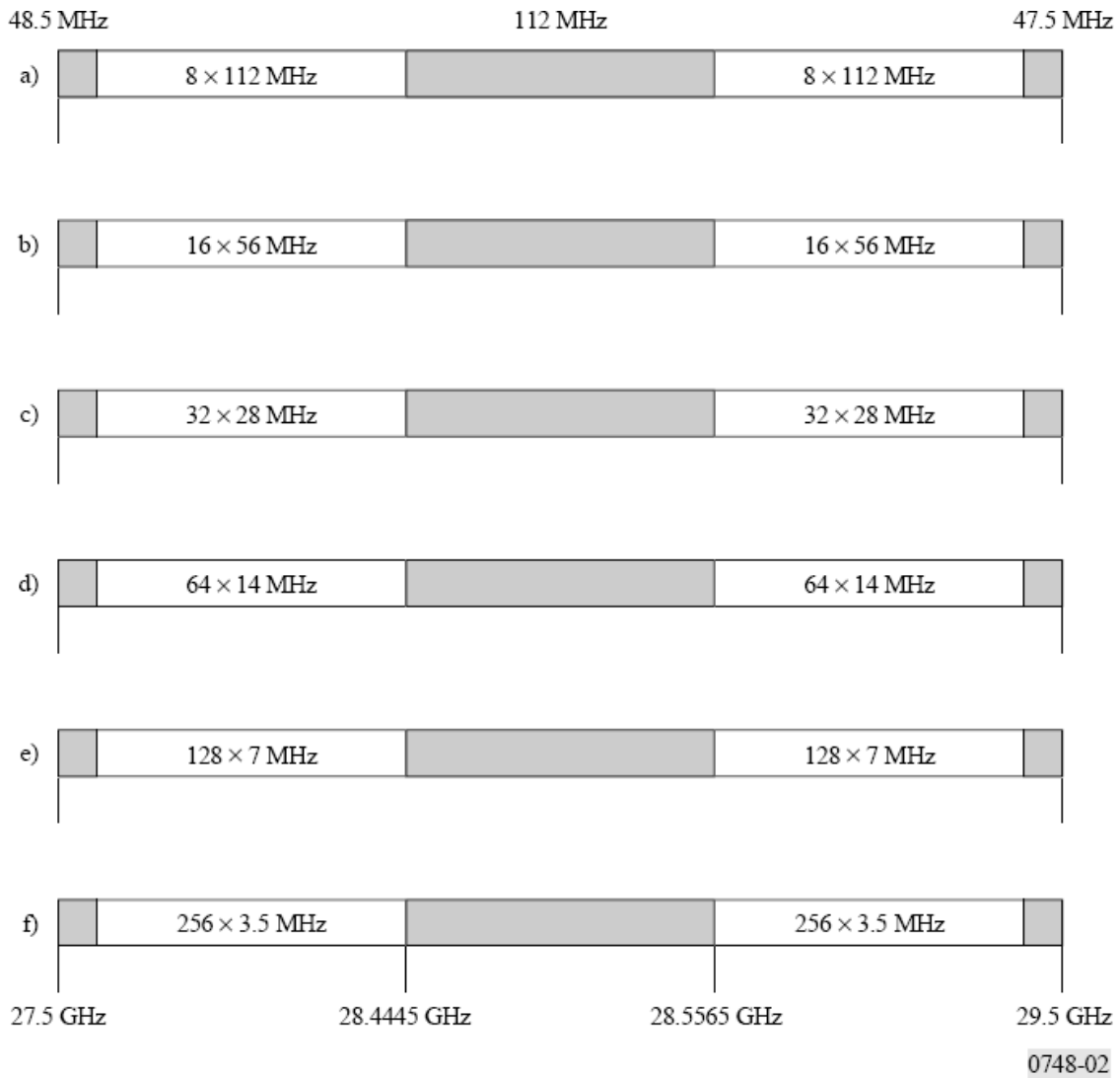
The preferred RF channel arrangement for low, medium and high capacity systems operating in the frequency band 24.5-26.5 GHz in Eswatini is as presented in Figure 1 of ITU-R Recommendation F.748 (Annex 1). Although this recommendation addresses the 25 GHz, 26 GHz and 28 GHz bands, in Eswatini the frequency range 24.5-26.5 GHz is addressed as one frequency band (25 GHz and 26 GHz).

ITU-R Recommendation F.748 provides for various channel spacing options including 112 MHz, 56 MHz, 28 MHz, 14 MHz, 7 MHz and 3.5 MHz and is indicated in the figure below. The centre frequency for the 26 GHz band plan is **F₀ = 25 501 MHz**.



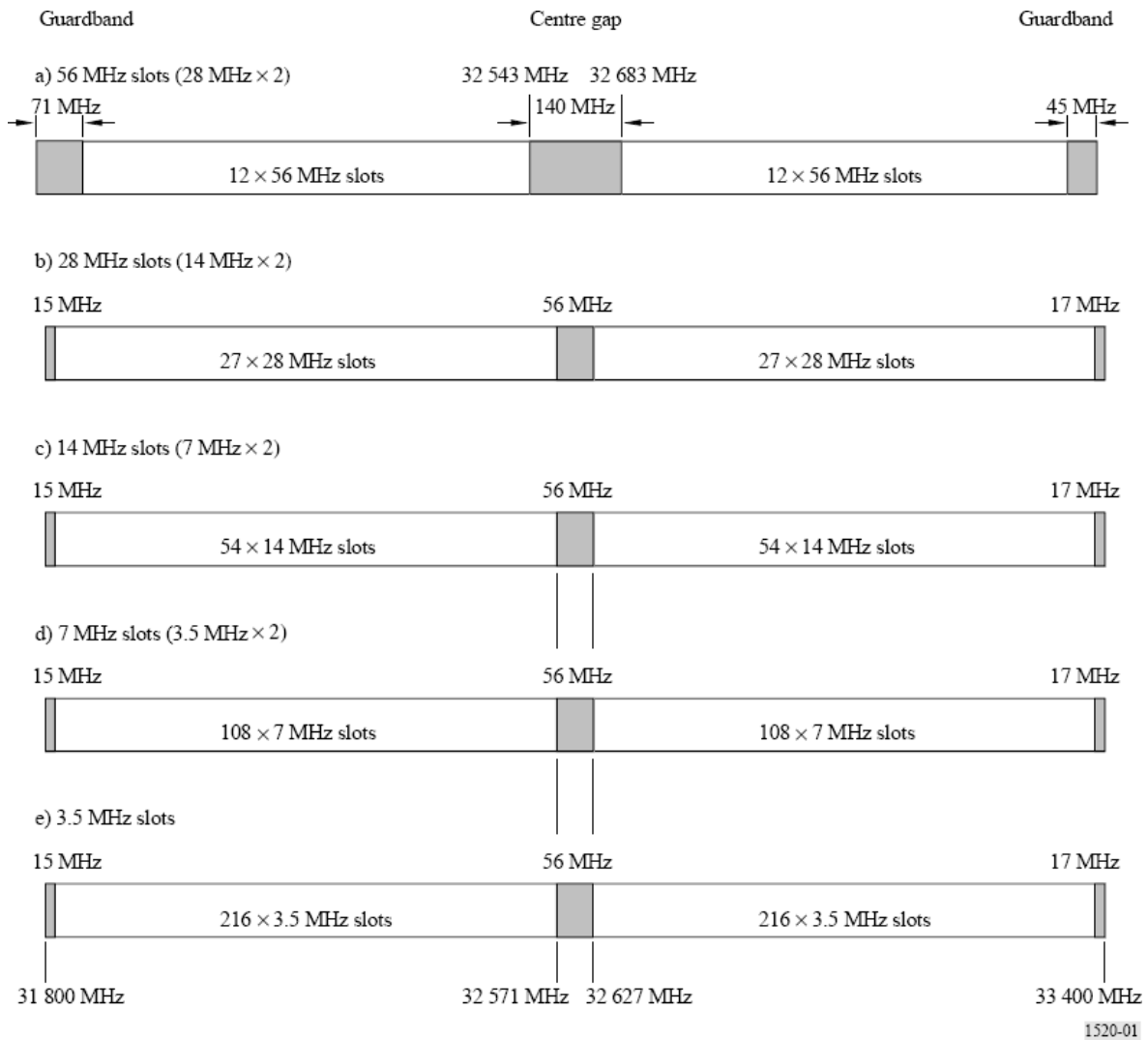
2.4.19 Channel Arrangement in the 28 GHz band.

The preferred RF channel arrangement for low, medium and high capacity systems operating in the frequency band 27.5-29.5 GHz in Eswatini is as presented in Figure 2 of ITU-R Recommendation F.748 (Annex 2), which provides for various channel spacing options including 112 MHz, 56 MHz, 28 MHz, 14 MHz, 7 MHz and 3.5 MHz and is indicated in the figure below. The centre frequency for the 28 GHz band plan is **F0 = 28 500.5 MHz**.



2.4.20 Channel Arrangement in the 32 GHz band.

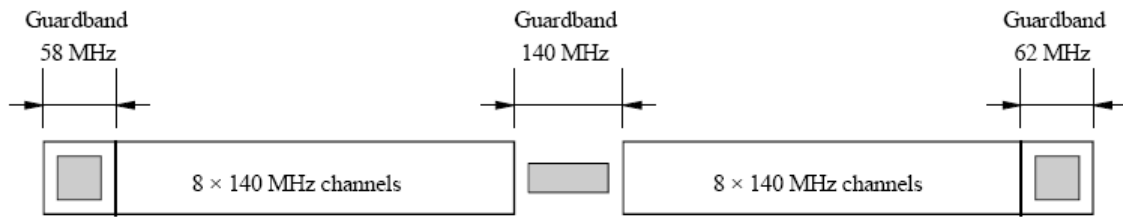
The preferred RF channel arrangement for HDFS systems operating in the frequency band 31.8- 33.4 GHz in Eswatini is as presented in Figure 1 of ITU-R Recommendation F.1520 (Annex 1). This recommendation provides for various channel spacing options including 56 MHz, 28 MHz, 14 MHz, 7 MHz and 3.5 MHz and is indicated in the figure below.



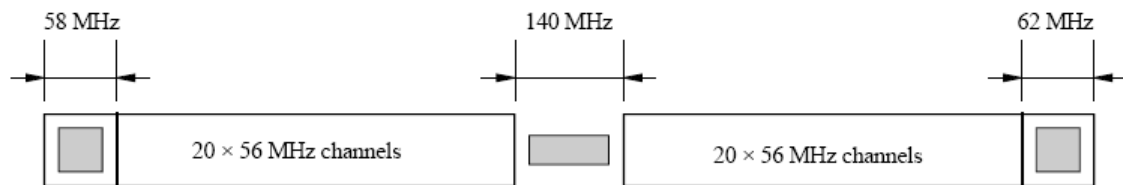
2.4.21 Channel Arrangement in the 38 GHz band.

The preferred RF channel arrangement for low, medium and high capacity systems operating in the frequency band 37.0 – 39.5 GHz in Eswatini is as presented in Figure 1 of ITU-R Recommendation F.749 (Annex 1). Recommendation F.749 provides for various channel spacing options including 140 MHz, 56 MHz, 28 MHz, 14 MHz, 7 MHz and 3.5 MHz and is indicated in the figure below. The centre frequency for the 38 GHz band plan is **F₀ = 38 248 MHz**. The 38 GHz band can be used for PTP, PTMP and BWA systems.

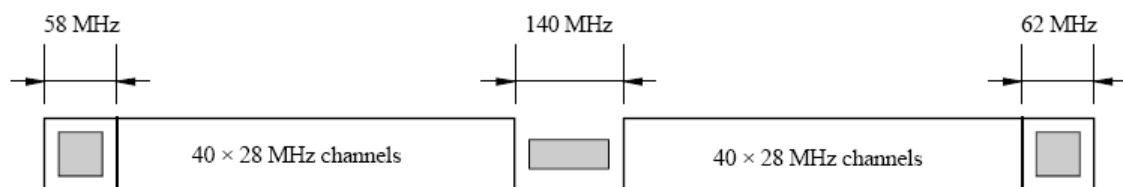
a) 140 MHz channels ($7 \text{ MHz} \times 20$)



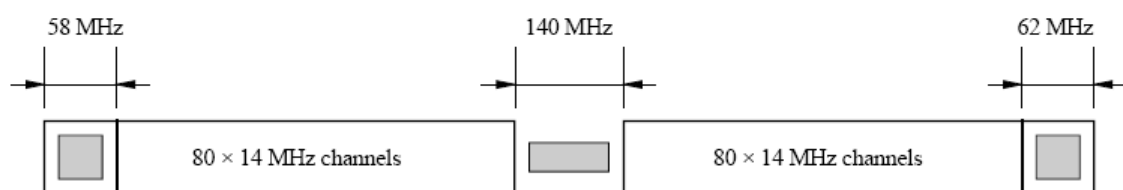
b) 56 MHz channels ($7 \text{ MHz} \times 8$)



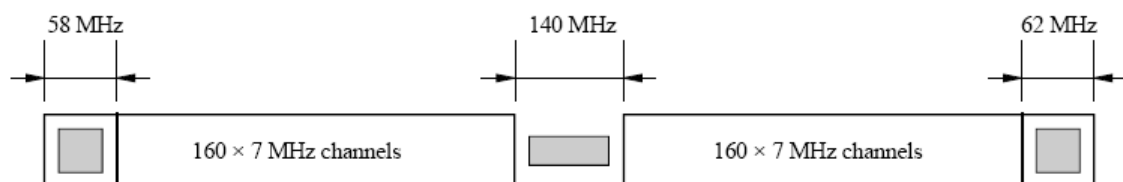
c) 28 MHz channels ($7 \text{ MHz} \times 4$)



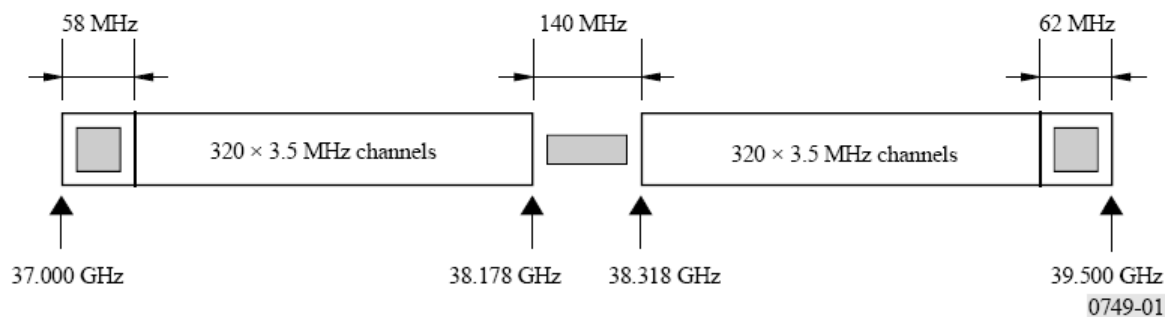
d) 14 MHz channels ($7 \text{ MHz} \times 2$)



e) 7 MHz channels



f) 3.5 MHz channels



3 Current Usage in the Fixed Services Bands

It can be noted that there are current assignments in the terrestrial fixed services bands which have been deployed. Further analysis of the assignments shows that some of the assignments are not according to the ITU recommendations and the also not according to the proposed channeling arrangements in the CRASA harmonized Radio Frequency Channeling Arrangements for Terrestrial Fixed and Mobile Systems in SADC. The section describes all the current assignments in all the fixed services bands and the summary of the usage of the bands is shown in Annex A.

3.1 2GHz Band

There are currently two assignments in the 2 GHz band which are being utilized for microwave links by the Eswatini Post and Telecommunications Company (EPTC). These assignments are not in accordance with the channelling arrangements in this band plan. The current assignments are as follows:

Table 22: Channel Assignments in 2GHz Band

TX Freq	RX Freq	Usage
2038.0000	2251.0000	EPTC Microwave link
2080.0000	2251.0000	EPTC Microwave link

The effects of this assignment on the 2 GHz plan is that it renders 4 channels in the new channeling arrangement fully occupied leaving only two channels available for assignment (Channel 2,3):

3.2 4GHz Band

There are currently three assignments in the 4 GHz band which are being utilized for microwave links by the Eswatini Post and Telecommunications Company (EPTC) and VSAT by the Eswatini Civil Aviation Authority (ECAA). These assignments are not in accordance with the channelling arrangements in this band plan

Table 23: Channel Assignments in 4GHz Band

TX Freq	RX Freq	Usage
3 689.99	4 010.01	EPTC Microwave link
3 749.99	4 069.04	EPTC Microwave link
3 938.832		ECAA VSAT

The effects of this assignment in the 4GHz band is that it renders 4 channels in the new channeling arrangement fully occupied as shown below leaving 5 channels available for assignment (Channel 2,4,7,8,9):

3.3 5GHz Band

There are currently two assignments in the 5 GHz band which are being utilized for last mile connectivity of the microwave links used by Eswatini Nation Fire & Emergency Services:

Table 24: Channel Assignments in 5GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency	User
6	4 630	6'	4 930	Eswatini Nation Fire & Emergency Services
7	4 670	7'	4 970	Eswatini Nation Fire & Emergency Services

This means that there are 5 channels available for assignment in this band (Channel 1, 2, 3, 4, 5).

3.4 Lower 6GHz Band

There are currently several assignments in the L6 GHz band which are being utilized for microwave links by the Eswatini Post and Telecommunications Company (EPTC) and VSAT by the Eswatini Civil Aviation Authority (ECAA).

Table 25: Channel Assignments in Lower 6GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency	User
1	5 945.20	1'	6 197.24	EPTC Microwave link
2	5 974.85	2'	6 226.89	EPTC Microwave link
3	6 004.50	3'	6 256.54	EPTC Microwave link
4	6 034.15	4'	6 286.19	EPTC Microwave link
			6 263.832	ECAA VSAT

This means that there are 4 channels available for assignment in this band (Channel 5, 6, 7, 8).

3.5 Upper 6GHz Band

There are currently six assignments in the L6 GHz band which are being utilized for microwave links by the Eswatini Post and Telecommunications Company (EPTC) as shown in the table below:

Table 26: Channel Assignments in Upper 6GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency	User
2	6 460	2'	6 800	EPTC Microwave link

4	6 500	4'	6 840	EPTC Microwave link
6	6 540	6'	6 880	EPTC Microwave link
8	6 580	8'	6 920	EPTC Microwave link
12	6 660	12'	7 000	EPTC Microwave link
14	6 700	14'	7 040	EPTC Microwave link

This means that there are ten (10) channels available for assignment, (Channel 1,3,5,7,9,10,11,13,15,16).

3.6 7GHz Band

Currently nine out of the ten go and return channels have been assigned and are being utilized for microwave and CDMA by EPTC, microwave by Swazi Mobile and microwave by MICT DTT.

Table 27: Channel Assignments in 7GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency	User
1l	7 121	1l'	7 317	EPTC, Swazi Mobile
2l	7 149	2l'	7 345	EPTC, MICT DTT, Swazi Mobile
3l	7 177	3l'	7 373	EPTC, Swazi Mobile,
4l	7 205	4l'	7 401	EPTC, MICT DTT, Swazi Mobile
5l	7 233	5l'	7 429	EPTC CDMA Backhauling
1h	7 457	1h'	7 625	Swazi Mobile,
2h	7 485	2h'	7 653	Swazi Mobile,
4h	7 541	4h'	7 709	Swazi Mobile
5h	7 569	5h'	7 737	Swazi Mobile

There is only one unassigned channel in this band (Channel 3h).

3.7 Lower 8GHz Band

There are currently four (4) channels which are assigned in this band for EPTC and Swazi Mobile as shown in the table below:

Table 28: Channel Assignments in lower 8GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency	User
1	7 747.70	1'	8 059.02	EPTC,
3	7 807.00	3'	8 118.32	EPTC,
7	7 925.60	7'	8 236.92	Swazi Mobile
8	7 955.25	8'	8 266.57	Swazi Mobile

There are also other assignments in this band which do not conform to the channeling arrangement and were assigned to EEC and Swazi MTN. These affect all the other channels and renders them un-usable. The assignments are shown below:

Table 29: Channel Usage in lower 8GHz Band

Transmit Frequency	Receive Frequency	User
7 926	8 192	Swazi-MTN
7 940	8 206	Swazi-MTN
7 954	8 220	Swazi-MTN
7 982	8 248	Swazi-MTN
7 996	8 262	Swazi-MTN
8 010	8 276	Swazi-MTN
8 030	8 296	Eswatini Electricity company
8 052	8 318	Swazi-MTN
8 066	8 332	Swazi-MTN
8 071	8 337	Swazi-MTN
8 094	8 360	Eswatini Electricity company
8 098	8 364	Eswatini Electricity company
8 112	8 378	Eswatini Electricity company
8 122	8 388	Eswatini Electricity company

3.8 Upper 8GHz Band

In this band, the spectrum is assigned on 7MHz or channels can be paired to have an assignment on 14MHz. Currently in this band we have one channel (Channel 4) assigned on the 7MHz bandwidth as shown below:

Table 30: Channel Assignment in upper 8GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency	User
4	8307	4'	8433	Eswatini Electricity Company.

This means that there are 11 channels available for assignment on 7MHz or 5 channels in the 14MHz.

3.9 10.5 GHz Band

Currently there are no channel assignments in this band.

3.10 11GHz Band

In this band, six (6) of the available channels have been assigned to His Majesty's Correctional Services and Eswatini National Fire and Emergency services. The assignment

for His Majesty's Correctional Services is on frequencies which are the same as the ones for channel 1.

Table 31: Channel Assignment in 11GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency	User
1	10 735	1'	11 225	His Majesty's Correctional Services (10.73-11.22) Eswatini Nation Fire & Emergency Services
3	10 815	3'	11 305	Eswatini Nation Fire & Emergency Services
4	10 855	4'	11 345	Eswatini Nation Fire & Emergency Services
5	10 895	5'	11 385	Eswatini Nation Fire & Emergency Services
6	10 935	6'	11 425	Eswatini Nation Fire & Emergency Services
7	10 975	7'	11 465	Eswatini Nation Fire & Emergency Services

This means that there are 6 channels available for assignment.

3.11 13GHz Band

In this band, six (6) of the available channels have been assigned to Swazi MTN.

Table 32: Channel Assignment in 13GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency	User
1	12 765	1'	13 031	Swazi-MTN
2	12 793	2'	13 059	Swazi-MTN
3	12 821	3'	13 087	Swazi-MTN
4	12 849	4'	13 115	Swazi-MTN
5	12 877	5'	13 143	Swazi-MTN
6	12 905	6'	13 171	Swazi-MTN

This means that there are two (2) channels available for assignment.

3.12 15GHz Band

In this band, nine (9) of the available channels have been assigned to EPTC and Swazi Mobile as shown in the table below:

Table 33: Channel Assignment in 15GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency	User
1	14 515	1'	15 131	EPTC (microwave/wireless local loop)
3	14 571	3'	15 187	EPTC (wireless local loop)
7	14 683	7'	15 299	Swazi-Mobile (microwave)
8	14 711	8'	15 327	Swazi-Mobile (microwave)
9	14 739	9'	15 355	Swazi-Mobile (microwave)
10	14 767	10'	15 383	Swazi-Mobile (microwave)

11	14 795	11'	15 411	Swazi-Mobile (microwave)
12	14 823	12'	15 439	Swazi-Mobile (microwave)
14	14 879	14'	15 495	Swazi-Mobile (microwave)

This means that there are six (6) channels available for assignment.

3.13 18GHz Band

In this band, there are Thirty-five (35) channels which have been assigned to Swazi MTN for microwave backhauling as shown in the table below:

Table 34: Channel Assignment in 18GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency	User
1	17710.0	1'	18720.0	Swazi-MTN (microwave)
2	17717.5	2'	18727.5	Swazi-MTN (microwave)
39	17995.0	39'	19005.0	Swazi-MTN (microwave)
40	18002.5	40'	19012.5	Swazi-MTN (microwave)
41	18010.0	41'	19020.0	Swazi-MTN (microwave)
42	18017.5	42'	19027.5	Swazi-MTN (microwave)
43	18025.0	43'	19035.0	Swazi-MTN (microwave)
44	18032.5	44'	19042.5	Swazi-MTN (microwave)
45	18040.0	45'	19050.0	Swazi-MTN (microwave)
46	18047.5	46'	19057.5	Swazi-MTN (microwave)
47	18055.0	47'	19065.0	Swazi-MTN (microwave)
48	18062.5	48'	19072.5	Swazi-MTN (microwave)
49	18070.0	49'	19080.0	Swazi-MTN (microwave)
50	18077.5	50'	19087.5	Swazi-MTN (microwave)
56	18122.5	56'	19132.5	Swazi-MTN (microwave)
58	18137.5	58'	19147.5	Swazi-MTN (microwave)
59	18145.0	59'	19155.0	Swazi-MTN (microwave)
66	18197.5	66'	19207.5	Swazi-MTN (microwave)
67	18205.0	67'	19215.0	Swazi-MTN (microwave)
68	18212.5	68'	19222.5	Swazi-MTN (microwave)
69	18220.0	69'	19230.0	Swazi-MTN (microwave)
70	18227.5	70'	19237.5	Swazi-MTN (microwave)
76	18272.5	76'	19282.5	Swazi-MTN (microwave)
77	18280.0	77'	19290.0	Swazi-MTN (microwave)
84	18332.5	84'	19342.5	Swazi-MTN (microwave)
91	18385.0	91'	19395.0	Swazi-MTN (microwave)
92	18392.5	92'	19402.5	Swazi-MTN (microwave)
95	18415.0	95'	19425.0	Swazi-MTN (microwave)
99	18445.0	99'	19455.0	Swazi-MTN (microwave)
100	18452.5	100'	19462.5	Swazi-MTN (microwave)
102	18467.5	102'	19477.5	Swazi-MTN (microwave)
103	18475.0	103'	19485.0	Swazi-MTN (microwave)
106	18497.5	106'	19507.5	Swazi-MTN (microwave)
109	18520.0	109'	19530.0	Swazi-MTN (microwave)

110	18527.5	110'	19537.5	Swazi-MTN (microwave)
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This means that there are ninety-six (96) channels which are available for assignment.

3.14 23GHz Band

There are currently five (5) go and return channels that have been assigned in this band and are being utilized for microwave by Swazi-MTN as shown in the table below:

Table 35: Channel Assignment in 23GHz Band

Channel Nr	Centre frequency	Channel Nr	Centre frequency	User
5	21 728	5'	22 960	Swazi-MTN (microwave)
6	21 840	6'	23 072	Swazi-MTN (microwave)
7	21 952	7'	23 184	Swazi-MTN (microwave)
8	22 064	8'	23 296	Swazi-MTN (microwave)
9	22 176	9'	23 408	Swazi-MTN (microwave)

This leaves five (5) available channels for assignment.

3.15 26GHz Band

Currently there are no assignments in this band in Eswatini, and this means that all eight (8) channels are available for assignment.

3.16 28GHz Band

Currently there are no assignments in this band in Eswatini, and this means that all eight (8) channels are available for assignment.

3.17 32GHz Band

Currently there are no assignments in this band in Eswatini, and this means that all twelve (12) channels are available for assignment.

3.18 38GHz Band

Currently there are no assignments in this band in Eswatini, and this means that all twenty (20) channels are available for assignment.

4 Conclusion and Recommendations

Below is a summary of the recommended actions with respect to the implementation of the band plan:

4.1 Spectrum Assignment

The Commission in implementing this plan will use a regime of per link assignment where each link is considered individually as opposed to a nationwide assignment of spectrum in the terrestrial fixed services band. However, in the event that a particular licensee makes extensive use of a particular frequency range for the deployment of fixed links and feels it may be more cost effective to apply for the exclusive use of that particular range over a geographical area that encompasses all current and planned fixed link deployments, the licensee may be allowed to apply for the exclusive use based on the sterilized area.

4.2 2GHz Band

It is recommended that EPTC migrates to the preferred channel arrangement for Eswatini in accordance with the harmonized SADC channel arrangements and this is expected to be done within 3 years from the 1st April 2019. The recommended migration is that which shall assign channel 1 and 4 of the six available channels to EPTC as following;

Table 36: Recommended Assignments in the 2GHz band

Channel Nr	Centre frequency	Channel Nr	Centre frequency
1	2032.5	1'	2207.5
4	2074.5	4'	2249.5

4.3 4GHz Band

It is recommended that since the above assignments do not conform to the preferred channel arrangement for the 4 GHz band, these users should be re-assigned frequencies that shall conform with the preferred channel arrangement. As such EPTC and ECAA are given 3 years with effect from 1st April 2019 to conform to the band plan and can be assigned the following frequency channels in the 4 GHz band;

Table 37: Recommended Assignments in the 4GHz band

Channel Nr	Centre frequency	Channel Nr	Centre frequency
1	3 620	1'	3 940
4	3 710	4'	4 030
5	3 740	5'	4 060

4.4 Lower 8GHz Band

It is recommended that the assignments which are not conforming to the channeling plan must be re-aligned to the channeling plan. The licensees are given a period of 3 years with effect from 1st April 2019 to conform to this band plan. These licensees can be reassigned their channels as follows:

Table 38: Recommended Assignments in the Lower 8GHz band

Channel Nr	Centre frequency	Channel Nr	Centre frequency
2	7 777.35	2'	8 088.67
3	7 807.00	3'	8 118.32
4	7 836.65	4'	8 147.97
5	7 866.30	5'	8 177.62

Appendix A Summary of Channel Assignments in the Fixed Services Bands

Service	Frequency Band	Assigned Spectrum	Available Spectrum
Point-to-Point links	2 GHz (BW: 14MHz)	Chl 1, 4	Chl 2, 3, 5, 6
	4 GHz (BW: 30MHz)	Chl 1, 4, 5	Chl 2, 3, 6, 7, 8, 9
	5 GHz (BW: 40MHz)	Chl 6, 7	Chl 1, 2, 3, 4, 5
	Lower 6GHz (BW: 29.65MHz)	Chl 1, 2, 3, 4, 6, 7	Chl 5, 8
	Upper 6GHz (BW: 20MHz)	Chl 1, 2, 3, 4, 6, 7	Chl 8, 9, 10, 11, 12, 13, 14, 15, 16
	Upper 6GHz (BW: 40MHz)	Chl 1, 2, 3, 4, 6, 7	Chl 5
	7 GHz (BW: 28MHz)	Chl 1l, 2l, 3l, 4l, 5l, 1h, 2h, 4h, 5h	Chl 3h
	Lower 8 GHz (BW: 29.65MHz)	Chl 1, 3, 7, 8	Chl 2, 4, 5, 6
	Upper 8 GHz (BW: 7MHz)	Chl 4	Chl 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12
	Upper 8 GHz (BW: 14MHz)	Chl 2	Chl 1, 3, 4, 5, 6
	10.5 GHz (BW: 28MHz)	-	Chl 1, 2, 3, 4, 5
	11 GHz (BW: 40MHz)	All Channels	-
	13 GHz (BW: 28MHz)	Chl 1, 2, 3, 4, 5, 6	Chl 7, 8
	15 GHz (BW: 28MHz)	Chl 1, 3, 7, 8, 9, 13	Chl 2, 4, 5, 6, 10, 11, 12, 13, 15
	18 GHz (BW: 7.5 MHz) 131 Chls	(35 channels)	(96 channels)
	23 GHz (BW: 112MHz)	Chl 5, 6, 7, 8, 9	Chl 1, 2, 3, 4, 10
	26 GHz (BW: 112MHz)	-	(8 channels)
	28 GHz (BW: 112MHz)	-	(8 channels)
	32 GHz (BW: 56MHz)	-	(12 channels)
	38 GHz (BW: 56MHz)	-	(20 channels)
38 GHz (BW: 140MHz)	-	(8 channels)	