



Spectrum Management System for Developing Countries (SMS4DC)

Training on SMS4DC

24-26 July, 2023

Livingstone, ZAMBIA

Ahmed BORAUD

ahmed.boraud@gmail.com





PRIDATrack 1 (T1)

CHANNEL ARRANGEMENT



PURPOSE

- ONCE A FREQUENCY BAND HAS BEEN ALLOCATED TO A SERVICE, IT IS NECESSARY TO MAKE PROVISION FOR SYSTEMS AND USERS TO ACCESS THE FREQUENCIES IN AN ORDERLY MANNER.
- THE MOST COMMONLY USED METHOD IS BY FREQUENCY DIVISION. THAT IS, BY DIVIDING THE SPECTRUM AVAILABLE INTO A NUMBER OF CHANNELS.
- THE BANDWIDTH OF THE CHANNELS DEPENDS ON THE TECHNOLOGY TO BE USED AND THE REQUIRED TRAFFIC CAPACITY OF THE SYSTEMS THAT WILL USE THE CHANNEL.
- IN MANY CASES, THE TYPE OF TRAFFIC TO BE SENT WILL REQUIRE SIMULTANEOUS BI-DIRECTIONAL COMMUNICATION (DUPLEX OPERATION), THEREFORE THE CHANNEL ARRANGEMENT SHOULD PROVIDE TWO- FREQUENCY CHANNELS FOR “GO AND RETURN”.
- IN ORDER TO PROVIDE HARMONISATION OF FREQUENCY USE, FOR EXAMPLE TO AID CROSS BORDER FREQUENCY COORDINATION, ITU-R HAS DEVELOPED RECOMMENDED CHANNELS ARRANGEMENTS FOR BANDS ALLOCATED TO THE FIXED SERVICE. FOR THE SAME REASON, SOME REGIONAL ORGANIZATIONS HAVE ALSO DEVELOPED ARRANGEMENTS FOR BOTH FIXED AND MOBILE SERVICES.





MODES OF CHANNEL OPERATION

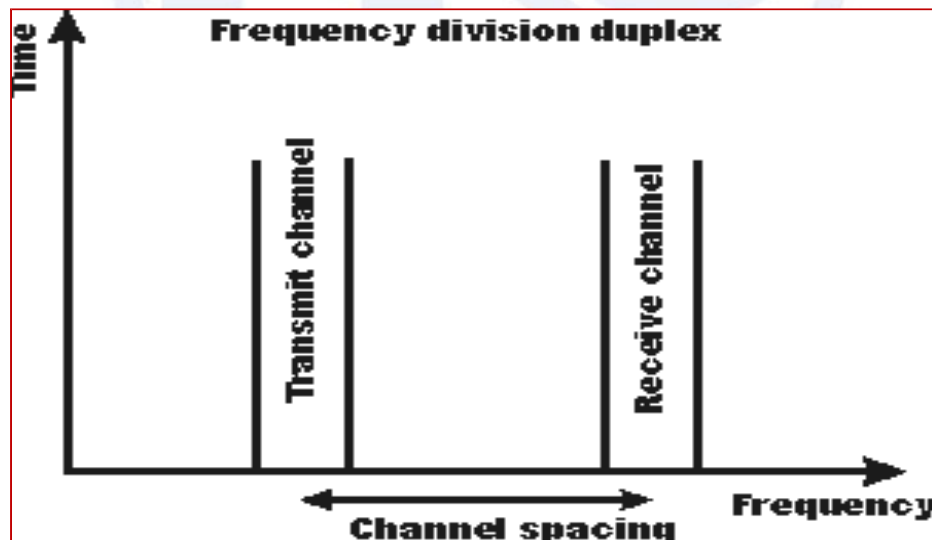
- **SIMPLEX OPERATION:** OPERATING METHOD IN WHICH TRANSMISSION IS MADE POSSIBLE, ALTERNATELY IN EACH DIRECTION OF A TELECOMMUNICATION CHANNEL, FOR EXAMPLE, BY MEANS OF MANUAL CONTROL
- **DUPLEX OPERATION:** OPERATING METHOD IN WHICH TRANSMISSION IS POSSIBLE SIMULTANEOUSLY IN BOTH DIRECTIONS OF A TELECOMMUNICATION CHANNEL
- **DUPLEX OPERATION:** OPERATING METHOD IN WHICH TRANSMISSION IS POSSIBLE SIMULTANEOUSLY IN BOTH DIRECTIONS OF A TELECOMMUNICATION CHANNEL
- **NECESSARY BANDWIDTH:** FOR A GIVEN CLASS OF EMISSION, THE WIDTH OF THE FREQUENCY BAND WHICH IS JUST SUFFICIENT TO ENSURE THE TRANSMISSION OF INFORMATION AT THE RATE AND WITH THE QUALITY REQUIRED UNDER SPECIFIED CONDITIONS



MODES OF CHANNEL OPERATION (2)

FREQUENCY DIVISION DUPLEX (FDD): FREQUENCY DIVISION DUPLEX (FDD) IS A TECHNIQUE WHERE SEPARATE FREQUENCY BANDS ARE USED AT THE TRANSMITTER AND RECEIVER SIDE BECAUSE THE FDD TECHNIQUE USES DIFFERENT FREQUENCY BANDS FOR SEND AND RECEIVE OPERATIONS.

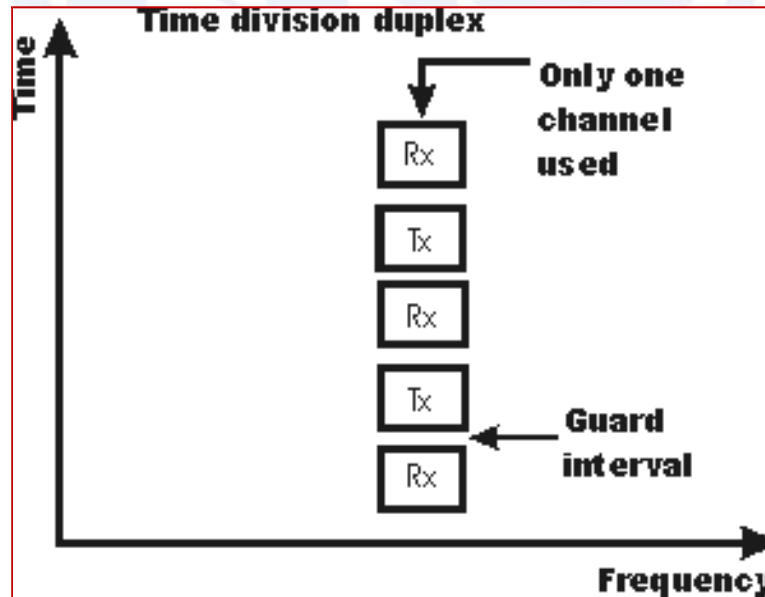
THE SENDING AND RECEIVING DATA SIGNALS DON'T INTERFERE WITH EACH OTHER. THIS MAKES FDD A BETTER CHOICE THAN TIME DIVISION DUPLEX (TDD) .



MODES OF CHANNEL OPERATION (3)

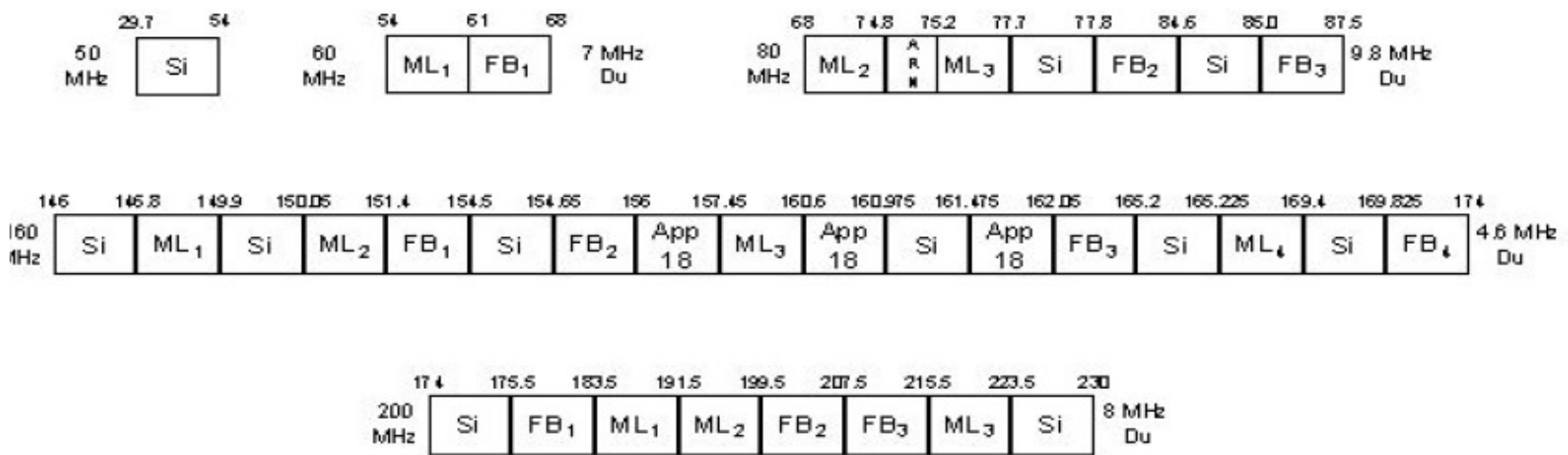
TIME DIVISION DUPLEX (TDD): TIME DIVISION DUPLEX (TDD) REFERS TO DUPLEX COMMUNICATION LINKS WHERE UPLINK IS SEPARATED FROM DOWNLINK BY THE ALLOCATION OF DIFFERENT TIME SLOTS IN THE SAME FREQUENCY BAND.

IT IS A TRANSMISSION SCHEME THAT ALLOWS ASYMMETRIC FLOW FOR UPLINK AND DOWNLINK DATA TRANSMISSION.



CEPT RECOMMENDATION TR25-08: FREQUENCY ARRANGEMENTS FOR VHF BANDS ALLOCATED TO THE MOBILE SERVICE

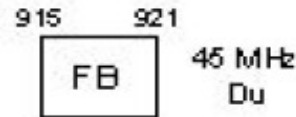
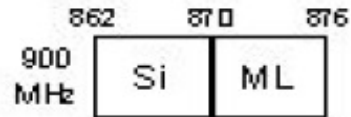
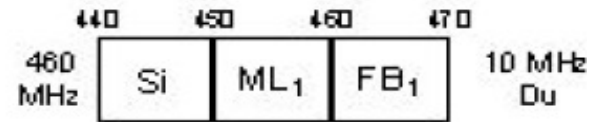
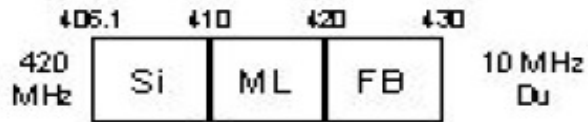
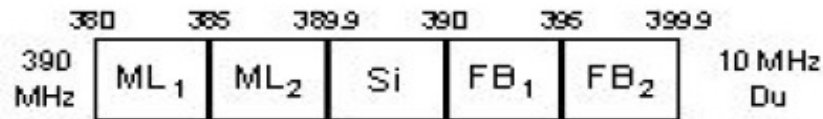
- 1) 29.7 – 54 MHz
- 2) 54 – 68 MHz
- 3) 68 – 87.5 MHz
- 4) 146 - 174 MHz
- 5) 174 – 230 MHz



FB = Fixed Base transmit frequency channels
 ML = Land Mobile transmit frequency channels
 Si = Single frequency

CEPT RECOMMENDATION TR 25-08: FREQUENCY ARRANGEMENTS FOR VHF BANDS ALLOCATED TO THE MOBILE SERVICE

5) 380 – 399.9 MHz 6) 406.1-430 MHz 7) 862 – 876 & 915 – 921 MHz



FB = Fixed Base transmit frequency channels
 ML = Land Mobile transmit frequency channels
 Si = Single frequency



SMS4DC FREQUENCY ARRANGEMENT

- FREQUENCY ARRANGEMENT ITEM IN THE “FREQUENCY ALLOCATION ” MENU OF SMS4DC.
- THERE ARE THREE POSSIBLE TYPES OF FREQUENCY ARRANGEMENT IN SMS4DC:
 - **HOMOGENOUS,**
 - **UNIFORM, AND,**
 - **NON-UNIFORM**
- ANY FREQUENCY PLAN SHALL BE IN CONFORMITY WITH FREQUENCY ALLOCATION TABLE.
- THERE ARE ALREADY LIST OF PLANNED ASSIGNABLE FREQUENCIES COULD BE BROWSED FROM ITEM “FREQUENCY TABLE” OF “FREQUENCY ALLOCATION ” MENU .



TYPES OF FREQUENCY ARRANGEMENT IN SMS4DC

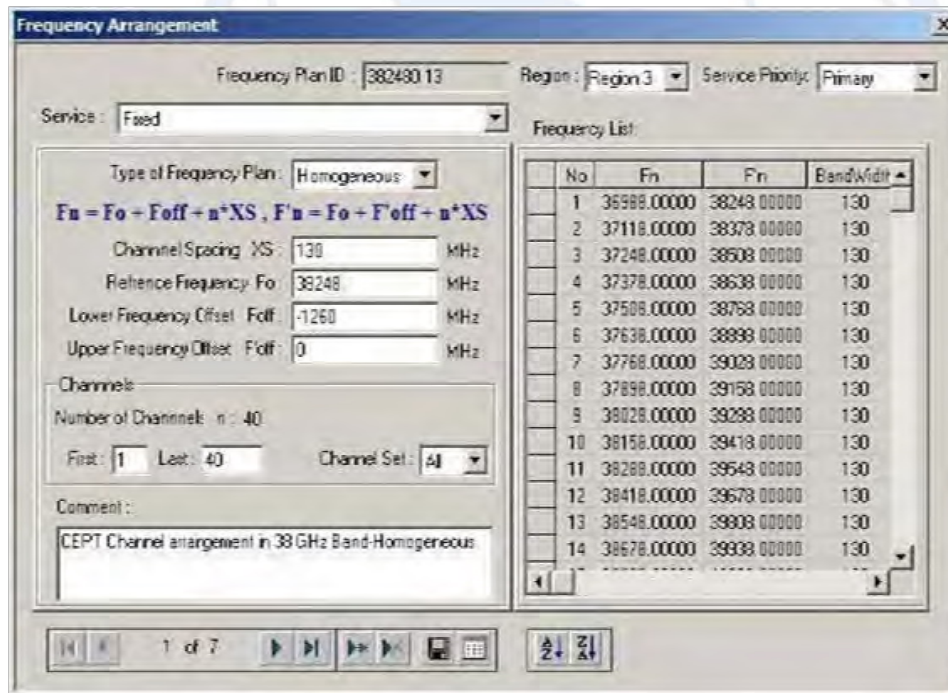
HOMOGENEOUS CHANNEL ARRANGEMENT(FDD):

$$f_n = f_0 + f_{offset} + n \cdot X \text{S MHz},$$

$$n = 0, 1, 2, \dots$$

$$f_{n'} = f_0 + f_{offset'} + n \cdot X \text{S MHz},$$

$$n = 0, 1, 2, \dots$$



The screenshot shows the 'Frequency Arrangement' window with the following configuration:

- Frequency Plan ID: 382430.13
- Region: Region 3
- Service Priority: Primary
- Service: Fixed
- Type of Frequency Plan: Homogeneous
- Formula: $F_n = F_0 + F_{off} + n \cdot X \text{S}$, $F_{n'} = F_0 + F'_{off} + n \cdot X \text{S}$
- Channel Spacing (XS): 130 MHz
- Reference Frequency (F0): 38248 MHz
- Lower Frequency Offset (Foff): -1260 MHz
- Upper Frequency Offset (Foff'): 0 MHz
- Number of Channels (n): 40
- First: 1, Last: 40, Channel Set: All
- Comment: CEPT Channel arrangement in 39 GHz Band-Homogeneous

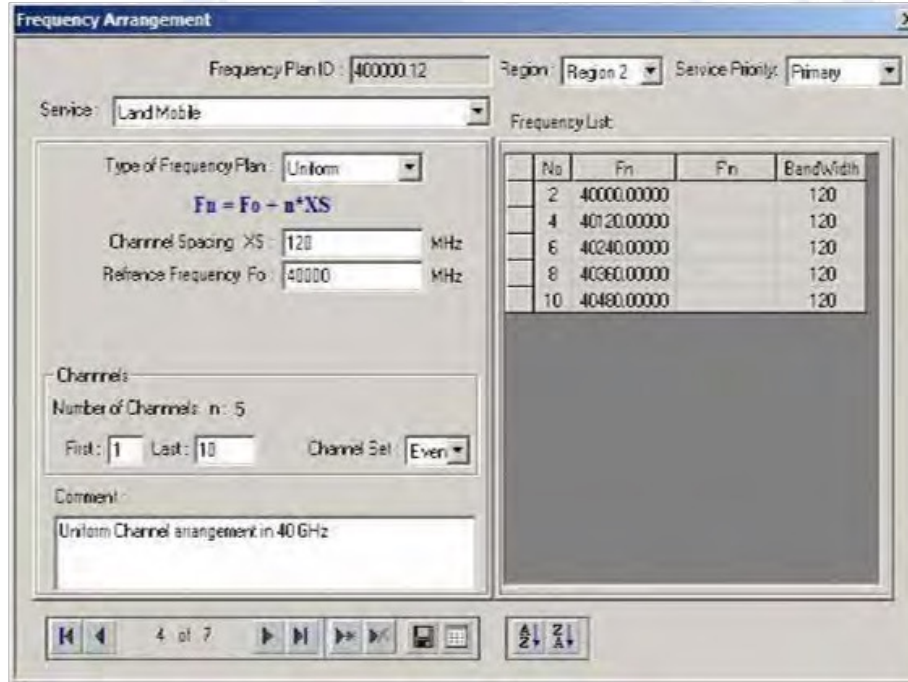
No	F _n	F _{n'}	Bandwidth
1	36988.00000	38248.00000	130
2	37118.00000	38378.00000	130
3	37248.00000	38508.00000	130
4	37378.00000	38638.00000	130
5	37508.00000	38768.00000	130
6	37638.00000	38898.00000	130
7	37768.00000	39028.00000	130
8	37898.00000	39158.00000	130
9	38028.00000	39288.00000	130
10	38158.00000	39418.00000	130
11	38288.00000	39548.00000	130
12	38418.00000	39678.00000	130
13	38548.00000	39808.00000	130
14	38678.00000	39938.00000	130

TYPES OF FREQUENCY ARRANGEMENT IN SMS4DC (2)

UNIFORM CHANNEL ARRANGEMENT:

$$f_n = f_0 + f_{offset} + n \cdot X \text{ MHz},$$

$$n = 0, 1, 2, \dots$$



The screenshot shows the 'Frequency Arrangement' window with the following settings:

- Frequency Plan ID: 40000.12
- Region: Region 2
- Service Priority: Primary
- Service: Land Mobile
- Type of Frequency Plan: Uniform
- Channel Spacing (XS): 120 MHz
- Reference Frequency (Fo): 40000 MHz
- Formula: $F_n = F_0 + n \cdot X$
- Number of Channels: n: 5
- First: 1, Last: 10, Channel Set: Even
- Comment: Uniform Channel arrangement in 40 GHz

No	F _n	F _n	BandWidth
2	40000.00000		120
4	40120.00000		120
6	40240.00000		120
8	40360.00000		120
10	40480.00000		120

TYPES OF FREQUENCY ARRANGEMENT IN SMS4DC (3)

NON-UNIFORM CHANNEL ARRANGEMENT:

Frequency Arrangement

Frequency Plan ID: 50000015 Region: Region 1 Service Priority: Primary

Service: Fixed

Type of Frequency Plan: Non-uniform

Number of Channels: n: 8

Comment: Test2

No	F _n	F _n	BandWidth
1	49000	51000	150
2	49150	51150	150
3	49300	51300	150
4	49450	51450	150
5	49600	51600	150
6	49750	51750	150
7	49900	51900	150
8	50050	52050	150

8 of 7 Add Channel Delete Channel

VHF FREQUENCY CHANNEL ARRANGEMENT 146-174 MHz

Tow Types of channel arrangement

Single-frequency channels for the mobile service

Dual frequency channels for the mobile service

Channel bandwidth in VHF 146-174 MHz systems are 6.25, 8.33, 12.5, 25 kHz

For the band of 146-146.8 , the Single channel arrangement result using SMS4DC is

ID : 20
 Frequency Plan ID : 1460.000025
 Region : 1
 Frequency Band : [146.012 - 146.813] MHz
 Channel Spacing : 0.025 MHz
 RadioCommunication Service : Land Mobile
 Priority : Primary
 Type of Frequency Plan : Uniform
 Comment :

Frequency Unit : MHz

No.	Center Frequency
001	146.025
002	146.05
:	:
031	146.775
032	146.8

The screenshot shows the 'Frequency Arrangement' window with the following details:

- ID: 20, Frequency Plan ID: 1460.000025, Region: Region 1, Service Priority: Primary
- Service: Land Mobile
- Type of Frequency Plan: Uniform
- Formula: $F_n = F_0 + n \cdot \Delta F$
- Channel Spacing ΔF : 0.025 MHz
- Reference Frequency F_0 : 146 MHz
- Number of Channels: n = 32
- Channel Set: All

No	F_n	F_n	Bandwidth
1	146.02500		0.025
2	146.05000		0.025
3	146.07500		0.025
4	146.10000		0.025
5	146.12500		0.025
6	146.15000		0.025
7	146.17500		0.025
8	146.20000		0.025
9	146.22500		0.025
10	146.25000		0.025
11	146.27500		0.025
12	146.30000		0.025
13	146.32500		0.025
14	146.35000		0.025
15	146.37500		0.025



VHF FREQUENCY CHANNEL ARRANGEMENT 146-174 MHz

Tow Types of channel arrangement

Single-frequency channels for the mobile service

Dual frequency channels for the mobile service

Channel bandwidth in VHF 146-174 MHz systems are 6.25, 8.33, 12.5, 25 kHz

For the GO band of 146.8-149.9 and RETURN band of 151.1-154.2 , the channel arrangement result using SMS4DC is

ID : 21
 Frequency Plan ID : 1468.000012
 Region : 1
 Frequency Band : [146.806 - 149.906] MHz [151.406 - 154.506] MHz
 Channel Spacing : 0.0125 MHz
 RadioCommunication Service : Land Mobile
 Priority : Primary
 Type of Frequency Plan : Homogeneous
 Comment :

 Frequency Unit : MHz

No.	Lower Center Frequency	Upper Center Frequency
001	146.813	151.412
002	146.825	151.425
003	146.838	151.438
:	:	:
247	149.888	154.488
248	149.9	154.5

The screenshot shows the 'Frequency Arrangement' window with the following details:

- ID: 21, Frequency Plan ID: 1468.000012, Region: Region 1, Service Priority: Primary
- Service: Land Mobile
- Type of Frequency Plan: Homogeneous
- Equation: $F_n = F_o + F_{off} + n \cdot X_S$, $F_n = F_o + F_{off} + n \cdot X_S$
- Channel Spacing: 0.0125 MHz
- Reference Frequency: 146.8 MHz
- Lower Frequency Offset: 0 MHz
- Upper Frequency Offset: 4.6 MHz
- Number of Channels: 248
- Frequency List table with columns: No, F_n, F_n, Bandwidth



RF CHANNEL ARRANGEMENTS FOR DIGITAL FIXED WIRELESS SYSTEMS OPERATING IN THE 7900 - 8400 MHz BAND(1)

- RF CHANNEL ARRANGEMENT SUITABLE FOR DIGITAL FIXED WIRELESS SYSTEMS WITH A CHANNEL SEPARATION UP TO 28 MHz,

LOWER HALF OF THE BAND:

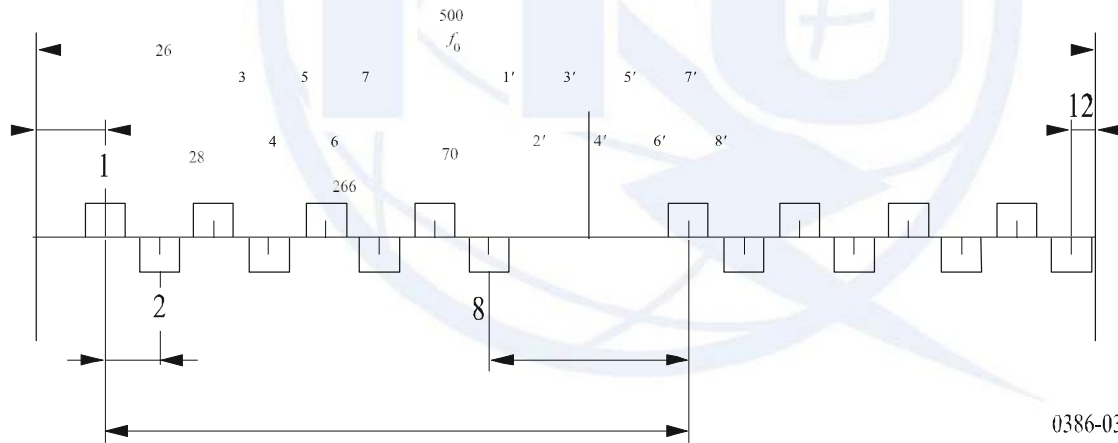
$$F_N = F_0 - 259 + 28 N \text{ MHz}$$

UPPER HALF OF THE BAND:

$$F'_N = F_0 + 7 + 28 N \text{ MHz}$$

WHERE:

$$F_0 = 8150, N = 1, 2, 3, \dots, 8$$





RF CHANNEL ARRANGEMENTS FOR DIGITAL FIXED WIRELESS SYSTEMS OPERATING IN THE 7900 - 8400 MHz BAND (2)

RF channel arrangements for band the 7900 - 8400 MHz band using SMS4DC is

ID : 22
 Frequency Plan ID : 81500.028000
 Region : 1
 Frequency Band : [7905 - 8129] MHz [8171 - 8395] MHz
 Channel Spacing : 28 MHz
 RadioCommunication Service : Fixed
 Priority : Primary
 Type of Frequency Plan : Homogeneous
 Comment :

 Frequency Unit : MHz

No.	Lower Center Frequency	Upper Center Frequency
001	7919	8185
002	7947	8213
006	8059	8325
007	8087	8353
008	8115	8381

Frequency Arrangement

ID : 22 Frequency Plan ID : 81500.028 Region : Region 1 Service Priority : Primary

Service : Fixed

Type of Frequency Plan : Homogeneous

$F_n = F_o + F_{off} + n \cdot X_s$, $F'_n = F_o + F'_{off} + n \cdot X_s$

Channel Spacing X_s : 28 MHz
 Reference Frequency F_o : 8150 MHz
 Lower Frequency Offset F_{off} : -259 MHz
 Upper Frequency Offset F'_{off} : 7 MHz

Channels
 Number of Channels n : 8
 First : 1 Last : 8 Channel Set : All

Comment :

No	F_n	F'_n	Bandwidth
1	7919.00000	8185.00000	28
2	7947.00000	8213.00000	28
3	7975.00000	8241.00000	28
4	8003.00000	8269.00000	28
5	8031.00000	8297.00000	28
6	8059.00000	8325.00000	28
7	8087.00000	8353.00000	28
8	8115.00000	8381.00000	28

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LIST OF FREQUENCY BANDS AND ADOPTED RECOMMENDATIONS

Section	Frequency Band	Frequency band	ITU-R Recommendation or Reports
5.1	800 MHz	790 – 862 MHz	ITU-R M.1036
5.2	2 GHz	2025-2110 MHz//2200-2290 MHz	ITU-R F.1098
5.3	2.6 GHz	2 500 – 2 690 MHz	ITU-R M.1036
5.4	3.5 GHz	3 400 – 3 600 MHz	ITU-R F.1488, Annex 2
5.5	4 GHz	3 600 – 4 200 MHz	ITU-R F.635, Annex 1
	5 GHz	4 400 – 5 000 MHz	ITU-R F.1099, Annex 1
5.7	Lower 6 GHz	5 925 – 6 425 MHz	ITU-R F.383
5.8	Upper 6 GHz	6 425 – 7 110 MHz	ITU-R F.384
5.9	7 GHz (L7 + U7)	7 110 – 7 750 MHz	ITU-R F385, Annex 3
5.10	Lower 8 GHz	7 725 – 8 275 MHz	ITU-R F.386, Annex 6
5.11	Upper 8 GHz	8 275 – 8 500 MHz	ITU-R F.386, Annex 1
5.12	10.5 GHz	10.15-10.3 GHz//10.5-10.65 GHz	ITU-R F.1568, Annex 1
5.13	11 GHz	10.7 – 11.7 GHz	ITU-R F.387
5.14	13 GHz	12.75 – 13.25 GHz	ITU-R F.497
5.15	15 GHz	14.5 – 15.35 GHz	ITU-R F.636
5.16	18 GHz	17.7 – 19.7 GHz	ITU-R F.595, Annex 1
5.17	23 GHz	21.2-23.6 GHz or 22.0-23.6 GHz	ITU-R F.637, Annex 1 ITU-R F.637, Annex 3
5.18	26 GHz	24.5 – 26.5 GHz	ITU-R F.748, Annex 1
5.19	28 GHz	27.5 – 29.5 GHz	ITU-R F.748, Annex 2
5.20	32 GHz	31.8 – 33.4 GHz	ITU-R F.1520, Annex 1
5.21	38 GHz	37.0 – 39.5 GHz	ITU-R F.749 Annex 1



Thank you!

