



**Suruhanjaya Komunikasi dan Multimedia Malaysia**  
*Malaysian Communications and Multimedia Commission*

---

**CONCEPTS AND PROPOSED USAGE OF  
RADIO FREQUENCY SPECTRUM FOR  
EARTH STATIONS COMMUNICATING WITH  
MEASAT SATELLITE NETWORK.**

## **Section 1: Introduction**

In this discussion paper, the Malaysian Communications and Multimedia Commission (MCMC) seeks to invite submissions in relation to the introduction and implementation of fixed satellite services using Measat satellite networks sharing with terrestrial station in fixed service, mobile service and other terrestrial service, in particular the principle of sharing, methodology of assignment and proposed time plan.

## **Section 2: Background and state of usage in Malaysia**

This section contains a brief discussion on the current level of usage of radio frequency spectrum in the fixed satellite services of the above-mentioned band.

## **Section 3: Choice of priorities**

This section discusses the options on the usage and the current practice of assignment of frequencies in the band allocated to fixed satellite service, in particular Measat satellite network.

## **Section 4: Proposed next steps for considerations**

This section discusses the proposed treatment of new application for assignment using specific frequencies planned to be used by Measat-3 satellite network and treatment of existing assignments.

## **Section 5: Efficient resource utilization**

This section discusses the concept of speedy utilization of relevant radio frequency spectrum.

## **Section 6: Conclusion**

## **Section 7: Recommendations**

## **Section 1: Introduction**

1. In this discussion paper, the Malaysian Communications and multimedia Commission (MCMC) seeks to invite submissions in relation to the introduction and implementation of fixed satellite services using Measat satellite networks in particular:
  - (a) the use of radio frequency spectrum in the C-band (including extended C-band) from 5,925 MHz to 6,725 MHz and 3,400 MHz to 4,200 MHz;
  - (b) the use of radio frequency spectrum in the Ku-band 13,750 MHz to 14,450 MHz, 12,200 MHz to 12,750 MHz, 11,450 MHz to 11,700 MHz and 10,950 MHz to 11,200 MHz;
  - (c) the principles under which fixed satellite services co-exist with other primary services (including permitted services);
  - (d) The proposed timeframe for its implementation.

## **Section 2: Background and state of usage in Malaysia**

### **DECISION OF WORLD ADMINISTRATIVE RADIO CONFERENCE 1988**

- 2.1 World Administrative Radio Conference 1988 approved the inclusion of the frequency band between **3400MHz to 3700MHz** and **6425MHz to 6725MHz** as the new allocation for Fixed Satellite Service. This move enable the existing band for Fixed Satellite Service between 3700MHz to 4200MHz and 5925MHz and 6425MHz to be expanded by another 300MHz, thus meeting requirement of user for additional suitable band in the C-band worldwide.

**1. MCMC invites comments on the proposition of the potential of satellite service to meet demand for communication and related needs.**

2.2 Binariang Satellite Systems Sdn Bhd (BSS) first filed their requirement of operating frequencies and orbital slots in 1991 for their Measat network (Measat-1 to Measat-6). These submissions however were modified and expand across the spectrum range of frequencies and areas where the service can be given. These ranges of frequencies are made available in Chapter 3 of Spectrum Plan, as shown in Annex 1.

**Operating Frequency of Measat-1 at orbital slot of 91.5 degree East**

2.3 Currently Measat-1 earth stations have been operating within the standard C-band, and have not encountered any major interference problem with the existing terrestrial microwave network. However, on certain applications, the frequency range is allocated exclusively for earth stations, in order to give the flexibility and convenience of speedy installation and commissioning. Application outside these frequency ranges will be subjected to normal coordination between earth station and terrestrial microwave links, or coordination based on Article 9 of ITU Radio Regulation for coordination with other terrestrial network of other administrations.

2.4 In 2004, except for the backlog application from 2003 or earlier, all new application for fixed service i.e. microwave link and others that intend to use any part of the band 5,925 MHz to

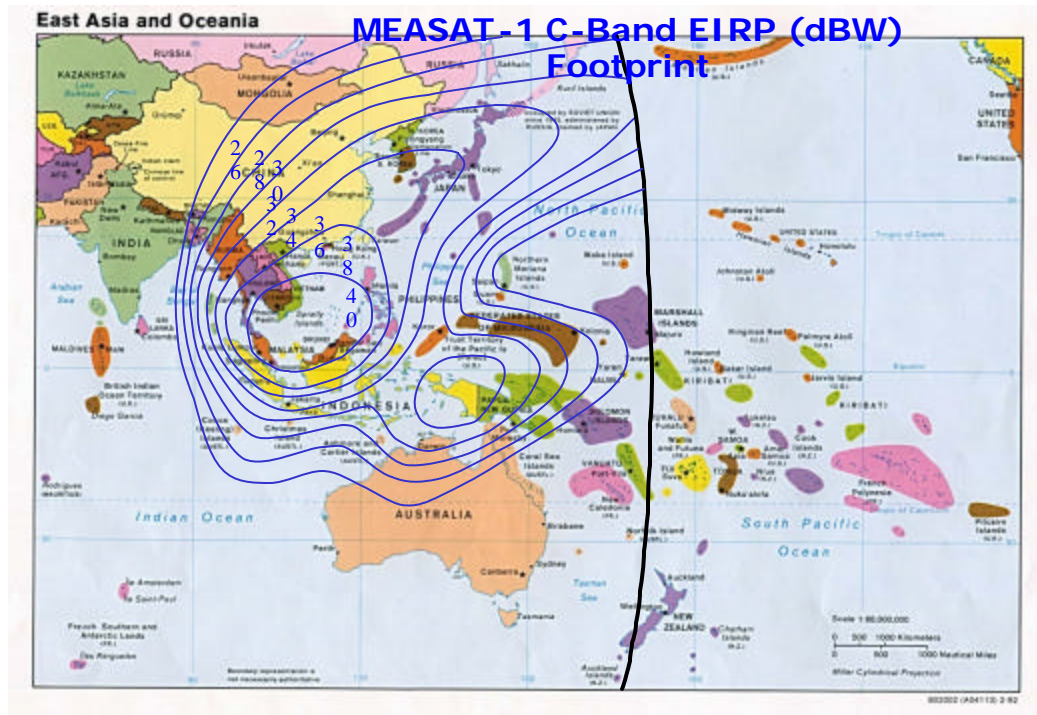
6,425 MHz and 3,700 MHz to 4,200 MHz is referred to higher band. The band 6,175 MHz to 6,425 MHz and 3,950 MHz to 4,200MHz is more less reserved for application of apparatus assignment of satellite earth station communicating with Measat-1. This will eventually prevent potential interference between satellite earth stations and terrestrial microwave link in future.

2.5 This arrangement also gives the flexibility and convenience of speedy installation and commissioning.

MEASAT -1 AT 91.5 DEG EAST			MEASAT -2 AT 148 DEG EAST		
Transponder No	Frequency Range		Transponder No	Frequency Range	
	(MHz)			(MHz)	
1	3702	3738	1C	3704	3776
2	3742	3778			
3	3782	3818	2C	3784	3856
4	3822	3858			
5	3862	3898	3C	3684	3936
6	3902	3938			
7	3942	3978	1	3944	4016
8	3982	4018			
9	4022	4058	2	4024	4096
10	4062	4098			
11	4102	4138	3	4104	4176
12	4142	4178			

2. The MCMC would like to invite comments on the arrangement of frequency band that is exclusively used for earth stations communicating with Measat-1 network.

FIGURE 1

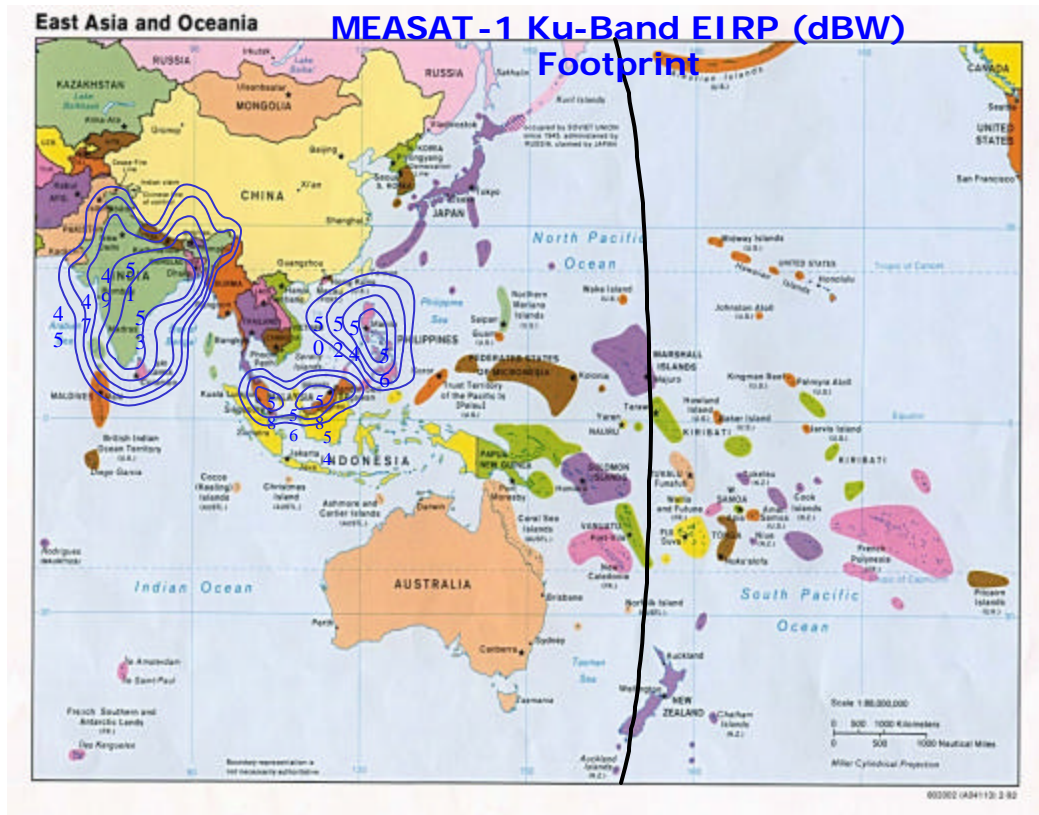


2.5 The entire Ku-band used by Measat-1 is used for transmission of broadcasting content direct to home. In 2004, analyses were carried out on the possibilities of retaining some critical microwave link operating in the band of 10,950 MHz to 11,200 MHz. Because of its height and direction of transmission, six links was allowed to continue operating in part of Ku band, while some others were under investigation of its mean to avoid interfering with Astro receiver. Otherwise, the entire band 10,950 MHz to 11,200 MHz is free from any microwave link.

***3. The MCMC would like to invite comments on the necessity for MCMC to carry out ad-hoc investigation on the possibility of terrestrial station to co-exist in the same area with same frequency band.***

2.6 In 2004, except for the backlog application from 2003 or earlier, all new application for fixed service i.e. microwave link and others that intend to use any part of the band 13,750 MHz to 14,500 MHz is referred to other band. The band 13,750 MHz to 14,000 MHz is more less reserved for application of apparatus assignment of satellite earth station communicating with Measat-1 using Ku-band. Taking into consideration that there will be fewer uplink earth station in this band communicating with Measat-1, some microwaves link are still allowed provided that they give way to new earth stations utilizing these band in future. This will eventually prevent potential interference between satellite earth stations and terrestrial microwave link in future.

FIGURE 2



### Operating Frequency of Measat-2 at orbital slot of 148 degree East

2.7 Currently Measat-2 earth stations have been operating within the standard C-band, and have not encountered any interference problem with the existing terrestrial microwave network. Transponder plan for C-band use a bandwidth of 72 MHz, therefore has different plan compared those employed by Measat-1 as in Table 1.



**TABLE 1**

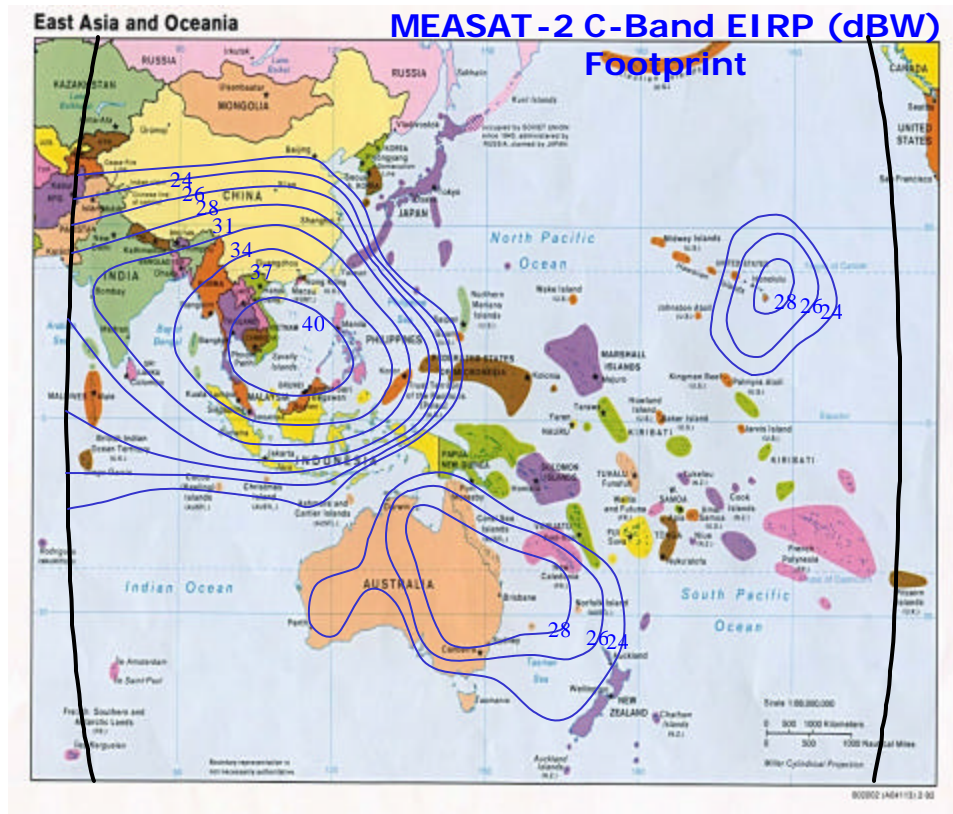
Transponder No	Frequency Range (MHz)		Condition of usage
1c	3704	3776	
2c	3784	3856	Heavily used
3c	3864	3936	Heavily used
1	3944	4016	
2	4024	4096	
3	4104	4176	Heavily used

2.8 In 2004, except for the backlog application from 2003 or earlier, all new application for fixed service i.e. microwave link and others that intend to use any part of the band 5,925 MHz to 6,425 MHz and 3,700 MHz to 4,200 MHz is referred to higher band. The band 5,925 MHz to 6,175 MHz and 3,700 MHz to 3,950 MHz is more less reserved for application of apparatus assignment of satellite earth station communicating with Measat-2. This will eventually prevent potential interference between satellite earth stations and terrestrial microwave link in future, as well as potential interference between satellite earth station communicating with Measat-1 and satellite earth station communicating with Measat-2.

2.9 This arrangement also gives the flexibility and convenience of speedy installation and commissioning.

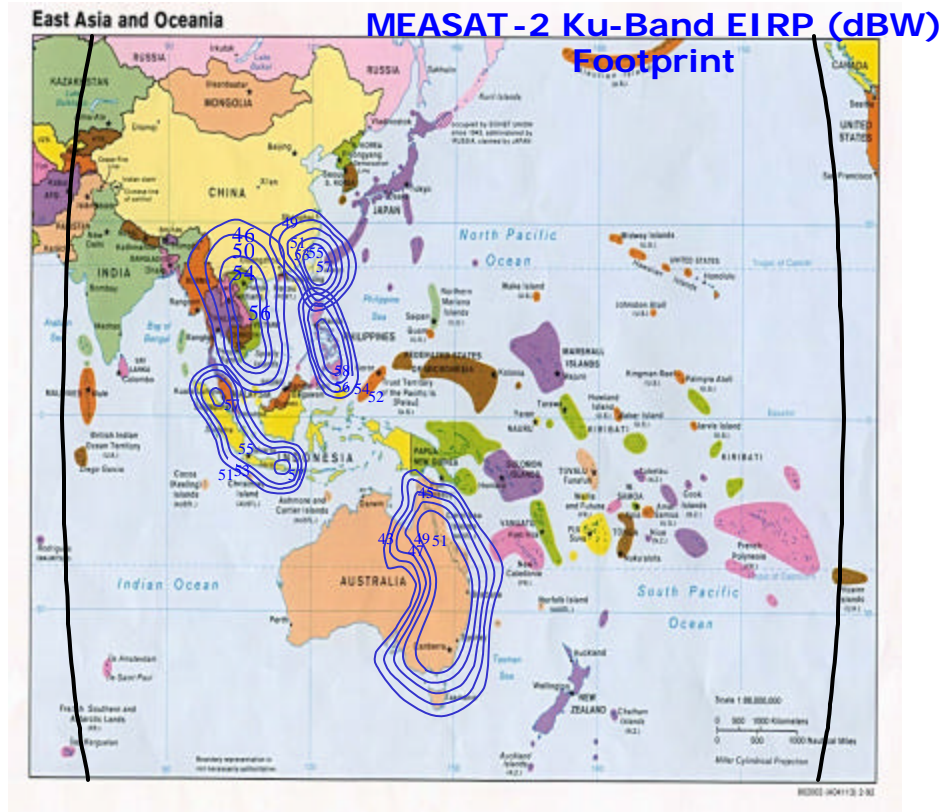
***4. The MCMC would like to invite comments on the arrangement of frequency band that is exclusively used for earth stations communicating with Measat-2 network.***

FIGURE 3



2.10 The Ku-band coverage of Measat-2 is meant to be used by customer outside Malaysia.

**FIGURE 4**



### **MEASAT-3 SATELLITE NETWORK**

2.2. Binariang Satellite System Sdn Bhd, operator of Measat-1 and Measat-2 satellite networks plan to launch their third satellite network in the second quarter 2005. The new satellite network will be co-located with Measat-1 at 91.5 degree East, and will provide additional capacity for the current satellite; and will be the replacement satellite when Measat-1 is taken out of service later on; as well as to provide capacity for restoration of the existing satellite in orbit.

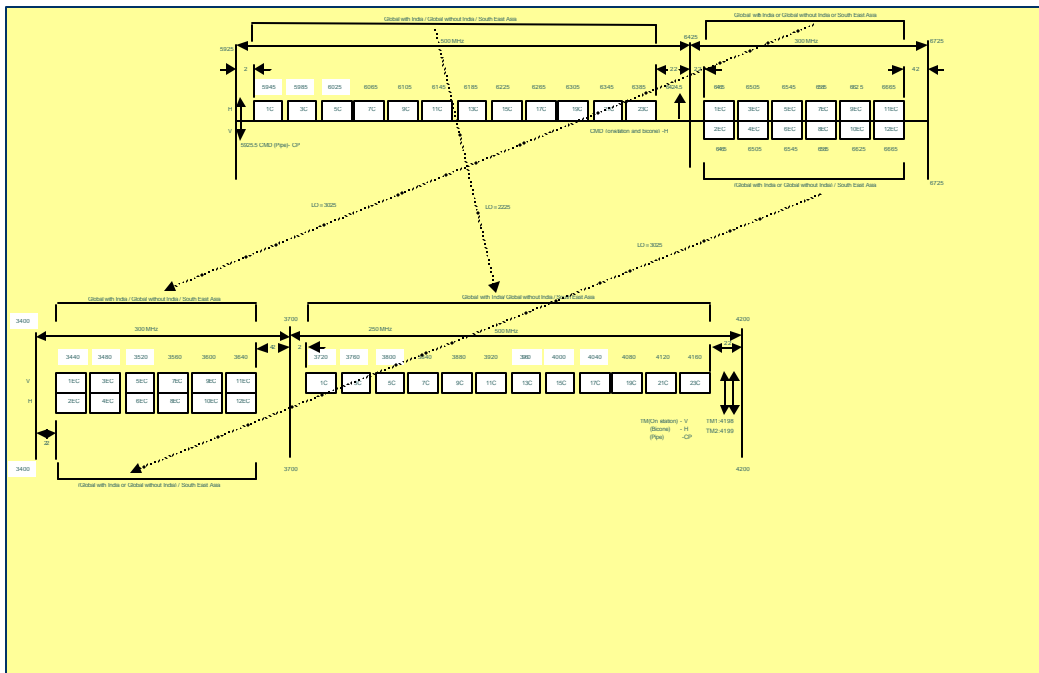
2.3. Frequency Bands filed for MEASAT-3 Satellite Network in the C-band and Ku-band is as in Table 2.

**TABLE 2**

MEASAT Networks	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Type of Service
MEASAT-3	5925-6725	3400-4200	Fixed Satellite
	7900-8400	7250-7750	Fixed Satellite
	13750-14500	10950-11200 11450-11700 12200-12750	Fixed Satellite

2.4 Measat-3 will operate on Ku-band, C-band and also extended C-band. The frequency configuration is as in Table 3 and 4. The coverage area that will use C-band is as shown in Figure 5, 6 and 7 for South East Asia beam, global beam and coverage area that use Ku-band.

**TABLE 3**



**TABLE 4**

<b>MEASAT Networks Polarization</b>	<b>Uplink Frequency (MHz)</b>	<b>Downlink Frequency (MHz)</b>	<b>Area of Service Coverage</b>
Vertical	6,425 – 6,725	3,400 – 4,200	South east Asia including Malaysia
Horizontal	5,925 – 6,725	3,400 – 3,700	South east Asia including Malaysia
Vertical	6,425 – 6,665	3,400 – 4,200	C-Band global without India
Horizontal	5,925 – 6,665	3,400 – 3,700	C-Band global without India
Vertical	6,425 – 6,665	3,400 – 4,200	C-Band global with India
Horizontal	5,925 – 6,665	3,400 – 3,700	C-Band global with India
Vertical	14,250 – 14,500	10,950 – 12,750	Ku-band over Malaysia
Horizontal	13,750 – 14,500	10,950 – 11,700	Ku-band over Malaysia

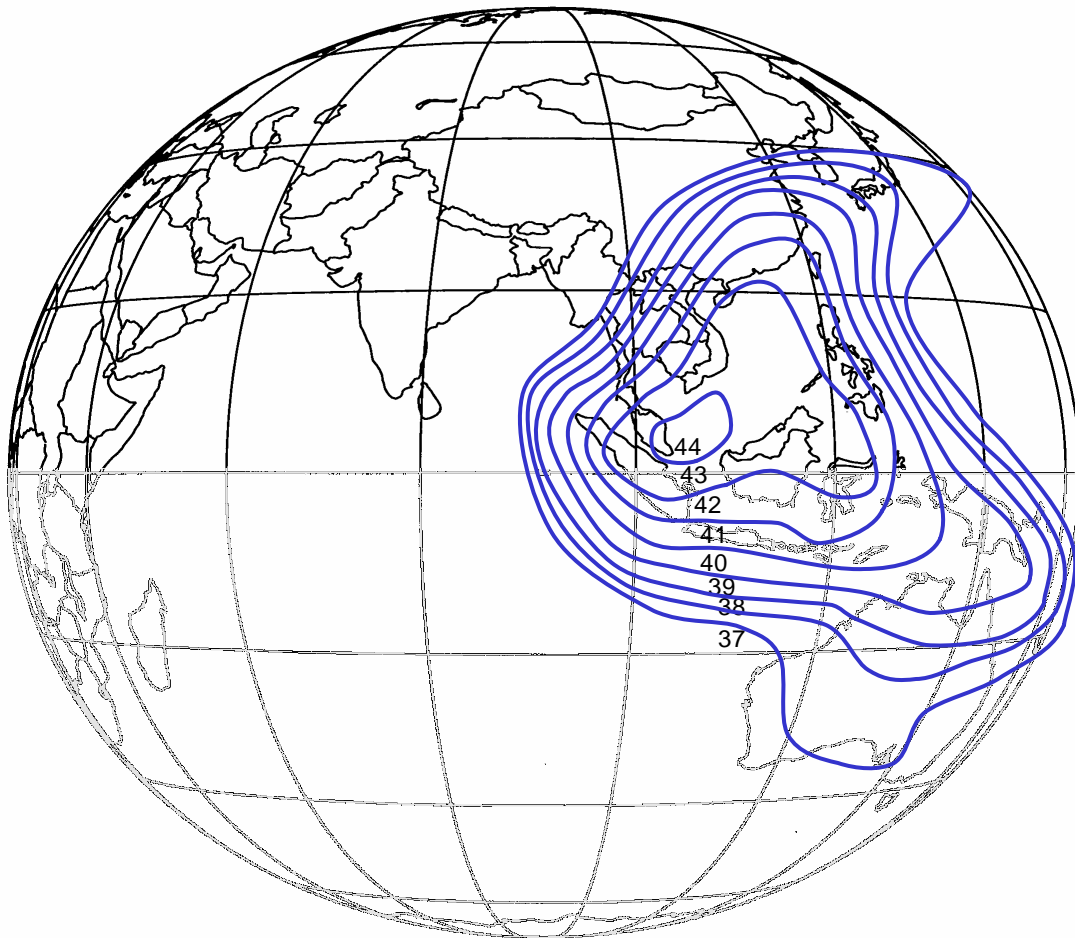
2.5 From the matrix given in Figure 1, it is apparent that not all entire frequency used by Measat-3 will be used over Malaysia by client in Malaysia.

2.6 These extended C-bands are used quite extensively by the terrestrial networks. In the case of frequency band between 3,400 MHz to 3,600 MHz, some frequencies have been assigned for the implementation of Fixed Wireless Access (FWA) systems, and in the case of frequency band between 6,425 MHz to 6,725 MHz, the frequencies are also assigned to the microwave links.

The number of microwave links involved are as shown in the Table-8.

**FIGURE 5**

**MEASAT-3 C-Band EIRP (dBW) SE Asia Footprints**

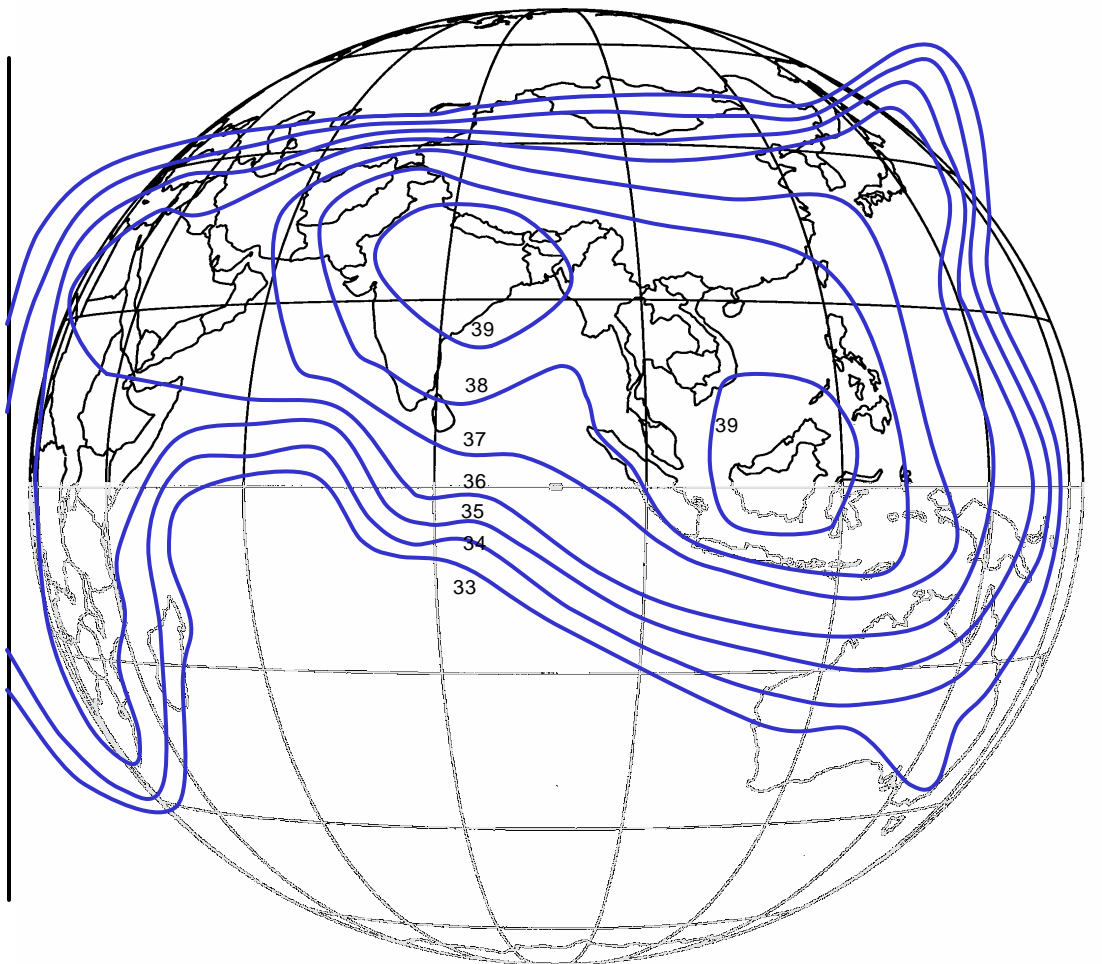


**5. Based on the current situation, the MCMC acknowledges reservation within industry with respect to assignment of microwave station in 6 GHz, and further difficulties of**

*deploying the station to a higher band to accommodate the commissioning of earth station in this band. In this regard, the MCMC would like to invite comments on the most suitable method to be applied for deploying the existing station to a higher band.*

**FIGURE 6**

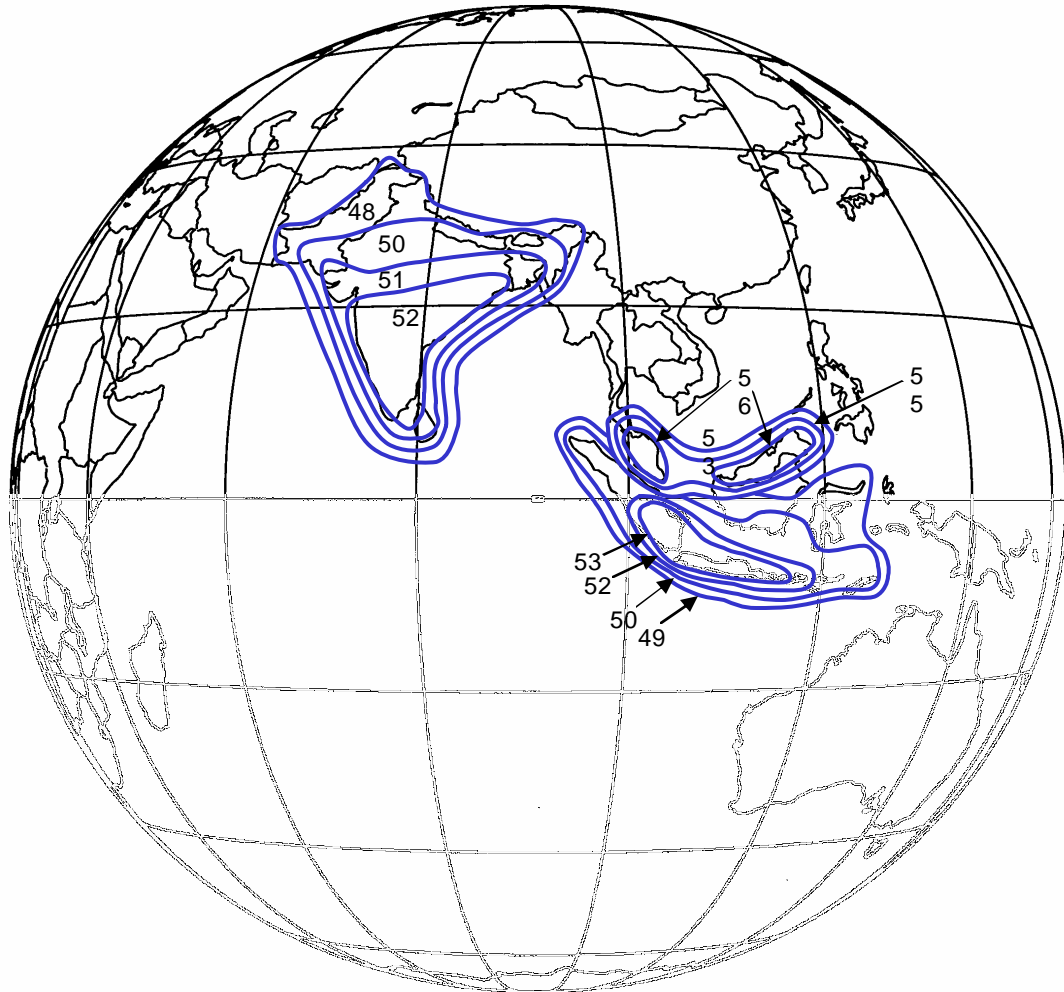
**MEASAT-3 C-Band EIRP (dBW) Global Footprints**





**FIGURE 7**

## **MEASAT-3 Ku-Band EIRP (dBW) Footprints**



2.10 Incidentally, the **immediate** requirement by Binariang Satellite System is for the operation of earth stations for domestic requirement and communication between Malaysia and nearby region. In this case, four transponders are required immediately after the launching of the satellite and another additional



transponder is also required within two years from the launching date. The actual numbers of microwave links involve are as in Table 5.

**TABLE 5**

Frequency range	No of microwave links	Major users
6625 to 6725 MHz	98	Telco
3600 to 3700 MHz	9	Telco

2.10 Measat-3 will also be operating using frequency in the Ku-band. The existing utilization of the Ku-band by microwave links is as in Table 6.

**TABLE 6**

Frequency range	No of microwave links	Major users
13.75 – 14.50 GHz	698	Telco
12.20 – 12.75 GHz	2	Telco
11.45 – 11.70 GHz	available	Telco
10.95 – 11.20 GHz	available	Telco

2.11 Except for certain critical link, the existing microwave links which are using frequencies within the range 10.95 GHz to 11.20 GHz are expected to cease operation completely by end of the year 2004.

**6. Based on the current situation, most links that use 14 GHz band are used in the urban and sub-urban area because of its limitation to be used for long distance application. The MCMC acknowledges reservation within industry with respect to the**

***possibility of using another non-radio alternative or moving up to a higher band. In this regard, the MCMC would like to invite comments on the most suitable method to overcome the possibility of deploying the links to other band.***

### **Section 3: Choice of priorities**

- 3.1 With regard to fixed satellite service, earth station implementation enjoy certain priorities over other terrestrial services, in both direction: earth to space direction because of its high power; and in space to earth direction because of its extremely low receive level, and therefore always susceptible of interference from other source transmission from station in terrestrial service. If the available bandwidth and the frequency band could be identified, it is possible that measures be taken in dealing with existing terrestrial service (including microwave link, last-mile fixed wireless access and radionavigation system). SRSP 507(a) provides suitable guideline on the allocation and choice of priorities over the usage of the band in questions.
- 3.2 SRSP 507(a) provide clearance for fixed satellite service to use about 100MHz immediately in downlink portion of extended C-band. Expansion of requirement in this band requires deployment of other services, particularly last-mile fixed wireless access and microwave link.
- 3.3 SRSP 512 and SRSP 513 provide guidance on the choice of channelling plan to be used by operator of fixed service if they want to use the band 5,925 MHz to 6,425 MHz and 6,430 MHz to 7,110 MHz respectively.

- 3.4 Footnote 5.433 in the Spectrum Plan enable radiolocation service to share the band 3,400 MHz to 3,600 MHz on primary basis and shall cease operation on a date to be decided by MCMC.
- 3.5 Thus, in the case of C-band (including extended-C band), satellite earth stations communicating with Measat network (i.e. Measat-1, Measat-2 and Measat-3) may use all frequencies in the band. Those already dedicated for Measat will be able to be used immediately, and those bands which are shared with stations of other services, the usage will be subject to non-interference basis to satellite earth stations. MCMC will no more accept application for new station of other services (fixed services and radiolocations) to use the C-band (including extended-C band). All existing stations will be subjected to termination process or to be deployed elsewhere.
- 3.6 In order to have orderly implementation of satellite earth station communicating with Measat-1 and Measat-3, frequencies in transponder 7 to transponder 12 will be exclusively used for earth stations communicating with Measat-1 and Measat-3. In addition Measat-3 will be able to use 3,600 MHz to 3,700 MHz immediately, while other requirement will made available in stages.
- 3.7 In order to have orderly implementation of satellite earth station communicating with Measat-2, frequencies in transponder 1c to 3c will be exclusively used for earth stations communicating with Measat-2. Other requirement will made available in stages.
- 3.8 These arrangements will prevent earth stations in Malaysia communicating with Measat-1 and Measat-3 from interfering with Measat-2 and vice-versa. These arrangements will also

enable all earth stations in Malaysia operating frequency band using transponder 7 to transponder 12 communicating with satellite at orbital arc 99 degrees westward and earth stations in Malaysia operating frequency band using transponder 1c to 3c communicating with satellite at orbital arc 109 degrees eastward, from interfering each other.

- 3.9 In Ku-band, the situation is not that critical, since it is only used in Peninsular.

**Section 4: Proposed next steps for considerations**

- 4.1 Based on these requirements, it is proposed that no new applications which utilize these frequency bands within the ranges as mentioned in Table 7 below be accepted.

**TABLE 7**

Frequency band	
C-band	Ku band
6625 to 6725 MHz	14.25 to 14.50 GHz
3600 to 3700 MHz	11.45 to 11.70 GHz
	10.95 to 11.20 GHz

- 4.2 It is proposed that all applications for the microwave links, in the process of issuing Apparatus Assignments shall be continued under the condition that the links shall be removed from service in stages beginning 31<sup>st</sup> March 2005 and to be completely withdrawn from operation by 31<sup>st</sup> December 2008. In between, coordination is required between the implementation of earth stations with the existing terrestrial networks. Otherwise the

commissioning of the above will be approved based on non-interference basis.

4.3 Summary of required range of frequencies, no of terrestrial stations occupying frequencies in these bands and the proposed time plan of deployment of these stations is as in Table 8.

**TABLE 8**

	No of link involved	2004	2005	2006	2007	2008
3400-3600	195					
3600-3700	9	Available	Available	Available	Available	Available
3700-3950	9					Available
3950-4200	84					Available
5925-6175	1194					Available
6175-6425	1030					Available
6425-6625	326					Available
6625-6725	98					Available
10950-11200		Available	Available	Available	Available	Available
11450-11700		Available	Available	Available	Available	Available
12200-12750	2		Available	Available	Available	Available
13750-14000	17		Available	Available	Available	Available
14000-14250	16		Available	Available	Available	Available
14250-14500	665					Available

***7. The MCMC would like to invite comments on the cost implication in the above cleaning process of the band for station operating with Measat satellite network, taking into account that the process is to be carried out in stages over five years.***

## **Section 5: Efficient resource utilization**

5.1 As for the conclusion it is propose that the following actions being taken:

- (a) Spectrum for four (4) transponder will be made available for use by earth stations by second quarter 2005, immediately after the successful launching of Measat-3 at 91.5 degree East;
- (b) 98 terrestrial microwave links in the band 6625 to 6725 MHz and 37 links in the band 3600 to 3700 MHz will be removed from operations in stages beginning 31<sup>st</sup> March 2005 and to be completely withdrawn from operation by 31<sup>st</sup> December 2008. In between, coordination is required between the implementation of earth stations with the existing terrestrial networks. Otherwise the commissioning of the above will be approved based on non-interference basis.
- (c) 665 terrestrial microwave links in the band 14.25GHz to 14.50GHz, will be deployed to other band by 31<sup>st</sup> March 2006.

5.2 Notice will be sent out before the expiry of their apparatus assignment of the microwave links.

5.3 One more transponder in the extended-C band will be made available after two years from date of launching of MEASAT 3.

## **Section 6: Conclusion - PROPOSALS FOR CONSIDERATION**

- 6.1 In introducing new services under fixed satellite service, one has to bear in mind that in some area, fixed satellite service can co-exist with other apparatus operating with the same band of frequencies, while in some other area, apparatus in the fixed satellite service can co-exist, however much coordination can be carried between operators of both services. Therefore, for certain frequency bands, MCMC will not accept any application for new assignment using frequencies that are required to be used for the four transponders of Measat-3 operation;
- 6.2 Notice for the cessation of usage of spectrum by microwave links operating with similar frequencies for four (4) transponder as required for initial operation of Measat-3 will be made before end of this year;
- 6.3 Additional condition of non-interference basis will be added to the apparatus assignment conditions that use the band of Measat-3 which will be on-sharing basis.
- 6.4 Notice for the additional transponder will be added as condition in the apparatus assignment for the respected links.

## **Section 7: Recommendations**

- 7.1 Members of the public are therefore invited to consider and provide comments to the above proposals. The MCMC would also welcome comments on other aspects of this discussion paper where views had not been specially sought.
- 7.2 MCMC proposed to use this discussion paper to facilitate public discussion on the subject of introducing new satellite network to cater for subscriber in Malaysia. Comments in writing

(preferably with soft copy attached) should be provided by 12.00 noon on Monday 1 November 2004, to:

Chairman,  
Malaysian Communications and Multimedia Commission,  
63000 Cyberjaya  
Selangor Darul Ehsan

For the attention of: **Encik Nasaruddin bin Che Abu**  
General Manager,  
Regulatory Division  
[xcband@cmc.gov.my](mailto:xcband@cmc.gov.my)



## ANNEX 1

### 3.5.12 Frequency Bands Filed for MEASAT Satellite Network

MEASAT Networks	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Inter-Satellite Links (MHz)	Type of Service	
MEASAT-1	5925-6725	3400-4200	22550-23550	FSS	
	7900-8400	7250-7750	32000-33000	FSS	
	13750-14500	10950-11200 11450-11700 12200-12750	54250-58200 59000-71000 116000-134000	FSS	
	27000-31000	17700-21200		FSS	
	42500-43500 47200-50200 50400-51400	37500-40500		FSS	
	71000-74000 92000-95000	37500-40500 81000-84000		FSS	
	1626.5-1645.5	1525-1544		Maritime-MSS	
	1656.5-1660.5	1555-1559		Land-MSS	
	5925-6725 13750-14500	1452-1492 2310-2360 2535-2655		DAB	
	47200-49200	40500-42500		BSS	
	27500-30000 24750-25250 18100-18400	21400-22000		HDTV	
	MEASAT-2	5925-6725	3400-4200	22550-23550	FSS
		7900-8400	7250-7750	32000-33000	FSS
13750-14500		10950-11200 11450-11700 12200-12750	54250-58200 59000-71000 116000-134000	FSS	
27000-31000		17700-21200		FSS	
42500-43500 47200-50200 50400-51400		37500-40500		FSS	
71000-74000		37500-40500		FSS	

MEASAT Networks	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Inter-Satellite Links (MHz)	Type of Service
	92000-95000	81000-84000		
	1626.5-1645.5	1525-1544		Maritime-MSS
	1656.5-1660.5	1555-1559		Land-MSS
	5925-6725 13750-14500	1452-1492 2535-2655		DAB
	47200-49200	40500-42500		BSS
	27500-30000 24750-25250 18100-18400	21400-22000		HDTV
MEASAT-3	5925-6725	3400-4200	22550-23550	FSS
	7900-8400	7250-7750	32000-33000	FSS
	13750-14500	10950-11200 11450-11700 12200-12750	54250-58200 59000-64000 116000-134000	FSS
	27000-31000	17700-21200		FSS
	42500-43500 49200-50200 50400-51400	37500-40500		FSS
	71000-74000 92000-95000	37500-40500 81000-84000		FSS
	1626.5-1645.5	1525-1544		Maritime-MSS
	1656.5-1660.5	1555-1559		Land-MSS
	5925-6725 13750-14500	1452-1492 2310-2360 2535-2655		DAB
	27500-30000 24750-25250 18100-18400	21400-22000		HDTV
MEASAT-4	6425-6725	3400-3700	22550-23550	FSS
	7900-8400	7250-7750	32000-33000	FSS
	13750-14500	10950-11200 11450-11700	54250-58200 59000-64000 116000-134000	FSS
	27000-31000	17700-21200		FSS
	42500-43500 49200-50200	37500-40500		FSS

MEASAT Networks	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Inter-Satellite Links (MHz)	Type of Service
	50400-51400			
	71000-74000 92000-95000	37500-40500 81000-84000		FSS
	1626.5- 1645.5	1525-1544		Maritime-MSS
	1656.5- 1660.5	1555-1559		Land-MSS
	5925-6725 13750-14500	1452-1492 2310-2360 2535-2655		DAB
	27500-30000 24750-25250 18100-18400	21400-22000		HDTV
MEASAT-SA1	5925-6725	3400-4200	22550-23550 32000-33000	FSS
	7900-8400	7250-7750	54250-58200	FSS
	13750-14500	10950-11200 11450-11700 11700-12200 12500-12750	59000-71000 116000-134000	FSS
	27000-31000	17700-21200		FSS
	42500-43500 47200-50200 50400-51400	37500-40500		FSS
	71000-74000 92000-95000	37500-40500 81000-84000		FSS
	1626.5- 1645.5	1525-1544		Maritime-MSS
	1656.5- 1660.5	1555-1559		Land-MSS
	5925-6725 13750-14500	1452-1492 2535-2655		DAB
	47200-49200	40500-42500		BSS
	27500-30000 18100-18400	21400-22000		HDTV
MEASAT-SA2	5925-6725	3400-4200	22550-23550 32000-33000	FSS
	7900-8400	7250-7750	54250-58200	FSS
	13750-14500	10950-11200 11450-11700 11700-12200	59000-64000 116000-134000	FSS

MEASAT Networks	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Inter-Satellite Links (MHz)	Type of Service
		12200-12750		
	27000-31000	17700-21200		FSS
	42500-43500 49200-50200 50400-51400	37500-40500		FSS
	71000-74000 92000-95000	37500-40500 81000-84000		FSS
	1626.5-1645.5	1525-1544		Maritime-MSS
	1656.5-1660.5	1555-1559		Land-MSS
	5925-6725 13750-14500	1452-1492 2535-2655		DAB
	27500-30000 18100-18400	21400-22000		HDTV
MEASAT-SA3	5925-6725	3400-4200	22550-23550 32000-33000	FSS
	7900-8400	7250-7750	54250-58200	FSS
	13750-14500	10950-11200 11450-11700 12200-12500	59000-64000 116000-134000	FSS
	27000-31000	17700-21200		FSS
	42500-43500 49200-50200 50400-51400	37500-40500		FSS
	71000-74000 92000-95000	37500-40500 81000-84000		FSS
	1626.5-1645.5	1525-1544		Maritime-MSS
	1656.5-1660.5	1555-1559		Land-MSS
	5925-6725 13750-14500	1452-1492 2310-2360 2535-2655		DAB
	27500-30000 18100-18400	21400-22000		HDTV
MEASAT-SA4	5925-6725	3400-4200	22550-23550 32000-33000	FSS
	7900-8400	7250-7750	54250-58200	FSS
	13750-14500	10950-11200 11450-11700 12200-12500	59000-64000 116000-134000	FSS

MEASAT Networks	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Inter-Satellite Links (MHz)	Type of Service
	27000-31000	17700-21200		FSS
	42500-43500 49200-50200 50400-51400	37500-40500		FSS
	71000-74000 92000-95000	37500-40500 81000-84000		FSS
	1626.5-1645.5	1525-1544		Maritime-MSS
	1656.5-1660.5	1555-1559		Land-MSS
	5925-6725 13750-14500	1452-1492 2310-2360 2535-2655		DAB
	27500-30000 18100-18400	21400-22000		HDTV
MEASAT-LA1	5925-6725	3400-4200	22550-23550 32000-33000	FSS
	7900-8400	7250-7750	54250-58200	FSS
	13750-14500	10950-11200 11450-11700 11700-12200	59000-71000 116000-134000	FSS
	27000-31000	17700-21200		FSS
	42500-43500 47200-50200 50400-51400	37500-40500		FSS
	71000-74000 92000-95000	37500-40500 81000-84000		FSS
	1626.5-1645.5	1525-1544		Maritime-MSS
	1656.5-1660.5	1555-1559		Land-MSS
	5925-6725 13750-14500	1452-1492 2310-2360 2535-2655		DAB
	47200-49200	40500-42500		BSS
	24750-25250 27500-30000 18100-18400	17300-17800		HDTV