AUCTION OF PUBLIC CELLULAR MOBILE TELECOMMUNICATION SERVICES SPECTRUM RIGHTS

APPENDIX 6 – ILLUSTRATIONS

18 JANUARY 2008 INFO-COMMUNICATIONS DEVELOPMENT AUTHORITY OF SINGAPORE

ILLUSTRATIONS

This Appendix 6 - Illustrations is provided as an example and solely for illustration purposes. Neither IDA nor any of its officers or employees or its advisers makes any representation nor warranty (express or implied) nor accepts nor will accept any responsibility or liability whatsoever as to, or in relation to, any errors or inaccuracies resulting from reference to this appendix.

This Appendix provides examples to illustrate the following:

- a) The determination as to whether the Auction proceeds, based on Section 2.6 of the Auction Rules; and
- b) The Clock Auction process, based on Section 7 of the Auction Rules
- c) The Assignment Stage process, based on Section 10 of the Auction Rules

Part I : Determination as to whether Auction is to proceed.

The following three scenarios illustrate how IDA will determine whether the Auction will proceed, based on the Bidders' Initial Offers. In each scenario, assume there are four Bidders, A, B, C and D.

Scenario A1: Auction does not proceed as there is no more than one First Initial Offer for each of the eighteen PCMTS Spectrum Lots. ("X" indicates the PCMTS Spectrum Lot(s) that a Bidder has specified in its First Initial Offer Document). The Bidders are allocated the PCMTS Spectrum Lots which they made First Initial Offers for, at the Reserve Price.

Number of	Paired		Bidders' Initial Offers		fers	
Spectrum Lot	Lower band (MHz)	Upper Band (MHz)	A	В	С	D
	EGSM Lot					
1	885 - 890	930 – 935	Х			
		900 MHz Lots				
2	890 – 895	935 – 940		Х		
3	895 – 900	940 – 945		Х		
4	900 – 905	945 – 950			Х	
5	905 – 910	950 – 955			Х	
6	910 – 915	955 - 960			Х	
		1800 MHz Lots	5			
7	1710 – 1715	1805 - 1810	Х			
8	1715 – 1720	1810 – 1815	Х			
9	1720 – 1725	1815 – 1820	Х			
10	1725 – 1730	1820 – 1825		Х		
11	1740 – 1745	1835 – 1840		Х		
12	1745 – 1750	1840 – 1845		Х		
13	1750 – 1755	1845 – 1850			Х	
14	1755 – 1760	1850 – 1855			Х	
15	1760 – 1765	1855 – 1860				Х
16	1765 – 1770	1860 – 1865				Х
17	1770 – 1775	1865 – 1870				Х
18	1775 – 1780	1870 – 1875				Х

Scenario A2: Auction of all eighteen PCMTS Spectrum Lots proceeds with the Clock Auction, as there is excess demand in at least one category of PCMTS Spectrum Lots. In this example, there are six Initial Offers for the five 900MHz Lots.

Number of	Paired		Bio	ders' l	nitial Of	fers	
Spectrum Lot	Lower band (MHz)	Upper Band (MHz)	Α	В	С	D	
	EGSM Lot						
1	885 - 890	930 - 935	Х				
		900 MHz Lots					
2	890 - 895	935 – 940		X			
3	895 – 900	940 - 945		X			
4	900 – 905	945 – 950		X	Х		
5	905 – 910	950 – 955			Х		
6	910 – 915	955 - 960			Х		
		1800 MHz Lots	5				
7	1710 – 1715	1805 - 1810	Х				
8	1715 – 1720	1810 – 1815	Х				
9	1720 – 1725	1815 – 1820	Х				
10	1725 – 1730	1820 – 1825		Х			
11	1740 – 1745	1835 – 1840		Х			
12	1745 – 1750	1840 – 1845		Х			
13	1750 – 1755	1845 – 1850			Х		
14	1755 – 1760	1850 – 1855			Х		
15	1760 – 1765	1855 – 1860				Х	
16	1765 – 1770	1860 – 1865				Х	
17	1770 – 1775	1865 – 1870				Х	
18	1775 – 1780	1870 – 1875				Х	

Scenario A3: Auction proceeds with the Assignment Stage without conducting the Clock Auction as there is no excess demand in any category of PCMTS Spectrum Lots, but more than one Initial Offer for a specific Lot (Lot 14, in this example).

Number of	umber of Paired		Bio	ders' l	nitial Of	fers	
Spectrum Lot	Lower band (MHz)	Upper Band (MHz)	Α	В	С	D	
	EGSM Lot						
1	885 – 890	930 – 935	Х				
		900 MHz Lots					
2	890 – 895	935 – 940		Х			
3	895 – 900	940 – 945		Х			
4	900 – 905	945 – 950			Х		
5	905 – 910	950 – 955			Х		
6	910 – 915	955 - 960			Х		
		1800 MHz Lots	5				
7	1710 – 1715	1805 - 1810	Х				
8	1715 – 1720	1810 – 1815	Х				
9	1720 – 1725	1815 – 1820	Х				
10	1725 – 1730	1820 – 1825		Х			
11	1740 – 1745	1835 – 1840		Х			
12	1745 – 1750	1840 – 1845		Х			
13	1750 – 1755	1845 – 1850			Х		
14	1755 – 1760	1850 – 1855			X	X	
15	1760 – 1765	1855 – 1860				Х	
16	1765 – 1770	1860 – 1865				Х	
17	1770 – 1775	1865 – 1870				Х	
18	1775 – 1780	1870 – 1875					

Part II: Conduct of Clock Auction

This illustration of the Clock Auction process proceeds based on Scenario A2 in Part I. At the start of the Clock Auction (ie. the Start-of-Round Prices of Round 1), the Bidder's demand is deemed to be equal to the number of lots that the Bidder made Initial Offers for in each category of PCMTS Spectrum Lots in the Bidder's First Initial Offer Document. This is shown in Table 1 below.

Round 1	EGSM	900 MHz	1800 MHz
Bidder A	1	0	3
Bidder B	0	3	3
Bidder C	0	3	2
Bidder D	0	0	4

Table 1: Bidder's Demand at the start of the Clock Auction

Round 1

Table 2 shows the Start-of-Round and End-of-Round prices for Round 1. For the first round, the Start-of-Round Price is equal to the Reserve Price. For the EGSM and 1800 MHz Rounds, as there is no excess demand for the PCMTS Spectrum Lots in these categories at the start of the Auction, the End of Round Price has been set equal to the Start-of-Round price for this case.

Table 2 : Round 1 Prices

Round 1	EGSM	900 MHz	1800 MHz	
Start-of-Round	\$300,000	\$300,000	\$300,000	
End-of-Round	\$300,000	\$350,000	\$300,000	

Table 3 shows the bids made by each Bidder for Round 1. For simplicity, in this Round, every Bidder's Entire Bid comprises of just one Bid:

Round 1	Price Point		Bid	
		EGSM	900 MHz	1800 MHz
Bidder A	100.00%	1	0	3
Bidder B	50.00%	1	2	3
Bidder C	100.00%	0	3	2
Bidder D	100.00%	0	0	4

Table 3: Round 1 Bids

Based on the bids submitted, Bidders A, C and D hold their demand constant for the whole Round. Bidder B maintains its demand, as expressed in its Initial Offer, until the 49.99% Price Point. At the 50.00% Price Point, which corresponds to prices (\$300000, \$325000, \$300000)¹ for (EGSM, 900MHz,1800MHz)

¹ For the 900MHz Lots, the price at the 50% Price Point = $50\% \times $350,000 + (1-50\%) \times $300,000$. For the 1800MHz Lots and EGSM Lots, the price at the 50% Price Point = $50\% \times $300,000 + (1-50\%) \times $300,000$.

respectively, Bidder B switches, by one Lot, its demand for 900 MHz to EGSM.² Diagram 1 shows the aggregate demand for Round 1:



At the End of Round Price, the aggregate demand for EGSM Lots is 2 Lots. This exceeds the supply. Hence the Clock Auction proceeds to the next Round.

Round 2

Table 4 shows the Start-of-Round and End-of-Round prices for Round 2. The Start-of-Round Prices equal the End-of-Round Prices in Round 1.

Table 4. Round 2 Frices				
Round 2	EGSM	900 MHz	1800 MHz	
Start-of-Round	\$300,000	\$350,000	\$300,000	
End-of-Round	\$360,000	\$350,000	\$300,000	

Table 4 : Round 2 Prices

Table 5 shows the bids made by each bidder for Round 2:

Round 1	Price Point	Bid		
		EGSM	900 MHz	1800 MHz
Bidder A	80.00%	0	0	4
Bidder B	95.00%	0	3	3
Bidder C	100.00%	0	3	2
Bidder D	100.00%	0	0	4

Table 5: Round 2 Bids

² Note that the total number of PCMTS Spectrum Lots demanded by Bidder B remains at 6.

Bidder A maintains its demand, as at the end of Round 1, until the 79.99% Price Point. At the 80.00% Price Point, Bidder A stops demanding the EGSM Lot, and instead switches to demanding one more 1800 MHz Lot.

Bidder B maintains its demand, as at the end of Round 1, until the 94.99% Price Point. At the 95.00% Price Point, Bidder B stops demanding the EGSM Lot, and instead switches to demanding one more 900 MHz Lot.

Bidders C and D hold their demand constant for the whole Round.



Diagram 2 shows the aggregate demand in Round 2.

There is now excess demand for both the 900 MHz and 1800 MHz Lots at the End-of-Round Prices. Hence the Clock Auction proceeds to the next Round.

Round 3

Table 6 shows the Start-of-Round and End-of-Round prices for Round 3. The Start-of-Round Prices equal the End-of-Round Prices in Round 2.

Table 6. Round 3 Filles				
Round 2	EGSM	900 MHz	1800 MHz	
Start-of-Round	\$360,000	\$350,000	\$300,000	
End-of-Round	\$360,000	\$370,000	\$350,000	

Table 6: Round 3 Prices

Table 7 shows the bids made by each bidder for Round 3:

Table 7

Round 1	Price Point	Bid		
		EGSM	900 MHz	1800 MHz
Bidder A	20.00%*	0	1	3

	50.00%*	1	0	3
	*Bidder A has submitted 2 Bids for its Entire Bid in this Round			
Bidder B	60.00%	0	2	3
Bidder C	90.00%	0	2	2
Bidder D	100.00%	0	0	4

Bidder A's Entire Bid consists of 2 bids. It maintains its demand, as at the end of Round 2, until the 19.99% Price Point. At the 20.00% Price Point, Bidder A reduces its demand for 1800MHz Lots by one lot, and switches to demanding one more 900 MHz lot. This demand holds until the 49.99% Price point. At the 50.00% Price point, Bidder A switches its demand for one 900 MHz Lot to one EGSM Lot.

Bidder B maintains its demand, as at the end of Round 2, until the 59.99% Price Point. At the 60.00% Price Point, Bidder B reduces its demand for 900 MHz Lots by one Lot. It should be noted that at this point, Bidder B's total demand for PCMTS Spectrum Lots has reduced from six to five. The maximum number of PCMTS Spectrum Lots that Bidder B may subsequently bid for in subsequent Rounds should the Clock Auction proceed further (or at higher Price Points in the current Round) would be capped at five.

Bidder C maintains its demand, as at the end of Round 2, until the 89.99% Price Point. At the 90.00% Price Point, Bidder C reduces its demand for 900 MHz Lots by one Lot. This implies a decrease in its overall demand from five to four PCMTS Spectrum Lots.

Bidder D keeps its demand unchanged.



The Clock Auction closes at the 60% Price Point, as this is the first point where there is no excess demand in any category. The results of the Clock Auction are as follows:

Table	8:
-------	----

	EGSM	900 MHz	1800 MHz	
Closing	60% x \$360,000 +	60% x \$370,000 +	60% x \$350,000 +	
Clock	(1-60%)x \$360,000	(1-60%)x \$350,000	(1-60%)x \$300,000	
Prices	= \$360,000	= \$362,000	= \$330,000	
	Eligibility Points			
Bidder A	1	0	3	
Bidder B	0	2	3	
Bidder C	0	3	2	
Bidder D	0	0	4	

Part III: Assignment Stage

This illustration of the Assignment stage process proceeds based on Scenario A2 in Part I and the Clock Auction example in Part II.

Exercise of First Rights of Refusal

Assume that A is a new entrant, while Bidders B, C and D may possibly exercise First Rights of Refusal ("**FROR**") in respect of the following PCMTS Spectrum Lots:

Table 1

Biddor	900 MHz	1800 MH 7
Diduei	900 IVII 12	
В	Lots 2 & 3	Lots 10,11 & 12
С	Lots 5 & 6	Lots 13 & 14
D	Nil	Lots 15,16,17,18

In this case, the number of Eligibility Points that Bidders B, C and D have respectively is equal to or more than the number of FROR that they may possibly in each category.

Scenario B1:

Bidders B, C and D each exercise all their FROR, and their Eligibility Points are reduced accordingly. Table 2 shows the number of PCMTS Spectrum Lots remaining, as well as the Bidders remaining Eligibility Points after the FRORs are exercised.

	EGSM	900 MHz	1800 MHz
Lots remaining	Lot 1	Lot 4	Lots 7,8,9
		Eligibility Poi	nts
Bidder A	1	0	3
Bidder B	0	0	0
Bidder C	0	1	0
Bidder D	0	0	0

Table 2:

In this scenario, in each category, there is only one Bidder with Eligibility Points remaining, and the Bidder's Eligibility Points equals the number of Lots remaining in that category. The remaining PCMTS Spectrum Lots are thus allocated to the Bidder with the Eligibility Point(s) in that category.

The Auction closes since all PCMTS Spectrum Lots have been allocated. Table 3 summarises the result

Та	ble	3:
	210	۰.

Number of Peace Veer		Allocation				
Spectrum Lot	Base Year Charge (\$)	A	В	С	D	
1	360,000	Х				
2	362,000		Х			
3	362,000		Х			
4	362,000			Х		
5	362,000			Х		
6	362,000			Х		
7	330,000	Х				
8	330,000	Х				
9	330,000	Х				
10	330,000		Х			
11	330,000		Х			
12	330,000		Х			
13	330,000			Х		
14	330,000			Х		
15	330,000				X	
16	330,000				Х	
17	330,000				Х	
18	330,000				Х	

Scenario B2:

Bidder B exercises its FROR for PCMTS Spectrum Lots 2, 3 10 and 11, leaving it with one remaining Eligibility Point in the 1800 MHz category

Bidders C and D exercise all their FROR, and their Eligibility Points are reduced accordingly.

Table 4 shows the number of PCMTS Spectrum Lots remaining, as well as the Bidders remaining Eligibility Points after the FRORs are exercised.

Та	b	le	4
īα			Τ.

	EGSM	900 MHz	1800 MHz
Lots remaining	Lot 1	Lot 4	Lots 7,8,9,12
		Eligibility Poir	nts
Bidder A	1	0	3
Bidder B	0	0	1
Bidder C	0	1	0
Bidder D	0	0	0

In this scenario, for the EGSM and 900 MHz Lots, there is only one Bidder with Eligibility Points remaining, and the Bidders' Eligibility Points equal the number of Lots remaining. The EGSM and 900 MHz Lots are thus allocated to the Bidders with the Eligibility Point(s) in that category.

However, for the four 1800 MHz Lots remaining, both Bidder A and B have Eligibility Points in that category. Hence the Auction proceeds to the Second Initial Offer for the 1800 MHz Lots

Second Initial Offer

This illustration of the Second Initial Offer Phase is based on Scenario B2 of the Exercise of FROR.

Scenario C1: Sealed-Bid Combinatorial Auction does not proceed as there is no more than one Second Initial Offer for each of the four available 1800MHz Lots. ("X" indicates the PCMTS Spectrum Lot(s) that a Bidder has specified in its Second Initial Offer Document). The four 1800 MHz Lots are allocated to Bidders A and B according to the Second Initial Offers, at the Closing Clock Prices.

Table 5	

Number of	Second Initial Offer		
Spectrum Lot	A	В	
7	Х		
8	Х		
9		Х	

|--|

Scenario C2: Sealed-Bid Combinatorial Auction proceeds as there is more than one Second Initial Offer for at least one of the four available 1800MHz Lots (Lot 9 in this example).

Table 6

Number of	Second Initial Offer		
Spectrum Lot	Α	В	
7	Х		
8	Х		
9	X	X	
12			

Sealed Bid Combinatorial Auction

This illustration of the Sealed bid Combinatorial Auction is based on Scenario C2 of the Second Initial Offer Phase.

Based on the Closing Clock Prices of \$330,000 (see Table 8 of Part II) for each 1800 MHz Lot, Bidder A's Base Price is \$990,000 while Bidder B's Base Price is \$330,000.

The Bidders' Combinatorial Bids are shown below:

Table	7:	Bidder	A's	Bids
-------	----	--------	-----	------

Allowable Combination	Lots	Bid
A1	7,8,9	\$30,000
A2	7,8,12	\$10,000
A3	7,9,12	0
A4	8,9,12	\$10,000

Table 8: Bidder B's Bids

Allowable Combination	Lots	Bid
B1	7	\$0
B2	8	\$0
B3	9	\$10,000
B4	12	\$0

Based on the above Combinatorial Bids, the winning combination Combinatorial Bids is A1+B4, as this combination gives rise to the highest total value, as shown in Table 9

Table 9	
Feasible selection of Combinatorial Bids	Total value
A1 + B4	\$30,000
A2 + B3	\$20,000
A3 + B2	\$0
A4 + B1	\$10,000

Table 10 shows the result of the Sealed Bid Combinatorial Auction and the Base Year Charge for each lot that was allocated through the Sealed Bid Combinatorial Auction.

Table 10: Result of Sealed Bid Combinatorial Auction

Bidder	Lots	Base Year Charge of each lot
А	7,8,9	\$330,000 + (\$30,000 / 3) = \$340,000
В	12	\$330,000 + \$0 = \$330,000