

Spectrum Auctions  
in India  
Key Learnings  
&  
Way Forward

Parag Kar

# Outline

- Auction
  - Past Experiences
  - Key Issues
- Pricing Model
  - 4G Spectrum
  - 5G Spectrum

# **Auctions: Past Experiences**

## Key Issues- Summary

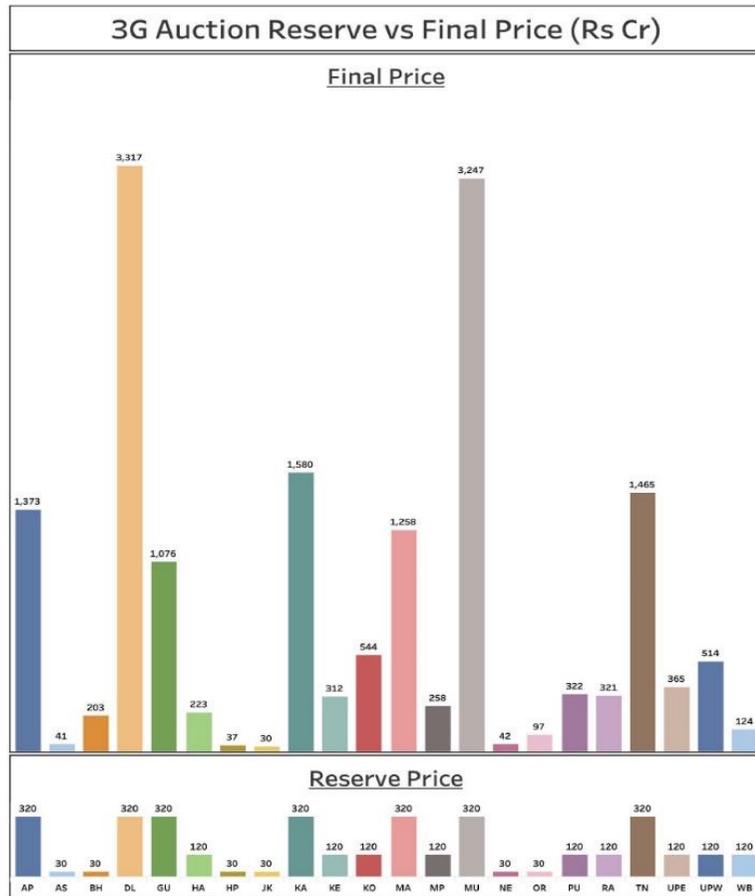
- Auction Prices Do Not reflect the true Value of spectrum
- Auction Prices reflect the value to preserve market Competitiveness
- Auction can be leveraged by incumbents to create barrier to entry
- Auction prices have no correlation with the revenue potential of a circle
- Auction prices of similar bands are significantly different
- Auction prices are linked with operator's needs to protect investments

Therefore, Auction Prices SHOULD NOT be used as the ONLY METRIC for Setting Reserve Price

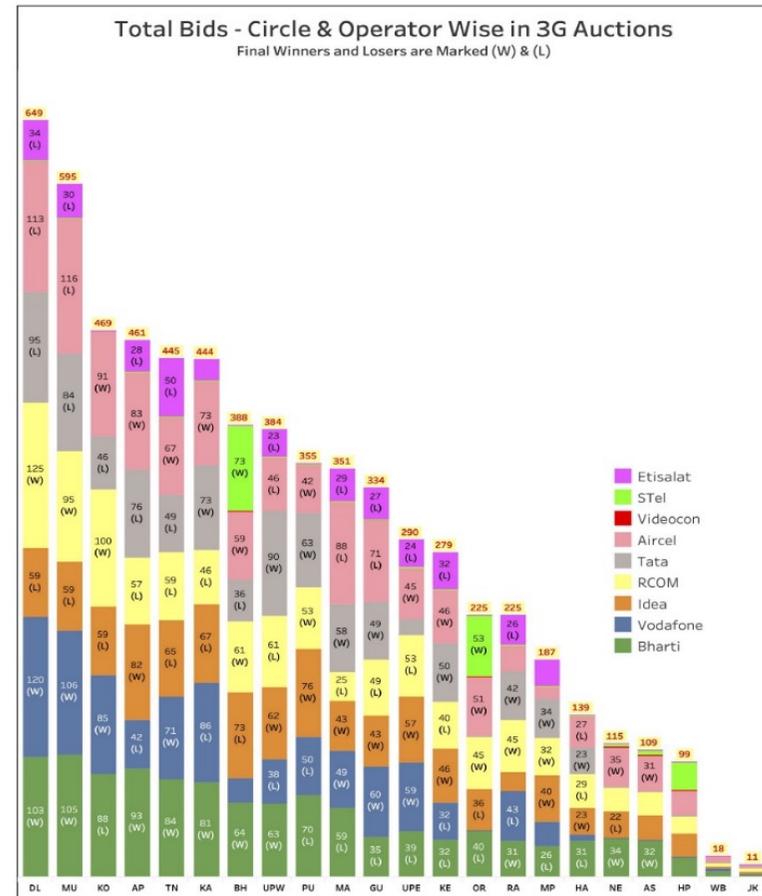
# 3G Auction Background

- 27<sup>th</sup> Sept 2006 – TRAI Recommended Reserve Price (2 x 5 MHz)
  - Delhi, Mumbai & Cat “A” – Rs 80 Cr (4<sup>th</sup> Cellular Entry Fee - Rs 143.69 Cr )
  - Chennai, Kolkata & Cat “B” – Rs 40 Cr (4<sup>th</sup> Cellular Entry Fee – Rs 47.74 Cr)
  - Cat “C” – Rs 15 Cr (4<sup>th</sup> Cellular Entry Fee – Rs 4.33 Cr)
  - **Pan India – Rs 1050 Cr** (4<sup>th</sup> Cellular Entry Fee – Rs 1633 Cr)
- 19<sup>th</sup> Oct 2007 – LOI for Dual Tech Issued to RCOM
- 10<sup>th</sup> Jan 2008 – LOI Issued to New UASL Operators
- 1<sup>st</sup> Aug 2008 – DoT Formally Announced Auction Guidelines
- 22<sup>nd</sup> May 2009 – MOU with Defense (Only 3 Slots Got Released)
- 9<sup>th</sup> April 2010 – 3G Auction Started
- 19<sup>th</sup> May 2010 – 3G Auction Ended

# 3G Auction Highlights (2010)



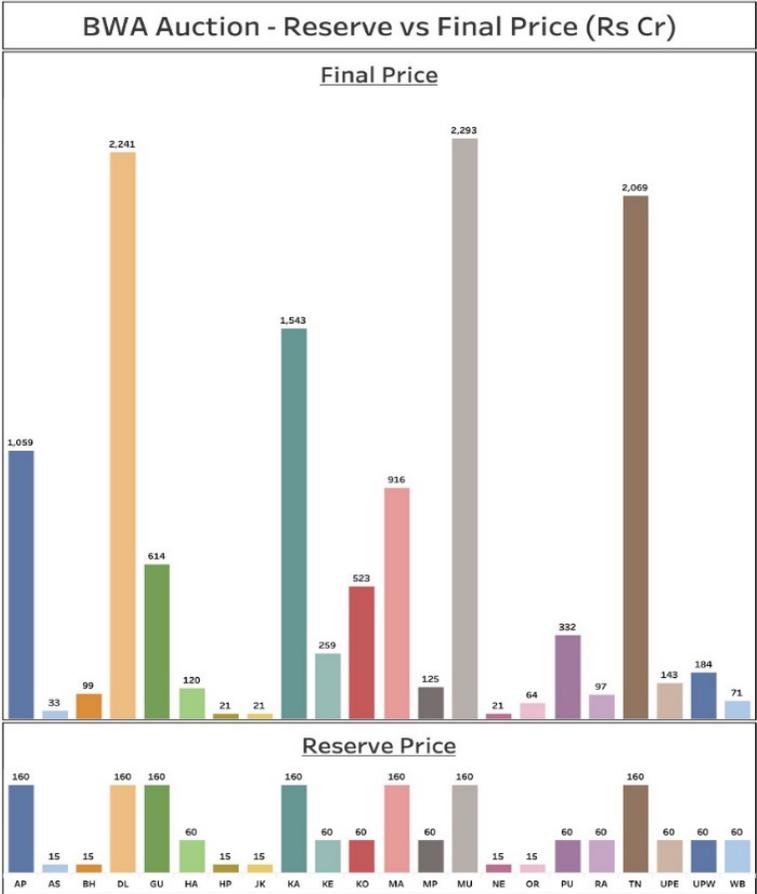
Final Price Increased 4.7 Times the Reserve Price  
 Delhi & Mumbai Increased 10 Times the Reserve Price



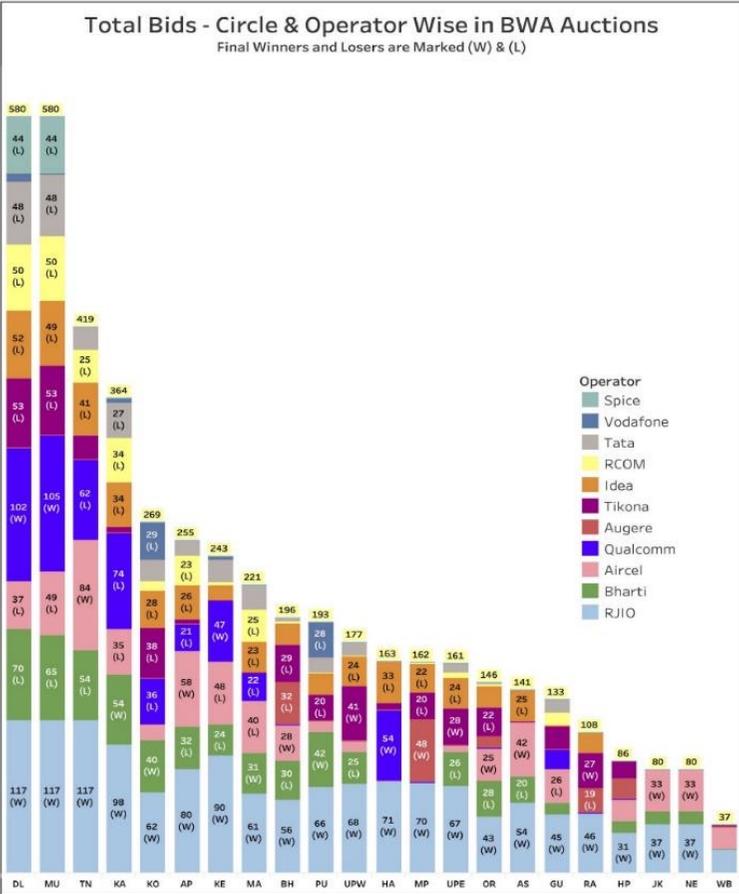
Delhi & Mumbai Saw a Total 649, 595 Bids in Total  
 Many Operators Bid with Equal Intensity But Lost in Key Circles



# BWA Auction Highlights (2010)



Reserve Price for BWA was set 25% that of 3G  
Final Price went Multiple Times the Reserve Price



Delhi & Mumbai Saw a Total 580, 580 Bids in Total  
Many Operators Bid with Equal Intensity But Lost in Key Circles

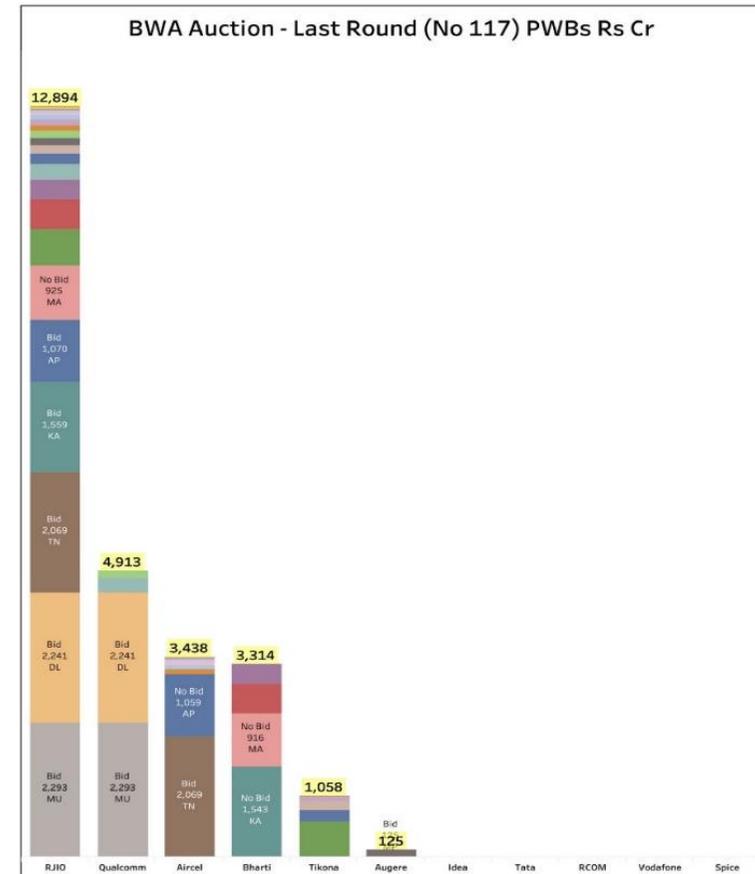
# BWA Auction Highlights (2010)

## 2010 Bidding Matrix (2300 MHz)



## Bidding Intensity

Some Bidders Bid Fanatically in Every Round & for Every Circle, Though they weren't needed to – Showed Lack of Experience



# 3G & BWA Auction Highlights (2010)

## Operators' Outflow

	2100	2100	2100	2100	2100	2100	2100	2300	2300	2300	2300	2300	2300	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	
Circle	Bharti	Voda	Idea	Aircel	RCOM	Tata	Total	Bharti	QCOM	Aircel	Tikona	RJIO	Total	Bharti	Voda	Idea	Aircel	RCOM	Tata	Tikona	QCOM	RJIO	Grand	
AP	1373		1373	1373			4119			1059		1059	2118	1373		1373	2432						1059	6238
AS	41			41	41		124			33		33	66	41			75	41					33	190
BH	203			203	203		610			99		99	199	203			303	203					99	809
DL	3317	3317			3317		9951		2241			2241	4482	5558	3317				3317			2241	2241	16674
GU		1076	1076			1076	3228				614	614	1228		1076	1076			1076	614			614	4456
HA		223	223			223	668		120			120	240	120	223	223			223		120	120	120	1027
HP	37		37		37		112				21	21	41	37		37		37		21			21	153
JK	30		30	30	30		121			21		21	43	30		30	52	30					21	164
KA	1580			1580		1580	4740	1543				1543	3087	3123			1580		1580				1543	7826
KE			312	312		312	937		259			259	517	259		312	312		312		259	259	259	1713
KO		544		544	544		1633	523				523	1046	523	544		544	544					523	2679
MA		1258	1258			1258	3773	916				916	1831	916	1258	1258			1258				916	5605
MP			258		258	258	775	125				125	249	125		258		258	258				125	1024
MU	3247	3247			3247		9741		2293			2293	4586	5540	3247				3247			2293	2293	16620
NE	42			42	42		127			21		21	43	42			64	42					21	169
OR				97	97		194			64		64	127				161	97					64	321
PU			322	322	322	322	1288	332				332	665	332		322	322	322	322				332	1953
RA	321				321	321	963				97	97	195	321					321	321	97		97	1158
TN	1465	1465		1465			4395		2069			2069	4139	1465	1465		3534						2069	8534
UPW	514	365	365	365			1094				143	143	285		365	365	365				143		143	1379
WB	124	124		124	124		495			71		71	142	124	124		195	124					71	636
<b>Total</b>	<b>12295</b>	<b>11618</b>	<b>5769</b>	<b>6499</b>	<b>8585</b>	<b>5864</b>	<b>50631</b>	<b>3439</b>	<b>4913</b>	<b>3438</b>	<b>1058</b>	<b>12848</b>	<b>25696</b>	<b>20647</b>	<b>11618</b>	<b>5769</b>	<b>9937</b>	<b>8585</b>	<b>5864</b>	<b>1058</b>	<b>4913</b>	<b>12848</b>	<b>81239</b>	

Total Outflow for 3G Was Rs 50,631 Cr and for BWA was Rs 25,696 Cr – Grand Total was Rs 81,239 (Excluding BSNL & MTNL)

# 3G & BWA Auction Key Issues (2010)

- 3G

- Demand & Supply Mismatch (3 Slots Chased by 8 to 10 Players)
- Faulty Auction Design (Closing Rules Forced Bidding)
- Subsidized 2G Entry Increased Desperation (Banks Funded Freely)
- No More 3G Spectrum (Defense Had Released More Than Enough)

- BWA

- Demand & Supply Mismatch (2 Slots Chased by 4 to 6 Players)
- Rules of BWA Spectrum Were Favorable (Compared to 3G)
- 3G Auction Loser became Desperate (Gap Fill Strategy)
- No More BWA Spectrum (Near Term)

# 2G Auction Background (2012)

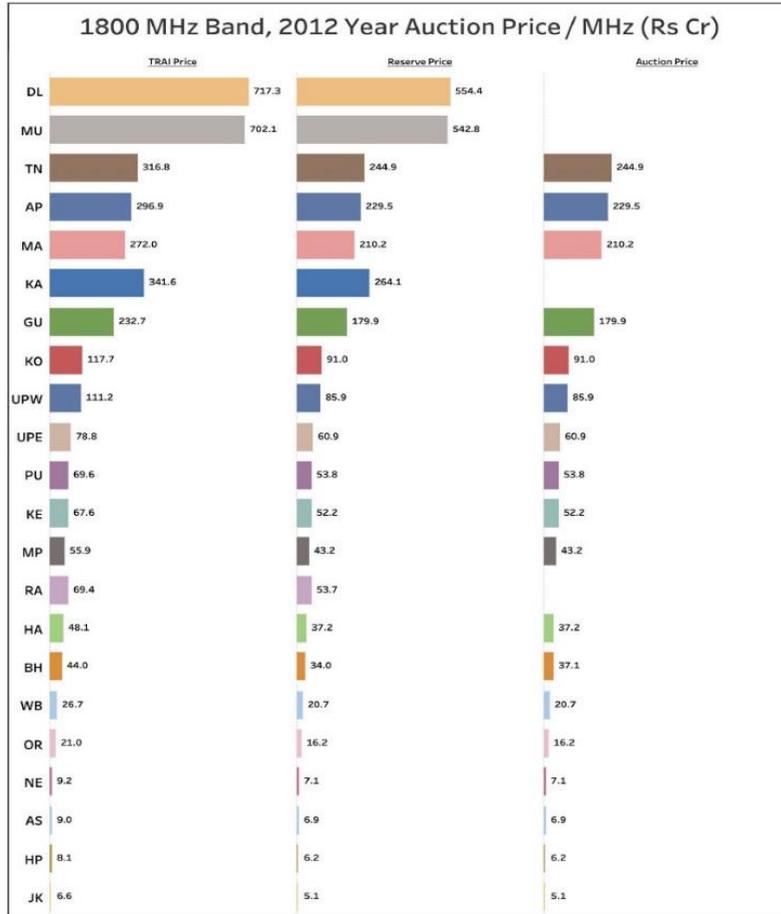
- 2<sup>nd</sup> Feb 2012 - SC Cancelled Licenses Granted on 10<sup>th</sup> Jan 2008 (Not Dual Technology)
- 23<sup>rd</sup> April 2012 – TRAI Recommended Reserve Price (700, 800, 900, 1800, 2100 Bands)
- 28<sup>th</sup> Sept 2012 – DoT Release NIA for Auction (800 & 1800 MHz Bands)
- 12<sup>th</sup> Nov 2012 – 2G Auction Started
- 14<sup>th</sup> Nov 2012 – 2G Auction Ended
  
- TRAI's Reserve Price Modeling
  - 2100 MHz Band – 2010 3G Auction Price x 1.1263 (SBI PLR)
  - 1800 MHz Band – 2010 3G Auction Price x 1.1263 (SBI PLR) x 1.2 (Band Efficiency) x 0.8 (Reserve Price Factor)
  - 800/900 MHz band – 1800 MHz Reserve Price x 2 (Band Efficiency)
  - 700 MHz band – 1800 MHz Reserve Price x 4 (**International Prices Table**)

# 2G Auction Reserve Price (2012)

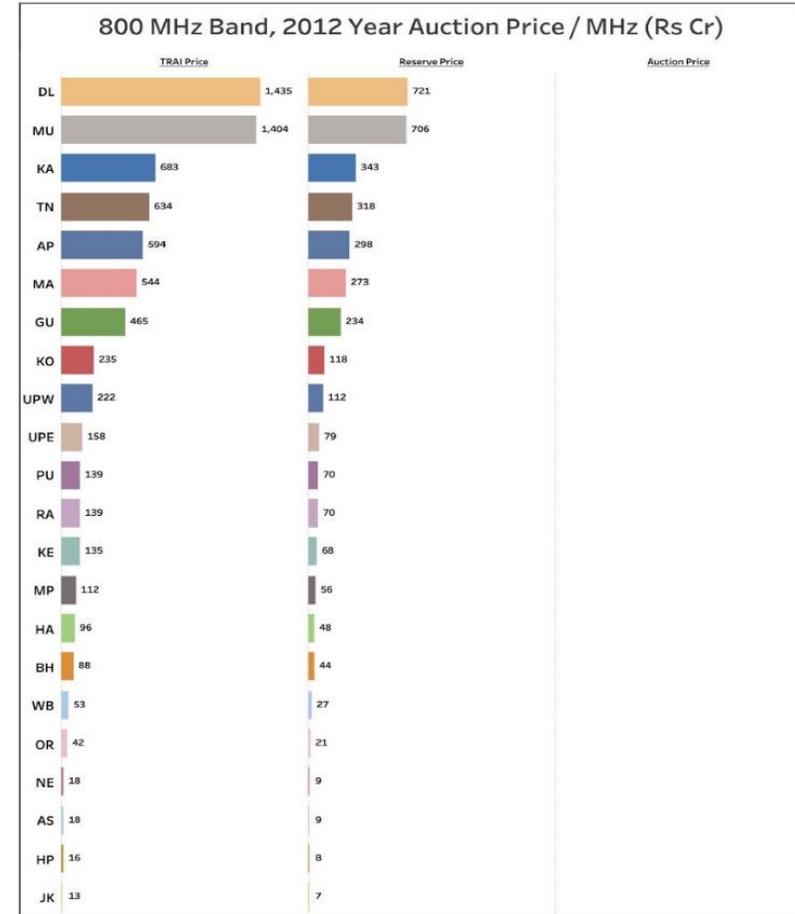
TRAI's Reserve Price Model for 2012 Auction					All Prices In Rs Cr
1	2	3	4	5	6
LSA	2100 Auction Price (May 2010)	Reserve Price of 1800 MHz = $1.1263 \times 1.2 \times 0.8$ of (2)	Reserve Price of 800/900 MHz = (3) X 2	Reserve Price of 700 MHz = (3) X 4	Reserve Price of 2100 MHz = (2) x 1.1263
DL	663.39	717.28	1434.57	2869.14	747.17
MU	649.41	702.18	1404.36	2808.71	731.43
KO	108.85	117.70	235.39	470.78	122.60
MA	251.56	272.00	544.01	1088.01	283.34
GU	215.21	232.70	465.40	930.79	242.39
AP	274.63	296.94	593.88	1187.76	309.31
KA	315.98	341.65	683.31	1366.62	355.89
TN	292.99	316.79	633.59	1267.17	329.99
KE	62.50	67.57	135.15	270.29	70.39
PU	64.40	69.63	139.27	278.54	72.54
HA	44.52	48.13	96.27	192.53	50.14
UPW	102.81	111.16	222.32	444.64	115.79
UPE	72.91	78.84	157.68	315.35	82.12
RA	64.21	69.42	138.85	277.69	72.32
MP	51.67	55.87	111.74	223.48	58.20
WB	24.73	26.73	53.47	106.94	27.85
HP	7.45	8.05	16.10	32.20	8.39
BH	40.69	44.00	88.00	175.99	45.83
OR	19.40	20.97	41.94	83.89	21.85
AS	8.30	8.97	17.94	35.88	9.34
NE	8.46	9.15	18.29	36.59	9.53
JK	6.06	6.55	13.10	26.21	6.83
<b>Pan India</b>	<b>3350</b>	<b>3622</b>	<b>7245</b>	<b>14489</b>	<b>3773</b>

DOT Reduced the Reserve Price of 1800 MHz Band by 30% and for 800 MHz band by 50% (No Reasons Were Provided)

# 2G Auction Highlights (2012)



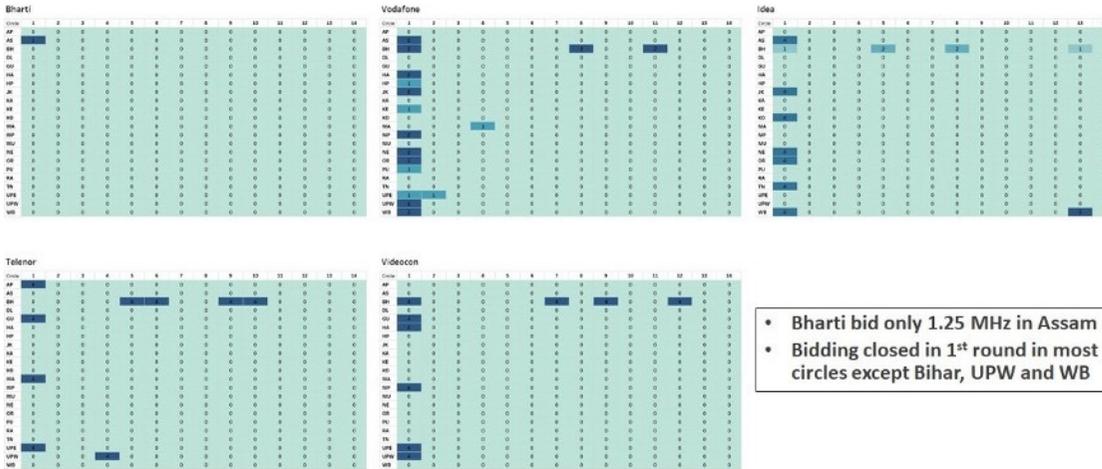
Delhi, Mumbai Karnataka, Rajasthan Saw No Bids  
All Spectrum Sold @ Reserve Price



No Circles Saw Any Bids

# 2G Auction Highlights (2012)

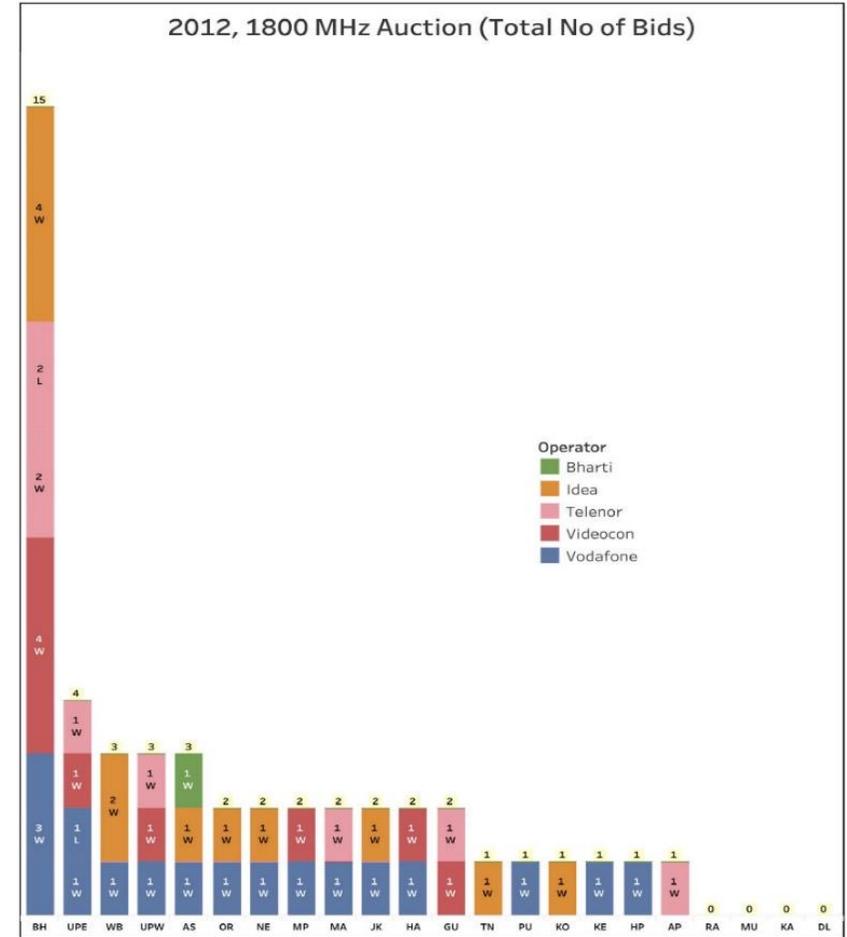
## 2012 Bidding Matrix (1800 MHz)



- Bharti bid only 1.25 MHz in Assam
- Bidding closed in 1<sup>st</sup> round in most circles except Bihar, UPW and WB

## Bidding Intensity

The Bidding Intensity Was Poor, There were hardly any bids  
Bihar Saw Max Bid of (15), followed by UPE (4) and Rest Between (3) to (0)



# 2G Auction Highlights (2012)

	800	800	800	1800	1800	1800	1800	1800	1800	1800
	Offered	Sold	Unsold	Offered	Sold	Sold	Sold	Sold	Sold	Unsold
Circle	Auction	NIL	NIL	Auction	Bharti	Vodafone	Idea	Uninor	Videocon	Auction
AP	2.50			13.75				5.00		8.75
AS	5.00			13.75	1.25	2.50	5.00			5.00
BH	5.00			13.75		2.50	1.25	5.00	5.00	0.00
DL	3.75			10.00						10.00
GU	5.00			13.75				5.00	5.00	3.75
HA	5.00			13.75		2.50			5.00	6.25
HP	5.00			13.75		1.25				12.50
JK	5.00			13.75		2.50	5.00			6.25
KA	5.00			13.75						13.75
KE	5.00			13.75		1.25				12.50
KO	3.75			13.75			5.00			8.75
MA	3.75			13.75		1.25		5.00		7.50
MP	5.00			13.75		2.50			5.00	6.25
MU	3.75			10.00						10.00
NE	5.00			13.75		2.50	5.00			6.25
OR	5.00			13.75		2.50	5.00			6.25
PU	2.50			13.75		1.25				12.50
RA				13.75						13.75
TN	5.00			13.75			5.00			8.75
UPE	5.00			13.75		1.25		5.00	5.00	2.50
UPW	5.00			13.75		2.50		5.00	5.00	1.25
WB	5.00			13.75		2.50	6.25			5.00
<b>Total</b>	<b>95.00</b>	<b>0.00</b>	<b>0.00</b>	<b>295.00</b>	<b>1.25</b>	<b>28.75</b>	<b>37.50</b>	<b>30.00</b>	<b>30.00</b>	<b>167.50</b>

800 MHz – 100 % Unsold; 1800 MHz – 57% Unsold

	1800	1800	1800	1800	1800	1800
Circle	Bharti	Voda	Idea	Telenor	Videocon	Total
AP				1148		1148
AS	9	17	35			61
BH		93	46	186	186	511
DL						
GU				899	899	1799
HA		93			186	279
HP		8				8
JK		13	25			38
KA						
KE		65				65
KO			455			455
MA		263		1051		1314
MP		108			216	324
MU						
NE		18	35			53
OR		41	81			122
PU		67				67
RA						
TN			1224			1224
UPE		76		305	305	686
UPW		215		430	430	1074
WB		52	129			181
<b>Total</b>	<b>9</b>	<b>1128</b>	<b>2031</b>	<b>4018</b>	<b>2221</b>	<b>9408</b>

Total Outflow Was Rs 9408 Cr

# 2G Auction Key Issues (2012)

- Concept of “Valuation” & “Reserve Price” Got Mixed up

- “Valuation” attempts to estimate the “Price of Spectrum”
- “Reserve Price” is the price at which auctions starts, and NOT the “Final Price” (clause 3.83, page 100)
- “Reserve Price” is always set below the final expected price (by some factor, between 0.5 to 0.8)
- TRAI estimated the valuation of all spectrum bands from 3G auction price of 2010
- TRAI reduced the “Reserve Price” for all spectrum bands (barring 2100) by a factor of 0.8
- **TRAI indexed the 2100 auction prices of 2010 by SBI PLR to arrive at its “Reserve Price”**

A study of various auctions held globally in last 3-4 years reveals that the reserve prices are generally around 0.5 times the final prices. However, in the context of Indian telecom sector, where the demand for spectrum is considerably higher, the Authority has decided to use a factor of 0.8 to determine the reserve price.  
(TRAI’s Recommendation dated 23<sup>rd</sup> April 2012)

*Key Error :- 3G Auction Price of 2010 was one of the many inputs used in estimating “valuation”, and therefore should NOT have been used as the only metric for calculating “Reserve Price”*

- Reserve Price of 700MHz Was Wrong

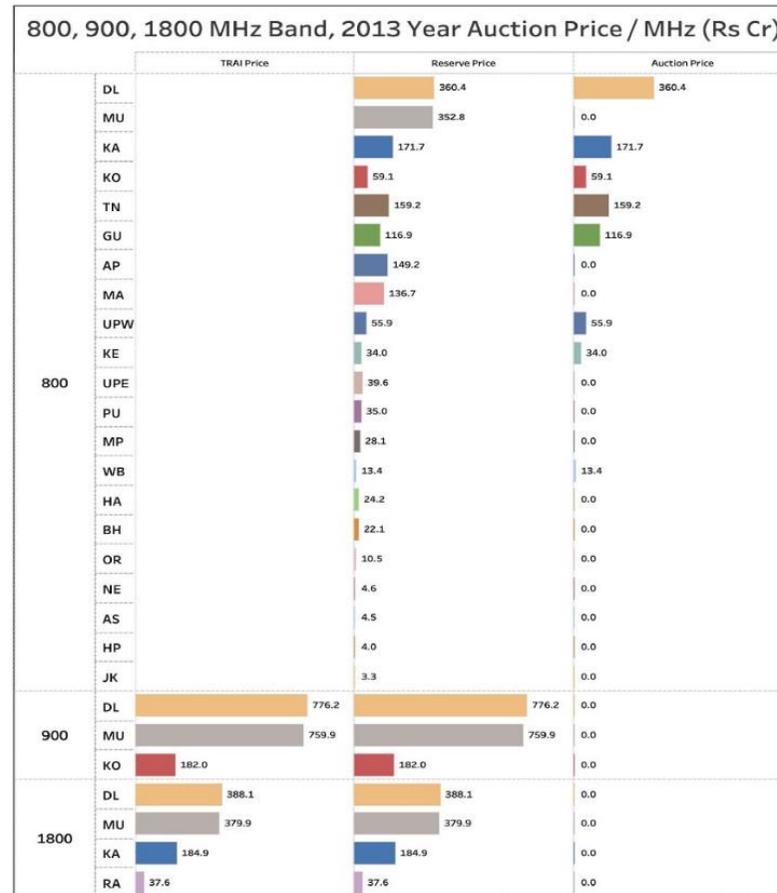
- Serious Calculation Mistake (TRAI used Factor 4 instead of 2.3)
- Serious Mistake of NOT following the same approach as 800/900
- Serious Mistake of Pricing when even the band plan was NOT Finalized

# 2G Auction Background (2013)

- 12<sup>th</sup> Dec 2013 – DOT Released NIA
  - 11<sup>th</sup> March 2013 – Auction Started
  - 11<sup>th</sup> March 2013 – Auction Concluded
- 
- Reserve Price
    - 800 MHz Band – DOT Cut the Price by another 50% (Now it is even less than 1800 MHz)
    - 1800 MHz Band – DOT Cut the Price by another 30% (In circles where spectrum was not sold)
    - 900 MHz Band – DOT raised the price of 900 MHz band to twice that of 1800 MHz band.

Q1. Why was no parity maintained between 800 & 900 MHz?  
Q2. Do you think the demand for 900 MHz would have been any different from 800 MHz if was put up for auction earlier?

# 2G Auction Highlights (2013)



800 MHz – 7 Circles sold @ RP, and no bids for 900 & 1800 MHz band

# 2G Auction Highlights (2013)

	800	800	800	900	900	1800	1800
	Offered	Sold	Unsold	Offered	Unsold	Offered	Unsold
Circle	Auction	MTS	Auction	Total	Total	Total	Total
AP	2.50		2.50				
AS	5.00		5.00				
BH	5.00		5.00				
DL	3.75	3.75		15.00	15.00	15.00	15.00
GU	5.00	3.75	1.25				
HA	5.00		5.00				
HP	5.00		5.00				
JK	5.00		5.00				
KA	5.00	3.75	1.25			13.75	13.75
KE	5.00	3.75	1.25				
KO	3.75	3.75		12.50	12.50		
MA	3.75		3.75				
MP	5.00		5.00				
MU	3.75		3.75	15.00	15.00	15.00	15.00
NE	5.00		5.00				
OR	5.00		5.00				
PU	2.50		2.50				
RA			0.00			13.75	13.75
TN	5.00	3.75	1.25				
UPE	5.00		5.00				
UPW	5.00	3.75	1.25				
WB	5.00	3.75	1.25				
<b>Total</b>	<b>95.00</b>	<b>30.00</b>	<b>65.00</b>	<b>42.50</b>	<b>42.50</b>	<b>57.50</b>	<b>57.50</b>

800 MHz – 68 % Unsold; 900, 1800 MHz – 100% Unsold

	800	800
Circle	MTS	Total
AP		
AS		
BH		
DL	1351	1351
GU	438	438
HA		
HP		
JK		
KA	644	644
KE	127	127
KO	222	222
MA		
MP		
MU		
NE		
OR		
PU		
RA		
TN	597	597
UPE		
UPW	209	209
WB	50	50
<b>Total</b>	<b>3639</b>	<b>3639</b>

Total Outflow Was Rs 3639 Cr

# 2G Auction Key Issues (2013)

- 900 MHz band was treated discriminately
  - Multiplier Factor of 2 with 1800 MHz was used (When it did not get tested in 2012)
  - 800 MHz price got drastically reduced compared to 900 MHz
  - 900 MHz band became pricy compared to 800 MHz band

# 2G Auction Background (2014)

- 16<sup>th</sup> April 2012 - TRAI Recommended Delinking License From Spectrum
- 19<sup>th</sup> Aug 2013 – DOT Issued Guidelines For Unified Licensing
- 9<sup>th</sup> Sept 2013 – TRAI Recommended Reserve Price
- 3<sup>rd</sup> Feb 2014 – 2G Auction Started
- 13<sup>th</sup> Feb 2014 – 2G Auction Ended
  
- TRAI's Reserve Price Modeling
  - Used various valuation models to estimated reserve price
  - **Discarded the 2100 MHz auction determined price**
  - Acknowledged that 2100 MHz price was result of irrational exuberance
  - Acknowledged that “Reserve Price” in NOT the eventual price of auction
  - Decided that “Reserve Price” should be 80% of the estimated valuation
  - Concluded that spectrum in India cannot be valued based on international prices
  - Used **“Median”** to check for outliers for the purpose of consistency

Note - It did not stop TRAI in 2016 to pick up its earlier (2012) recommendation to set its Reserve Price for 700 MHz band (4 times that of 1800 MHz)

# 2G Auction Highlights (2014)

## TRAI Calculation of RP (1800 MHz)

TRAI's 1800 MHz Reserve Price Model for 2014 Auction														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LSA	1800 MHz RP/AP Nov 2012 & Mar 2013	Correlating with AGR	Correlating with ARPU	GSDP per capita, Pop, Res Teledensit y, AGR per	AGR, Existing Tele Density	GSDP per Capita, Res Tele Density, MOU	GSDP per Capita, PoP Res Tele Density, AGR per	Producer Surplus	Production Function	Experts price 2011 indexed for 3 yrs (upto 6.2)	Average Value (3 to 11)	Average after removing highest & lowest	Median Value (3 to 11)	Reserve Price = Min(2,12 X 0.8)
Delhi	388.11	177.51	244.78	284.10	211.22	197.83	210.69	170.92	251.85	221.20	218.90	216.44	211.22	175
Mumbai	379.93	154.62	265.02	330.05	189.74	180.78	243.23	109.51	238.42	149.33	206.74	203.02	189.74	165
Kolkata	90.98						114.06	47.88	39.67	73.08	73.13	70.65	73.08	59
Andhra Pradesh	229.53						125.13	101.59	129.75	227.10	162.62	160.66	129.75	130
Gujarat	179.87						123.61	91.07	101.07	221.34	143.39	134.85	123.61	115
Karnataka	184.86	190.99	200.99	131.81	153.35	138.32	103.47	157.97	118.90	201.09	155.21	156.05	153.35	124
Maharashtra	210.25							170.74	137.64	173.00	172.91	171.87	171.87	138
Tamilnadu	244.87						129.17	276.74	111.95	276.73	207.89	216.92	244.87	166
Haryana	37.21							42.95	32.27	21.41	33.46	34.74	34.74	27
Kerala	52.24							71.59	55.80	109.26	72.20	63.70	63.70	52
MadhyaPradesh	43.19							74.66	78.69	129.54	81.50	76.60	76.60	43
Punjab	53.82							87.12	45.77	107.60	73.50	70.40	70.40	54
Rajasthan	37.56	58.17	51.89	50.97	88.49	55.28	43.12	118.90	66.29	156.59	76.60	70.00	58.10	26
U. P. (East)	60.94							125.92	83.70	224.13	123.60	104.80	104.80	61
U.P. (West)	85.93							71.75	64.40	88.77	77.70	78.80	78.80	62
West Bengal	20.67							21.34	53.84	66.15	40.50	37.50	37.50	21
Assam	6.93							12.25	10.73	15.36	11.30	11.40	11.40	7
Bihar	37.14							88.59	52.59	75.38	63.40	63.90	63.90	37
HimachalPradesh	6.22							7.33	9.63	13.79	9.20	8.40	8.40	6
Jammu & Kashmir	5.06							41.62	7.83	11.22	16.40	9.50	9.50	5
North East	7.07							27.14	10.93	15.67	15.20	13.30	13.30	7
Orissa	16.22							19.57	25.07	35.93	24.20	22.30	22.30	16
Pan India	2378.60	581.29	762.68	796.93	642.80	572.21	1092.48	1937.15	1726.79	2613.67	2059.55	1995.80	1950.93	1497

DOT Later Increased these prices by 25% without assigning any reasons

Reserve price was set as the “Minimum” of 1800 (RP/AP) of 2012 & 2013 And 80% of the Valuation

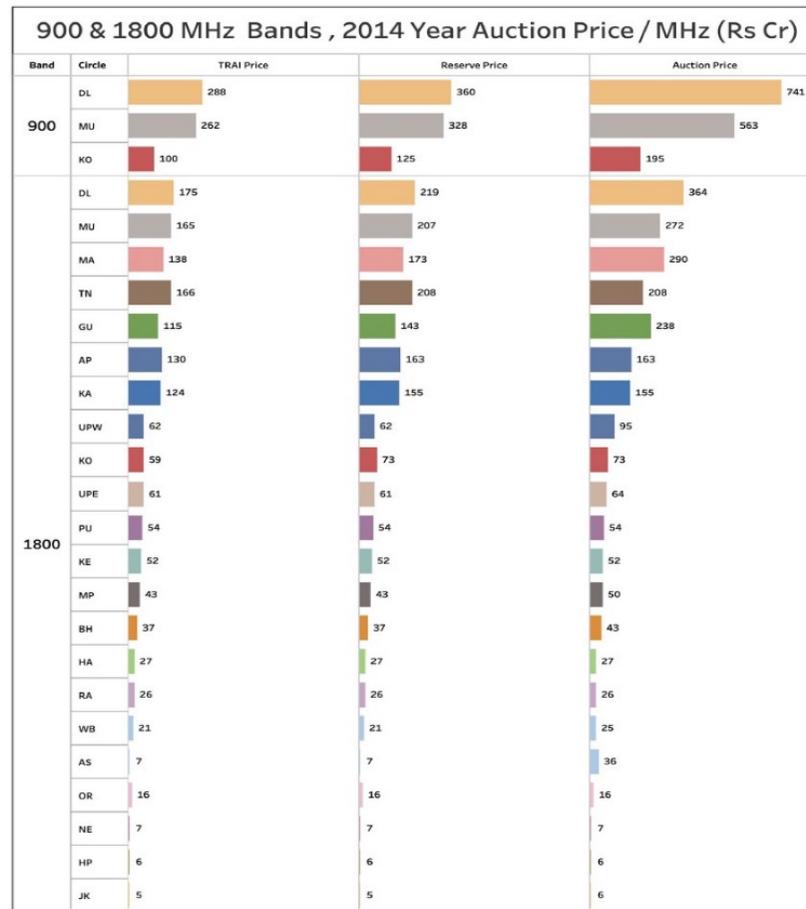
# 2G Auction Highlights (2014)

## TRAI Calculation of RP (900 MHz)

TRAI's 900 MHz Reserve Price Model for 2014 Auction						
1	2	3	4	5	6	7
	1.5 X Average Valuation of 1800 MHz	2 X Average Valuation of 1800 MHz	Economic Premium over 1800 MHz + Avg Val of 1800 MHz	Average Value (2 to 4)	Median Value (2 to 4)	Reserve Price = 0.8 x Average Value (5)
<b>LSA</b>						
Delhi	328.35	437.8	312.81	359.65	328.35	288
Mumbai	310.11	413.48	258.91	327.50	310.11	262
Kolkata	109.70	146.26	119.84	125.27	119.84	100
<b>Total</b>	<b>748.16</b>	<b>997.54</b>	<b>691.56</b>	<b>812.42</b>	<b>758.30</b>	<b>649.93</b>

DOT Later Increased these prices by 25% without assigning any reasons

# 2G Auction Highlights (2014)



900 MHz – Auction Prices went much above RP  
 1800 MHz – Auction Prices went above RP

Why? The operators were left with no choice, they were protecting their investments – proves that spectrum has not inherent valuation of its own – its is a tool to preserve market competitiveness

# 2G Auction Highlights (2014)

	900	900	900	900	900	1800	1800	1800	1800	1800	1800	1800	1800	1800
	Offered	Sold	Sold	Sold	Unsold	Offered	Sold	Sold	Sold	Sold	Sold	Sold	Sold	Unsold
Circle	Auction	Bharti	Voda	Idea	Auction	Auction	Bharti	Voda	Idea	Aircel	RCOM	Telenor	RJIO	Auction
AP						22.6	8.8	0.6	6			1.4	5.8	
AS						11.4						6	5.4	
BH						2.4						2.2		0.2
DL	16	6	5	5		21	7	8	0.6				5.4	
GU						12		4.4	1.6				6	
HA						16.4		2.4	6					8
HP						20.4	10.2							10.2
JK						4.4	2.6			1.8				
KA						24.6	8.8	5	5				5	0.8
KE						28	5	7	10				5	1
KO	14	7	7			25	5	8					5	7
MA						14			9				5	
MP						19.2	5.8		7				6.4	
MU	16	5	11			23.4	6	8.2	2		0.6		6.6	
NE						25	7		5	1.8			6.4	4.8
OR						26.2	5						5	16.2
PU						18.4	8.2	0.6	8					1.6
RA						19	8.2	0.8		1.6				8.4
TN						30.2	5						6.2	19
UPE						8		4		1.8		1.8		0.4
UPW						2.4						2		0.4
WB						11.2	4.4			1.2			5.6	
Total	46	18	23	5	0	385.2	97	49	60.2	8.2	0.6	13.4	78.8	78

900 MHz – 0 % Unsold; 1800 MHz – 20% Unsold

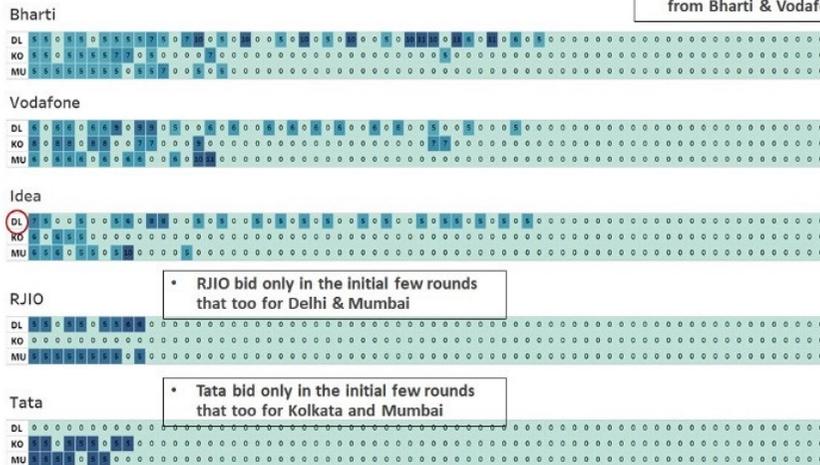
	900	900	900	900	1800	1800	1800	1800	1800	1800	1800	1800	1800	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Grand
	Bharti	Voda	Idea	Total	Bharti	Voda	Idea	Aircel	RCOM	Telenor	RJIO	Total	Total	Bharti	Voda	Idea	Aircel	RCOM	Uninor	Total	RJIO	Total	Total	
Circle	Bharti	Voda	Idea	Total	Bharti	Voda	Idea	Aircel	RCOM	Telenor	RJIO	Total	Total	Bharti	Voda	Idea	Aircel	RCOM	Uninor	Total	RJIO	Total	Total	
AP					1434	98	978			228	945	3684	1434	98	978					228	945	3684		
AS										217	195	412								217	195	412		
BH										95		95								95		95		
DL	4446	3705	3705	11855	2548	2912	218				1966	7644	6994	6617	3923					1966	945	3684	19499	
GU						1046	380				1427	2854		1046	380					1046	380	2854	1427	
HA						65	162					227		65	162					65	162	227		
HP						61						61	61										61	
JK						16			11			27	16							11			27	
KA						1364	775	775				775	3689	1364	775	775					775		3689	
KE						260	364	520				260	1404	260	364	520					260	364	1404	
KO	1362	1362				365	584					365	1314	1727	1946						365	1314	4039	
MA								2613				1452	4065			2613					1452		4065	
MP						292		353				323	968	292		353					323		968	
MU	2815	6194			9009	1632	2230	544		163		1795	6365	4447	8424	544			163		1795		15374	
NE						49		35	13			45	141	49		35	13				45		141	
OR						80						80	160	80							80		160	
PU						443	32	432				907	443	32	432						907		443	
RA						213	21			42		276	213	21						42			276	
TN						1040						1290	2330	1040									2330	
UPE							256			115		115	486		256					115			486	
UPW												190	190										190	
WB												138	276	108									276	
Total	8624	11261	3705	23590	9906	8384	7011	210	163	845	11054	37573	18530	19645	10716	210	163	845	11054				61162	

Total Outflow Was Rs 61162 Cr

# 2G Auction Highlights (2014)

## Bidding Matrix

### 2014 Bidding Matrix (900 MHz)



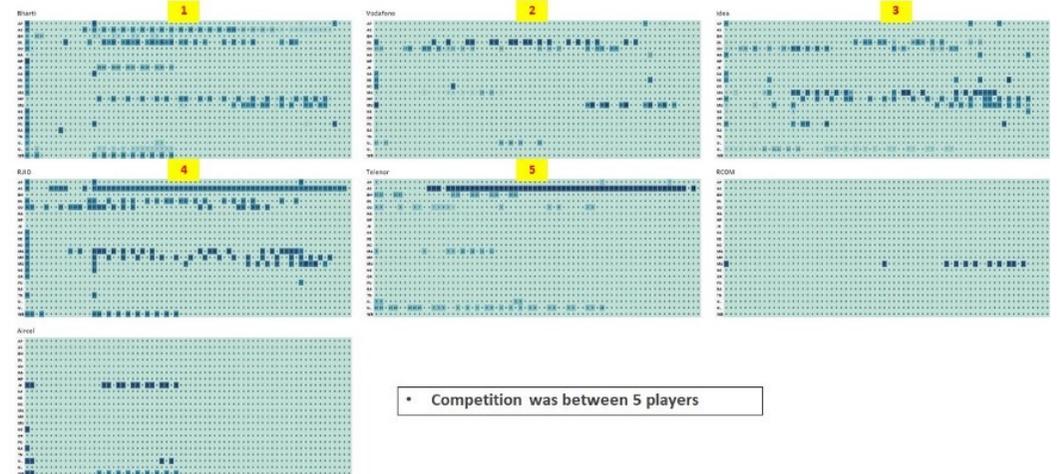
- Bidding closed for Mumbai & Delhi in 1<sup>st</sup> few rounds
- Idea snatched 5 MHz in Delhi from Bharti & Vodafone

- RJIO bid only in the initial few rounds that too for Delhi & Mumbai

- Tata bid only in the initial few rounds that too for Kolkata and Mumbai

RJIO bid in Delhi and Mumbai won nothing  
 Tata bid in Mumbai and Kolkata won nothing  
 Idea bid in Delhi and won 2x5 MHz

### 2014 Bidding Matrix (1800 MHz)



- Competition was between 5 players

Some circles saw intense bidding  
 Some circles were taken @ RP

## 2G Auction Key Issues (2014)

- No alternate spectrum was offered to address “business continuity”
- Players with no interest in 900 MHz bid and raised price
- 3G spectrum scarcity forced Idea to bid 900 MHz in Delhi
- 900 MHz (EGSM) was not seriously pursued by DoT

# 2G Auction Background (2015)

- 22<sup>nd</sup> Feb 2014 - TRAI Recommended Reserve Price for 800 MHz
- 15<sup>th</sup> Oct 2014 – TRAI Recommended Reserve Price for 900 & 1800 MHz
- 27<sup>th</sup> Nov 2014 – TRAI Revised the Reserve Price for 800 MHz
- 31<sup>st</sup> Dec 2014 – TRAI Recommended Reserve Price for 2100 MHz
- 9<sup>th</sup> Jan 2015 – DOT Issued NIA for Auctions
- 5<sup>th</sup> March 2015 – 2G Auction Started
- 25<sup>th</sup> March 2015 – 2G Auction Ended
  
- TRAI’s Reserve Price Modeling (1800 MHz)
  - The model used for valuation of spectrum was aligned to that of 2014
  - 1800 MHz RP was set MAX of the two figures a) 1800 MHz AP; b) 1800 MHz 80% Valuation
  
- TRAI’s Reserve Price Modeling (900 MHz)
  - The model used for valuation of spectrum was aligned to that of 2014
  - 900 MHz Valuation was set MIN of the two figures a) 2 x 1800 MHz Avg Val ; b) Average Val of Model
  - 900 MHz Reserve Price was set 80% of the Above Value

TRAI’s Recommendation Dated 9<sup>th</sup> Sept 2013 (Clause 3.54, Page 66)

**The reserve price is clearly related with the valuation of spectrum.** It is important to note however that it is not the eventual realized price in the auction. The reserve price is the starting point for an ascending price auction and bidding is a means to price discovery. A reserve price set lower than the a priori expected value of the object will enable price discovery and the final bid price is likely to be much higher than the reserve price. The reserve prices should not be too close to the estimates of valuation, and must be lower than these estimates, to enable competitive bidding and price discovery. A reserve price too close to estimations on valuations may discourage the bidders from participation in the auction. The issue for consideration relates to the setting of reserve price as ratio or percentage of the valuation of spectrum.

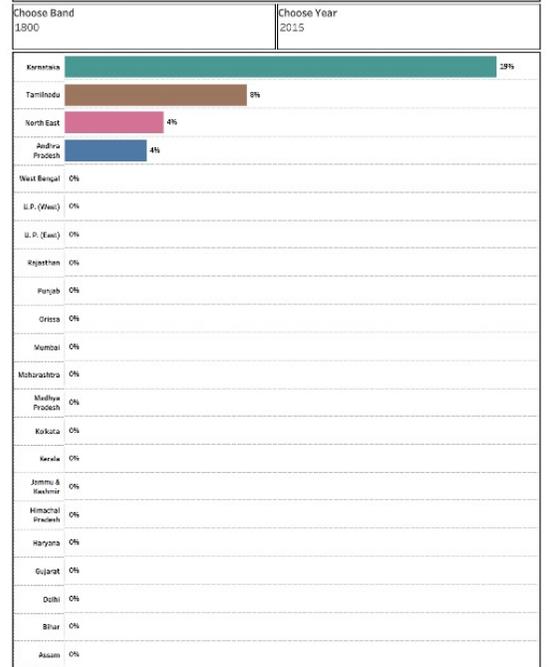
# 2G Auction Highlights (2015)

## TRAI Calculation of RP (1800 MHz)

TRAI's 1800 MHz Reserve Price Model for 2015 Auction										
1	2	3	4	5	6	7	8	9	10	
LSA	1800 MHz Auction Price (Feb 2014)	Producer Surplus	Production Function	Revenue Surplus	Average Value (2 to 5)	Median Value (2 to 5)	Recommended Average Value =MAX(2,6)	80% of Average Value (of 6)	80% of Recommended Average Value (of 8)	Reserve Price (MAX of 2 & 9)
Delhi*	364.00	247.61	349.34	213.03	293.50	298.48	364.00	234.80	291.20	364
Mumbai*	272.00	217.08	338.02	139.86	241.74	244.54	272.00	193.39	217.60	272
Kolkata	73.00	74.22	62.13	51.51	65.22	67.57	73.00	52.17	58.40	73
Andhra Pradesh	163.00	123.38	164.12	226.78	169.32	163.56	169.32	135.46	135.46	163
Gujarat	237.80	154.46	133.75	132.25	164.57	144.11	237.80	131.65	190.24	238
Karnataka	155.00	213.10	161.15	209.76	184.75	185.46	184.75	147.80	147.80	155
Maharashtra	290.35	305.07	182.33	221.79	249.89	256.07	290.35	199.91	232.28	290
Tamilnadu	208.00	247.30	185.59	260.74	225.41	227.65	225.41	180.33	180.33	208
Haryana	27.00	56.53	33.13	42.68	39.84	37.91	39.84	31.87	31.87	32
Kerala	52.00	92.15	60.40	170.88	93.86	76.28	93.86	75.09	75.09	75
Madhya Pradesh*	50.40	117.07	81.62	95.05	86.04	88.34	86.04	68.83	68.83	69
Punjab	54.00	145.66	51.34	102.52	88.38	78.26	88.38	70.70	70.70	71
Rajasthan	26.00	203.59	74.51	125.33	107.36	99.92	107.36	85.89	85.89	60
U. P. (East)	64.00	194.56	84.90	143.16	121.66	114.03	121.66	97.32	97.32	97
U.P. (West)	94.95	122.09	62.70	93.42	93.29	94.19	94.95	74.63	75.96	95
West Bengal	24.60	39.45	53.81	57.75	43.90	46.63	43.90	35.12	35.12	35
Assam*	36.10	17.42	12.85	64.13	32.63	26.76	36.10	26.10	28.88	36
Bihar	43.10	103.76	62.97	97.72	76.89	80.35	76.89	61.51	61.51	62
Himachal Pradesh	6.00	11.51	11.53	18.39	11.86	11.52	11.86	9.49	9.49	9
Jammu & Kashmir*	6.10	53.81	9.38	53.85	30.79	31.60	30.79	24.63	24.63	25
North East	7.00	43.80	13.09	41.43	26.33	27.26	26.33	21.06	21.06	11
Orissa	16.00	26.29	30.02	44.55	29.22	28.16	29.22	23.37	23.37	23
Pan India	2270.40	2809.91	2218.68	2606.58	2476.39	2428.60	2703.78	1981.11	2163.02	2463

### DOT Later Increased prices of some circles without assigning any reasons

In the past auctions by how much % DoT the raised the Reserve Price on top of what the TRAI's recommended?

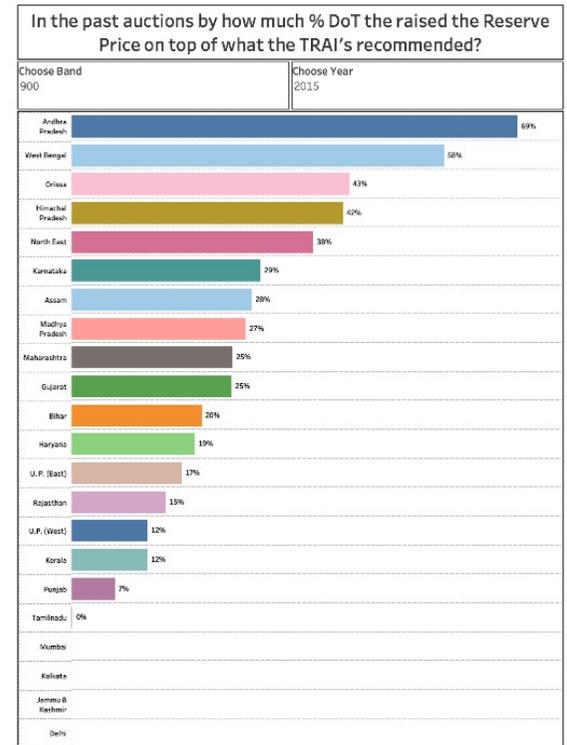


# 2G Auction Highlights (2015)

## TRAI Calculation of RP (900 MHz)

TRAI's 900 MHz Reserve Price Model for 2015 Auction							
1	2	3	4	5	6	7	8
LSA	1.5 X Average Val of 1800 MHz	2 X Average Val of 1800 MHz	Economic Premium over 1800 MHz + Avg Val of 1800 MHz	Average Value (2 to 4)	Median Value (2 to 4)	Recommended Value of 900 MHz = Min(3,5)	Reserve Price = 80% of 7
Andhra Pradesh	253.98	338.64	442.93	345.18	338.64	338.64	271
Gujarat	356.7	475.6	439.19	423.83	439.19	423.83	339
Karnataka	277.13	369.5	424.83	357.15	369.5	357.15	286
Maharashtra	435.53	580.7	557.47	524.57	557.47	524.57	420
Tamil Nadu	338.11	450.82	479.29	422.74	450.82	422.74	338
Haryana	59.75	79.67	145.24	94.89	79.67	79.67	64
Kerala	140.79	187.71	301.8	210.10	187.71	187.71	150
Madhya Pradesh	129.05	172.07	356.35	219.16	172.07	172.07	138
Punjab	132.57	176.76	258.02	189.12	176.76	176.76	141
Rajasthan	161.04	214.72	361.3	245.69	214.72	214.72	172
UP (East)	182.48	243.31	427.61	284.47	243.31	243.31	195
UP (W)	142.43	189.9	303.94	212.09	189.9	189.90	152
West Bengal	65.85	87.8	261.15	138.27	87.8	87.80	70
Assam	54.15	72.2	150.18	92.18	72.2	72.20	58
Bihar	115.33	153.78	284.41	184.51	153.78	153.78	123
Himachal Pradesh	17.78	23.71	61.62	34.37	23.71	23.71	19
North East	39.5	52.66	121.98	71.38	52.66	52.66	21
Orissa	43.82	58.43	148.24	83.50	58.43	58.43	47
<b>Pan India</b>	<b>2945.99</b>	<b>3927.98</b>	<b>5525.55</b>	<b>4133.17</b>	<b>3868.34</b>	<b>3779.65</b>	<b>3003</b>

**DOT Later Increased these prices without assigning any reasons**

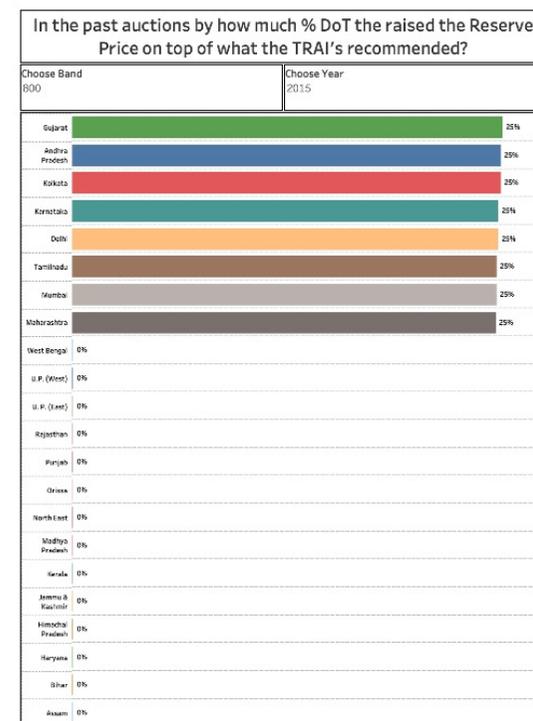


# 2G Auction Highlights (2015)

## TRAI Calculation of RP (800 MHz)

TRAI's 800 MHz Reserve Price Model for 2015 Auction (2nd Time)								
1	2	3	4	5	6	7	8	9
LSA	1.5 x Value of 1800 MHz	2 x Value of 1800 MHz	Producer Surplus Model	Growth Data Usage Model	900 MHz Auction Price (Feb 2014)	Average Value (2 to 6)	Median Value (2 to 6)	RP = 80% of Average Value (of 7)
Delhi	546.00	728.00	619.32	451.45	740.96	617.15	619.32	493.72
Mumbai	408.00	544.00	441.07	241.25	563.09	439.09	476.00	351.59
Kolkata	109.50	146.00	178.18	106.03	194.63	146.87	146.00	117.49
Andhra Pradesh	253.98	338.64	173.07	169.33		233.76	213.53	187.00
Gujarat	356.70	475.60	167.98	97.94		274.56	262.34	219.64
Karnataka	277.13	369.50	354.51	210.84		303.00	315.82	242.40
Maharashtra	435.53	580.70	167.26	174.26		339.44	304.90	271.55
Tamilnadu	338.11	450.82	470.25	182.14		360.33	394.47	288.26
Haryana	59.75	79.67	26.19	23.11		47.18	42.97	37.74
Kerala	140.79	187.71	92.71	74.60		123.95	116.75	99.16
Madhya Pradesh	129.05	172.07	66.72	85.40		113.31	107.23	90.65
Punjab	132.57	176.76	50.44	64.78		106.14	98.68	84.91
Rajasthan	161.04	214.72	115.10	129.68		155.14	145.36	124.11
U. P. (East)	182.48	243.31	178.54	64.47		167.20	180.51	133.76
U.P. (West)	142.43	189.90	88.49	53.44		118.57	115.46	94.85
West Bengal	65.85	87.80	79.46	49.77		70.72	72.66	56.58
Assam	54.15	72.20	2.20	9.94		34.62	32.05	27.70
Bihar	115.33	153.78	88.02	69.27		106.60	101.68	85.28
Himachal Pradesh	17.78	23.71	42.39	11.54		23.86	20.75	19.09
Jammu & Kashmir	46.17	61.57	26.15	4.54		34.61	36.16	27.69
North East	39.50	52.66	6.94	6.53		26.41	23.22	21.13
Orissa	43.82	58.43	69.24	20.07		47.89	51.13	38.31
Pan India	4055.66	5407.55	3063.16	2300.38	1498.68	3890.35	3876.94	3112.61

DOT Later Increased these prices of some circles without assigning any reasons

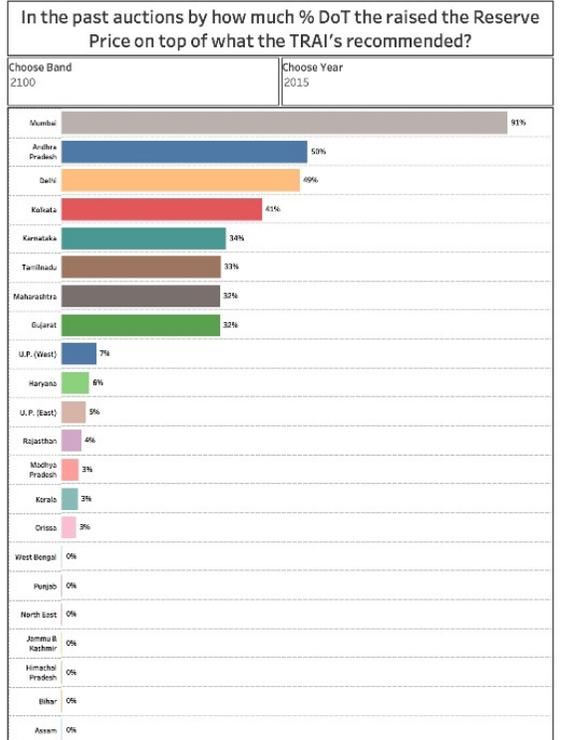


# 2G Auction Highlights (2015)

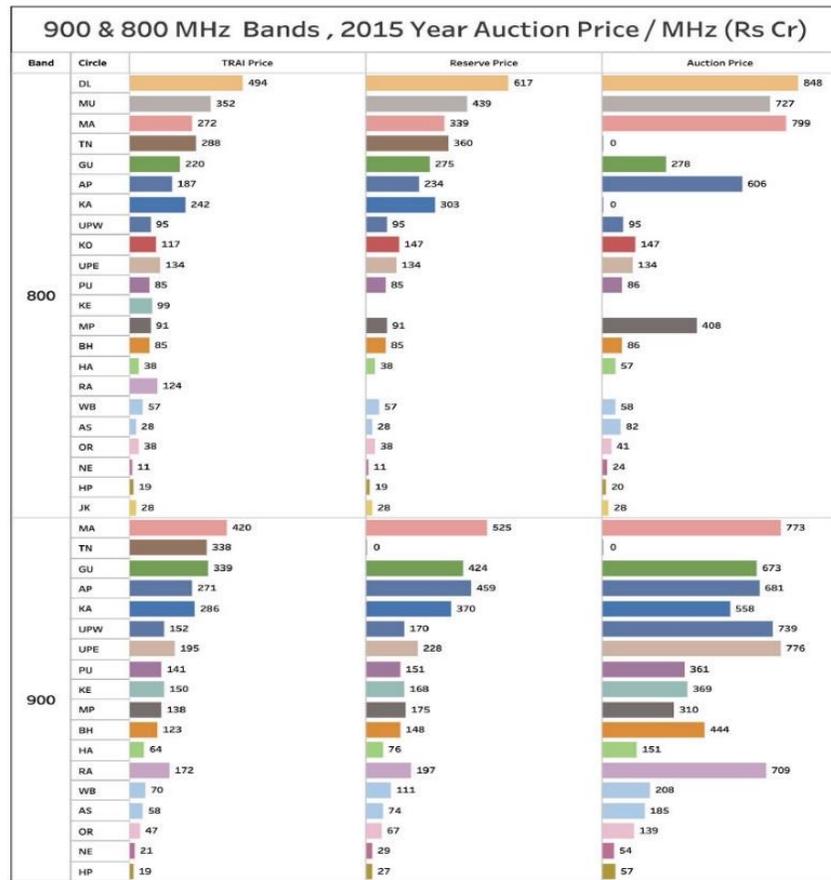
## TRAI Calculation of RP (2100 MHz)

TRAI's 2100 MHz Reserve Price Model for 2015 Auction									
1	2	3	4	5	6	7	8	9	10
LSA	Cat	2100 Auction Price (May 2010)	Indexed 2010 Auction Price(3) @ SBI Base Rate	0.83 X Auction Price of 1800 MHz (Feb 2014)	Producer Surplus Model	Growth Data Usage Model	Average Value (4 to 7)	Median Value (4 to 7)	RP = 80% of Average Value (of 8)
Delhi	Metro	663.4	965.35	302.12	206.78	755.15	557.35	528.64	445.88
Mumbai	Metro	649.41	945.00	225.76	184.79	342.97	424.63	284.37	339.70
Kolkata	Metro	108.85	158.40	60.59	49.10	118.39	96.62	89.49	77.30
Andhra Pradesh	A	274.6	399.59	140.54	160.80	213.95	228.72	187.38	182.98
Gujarat	A	215.2	313.15	197.37	187.56	276.74	243.71	237.06	194.96
Karnataka	A	316	459.83	153.34	265.46	325.25	300.97	295.36	240.78
Maharashtra	A	251.6	366.12	240.99	231.78	298.03	284.23	269.51	227.38
Tamilnadu	A	293	426.36	187.09	312.34	372.07	324.47	342.21	259.57
Haryana	B	44.6	64.90	33.06	60.17	59.51	54.41	59.84	43.53
Kerala	B	62.4	90.80	77.90	229.28	138.38	134.09	114.59	107.27
Madhya Pradesh	B	51.6	75.09	71.41	151.19	122.60	105.07	98.85	84.06
Punjab	B	64.4	93.71	73.35	76.65	83.64	81.84	80.15	65.47
Rajasthan	B	64.2	93.42	89.11	134.88	100.71	104.53	97.07	83.62
U. P. (East)	B	73	106.23	100.97	97.28	105.29	102.44	103.13	81.95
U.P. (West)	B	102.8	149.59	78.81	145.12	106.74	120.07	125.93	96.05
West Bengal	B	24.8	36.09	36.44	53.30	25.11	37.74	36.27	30.19
Assam	C	8.2	11.93	29.96	52.37	49.76	36.01	39.86	28.80
Bihar	C	40.6	59.08	63.82	118.60	86.88	82.10	75.35	65.68
Himachal Pradesh	C	7.4	10.77	9.84	12.09	19.31	13.00	11.43	10.40
Jammu & Kashmir	C	6	8.73	25.55	27.07	9.70	17.76	17.63	14.21
North East	C	8.4	12.22	21.85	28.47	13.41	18.99	17.63	15.19
Orissa	C	19.4	28.23	24.25	74.95	32.78	40.05	30.51	32.04
Pan India		3349.86	4874.59	2244.12	2860.03	3656.37	3408.78	3142.20	2727.02

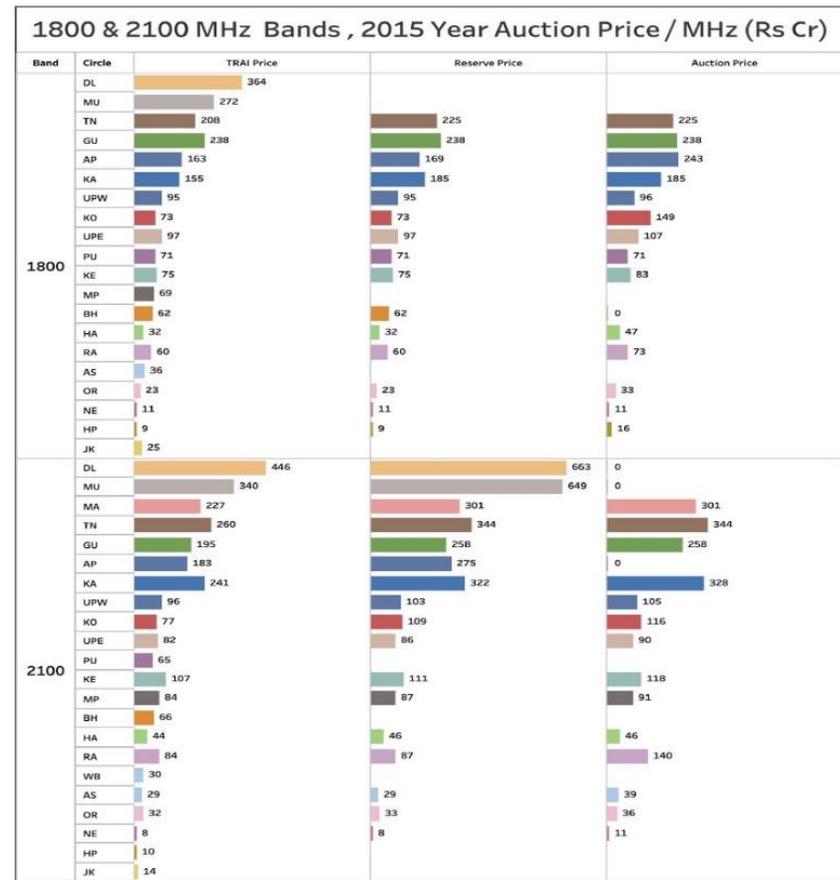
**DOT Later Increased these prices to the price discovered in 2010**



# 2G Auction Highlights (2015)



900 MHz – AP exploded (3.6 x RP for RA, 4 x RP for UPE, 5.2 x RP for UPW)  
 800 MHz – AP increased for Delhi, Mumbai, Maha, AP & MP



1800 MHz – Mostly Got Sold at Reserve Price  
 2100 MHz – All Bids were taken @ Reserve Price

# 2G Auction Highlights (2015)

## Spectrum Unsold

Circle	800					900						1800									2100					
	Offered Auction	Sold RCOM	Sold Tata	Sold RJIO	Unsold Auction	Offered Auction	Sold Bharti	Sold Voda	Sold Idea	Sold RCOM	Unsold Auction	Offered Auction	Sold Bharti	Sold Voda	Sold Idea	Sold Aircel	Sold Reliance	Sold Tata	Sold RJIO	Unsold Auction	Offered Auction	Sold Bharti	Sold Voda	Sold Idea	Unsold Auction	
AP	6.25		3.75		2.50	14.00	9.00		5.00		2.50	3.80	1.20					2.60			5.00				5.00	
AS	13.75	5.00		5.00	3.75	6.20	6.20														5.00		5.00			
BH	5.00			5.00		6.20	1.60				4.60	2.00													2.00	
DL	3.75		1.25		2.50																					2.00
GU	2.50	2.50				14.00		6.00	5.00		3.00	3.40		3.40												
HA	7.50	1.25	1.25	5.00		12.40		6.20	6.00		0.20	8.00	3.40			0.60			4.00		5.00	5.00				
HP	8.75	2.50		5.00	1.25	12.40	7.40			5.00		10.20		4.80					5.40							
JK	8.75	2.50		5.00	1.25																					
KA	1.25				1.25	14.00	8.80		5.00		0.20	1.80		1.00		0.60					5.00		5.00			
KE						12.40		6.40	6.00			1.00		1.00							5.00		5.00			
KO	1.25	1.25										7.00	2.00						5.00		5.00			5.00		
MA	3.75		2.50		1.25	14.00		5.00	9.00												5.00	5.00				
MP	6.25			5.00	1.25	12.40			7.40	5.00											5.00	5.00				
MU	7.50		2.50	5.00																	5.00	5.00				
NE	13.75	5.00		5.00	3.75	8.80	8.80					8.40	1.60	8.80	1.00		5.00				5.00		5.00		0.80	
OR	7.50	1.25		5.00	1.25	6.20	1.20	5.00				16.20	6.20	5.00		5.00					5.00	5.00				
PU	3.75	2.50			1.25	15.60	10.00		5.60			1.60	1.00			0.60										
RA						12.40	6.00	6.40				10.40							10.00	0.40	5.00		5.00			
TN	1.25				1.25							19.00		6.40	10.00				0.60	2.00	5.00	5.00				
UPE	3.75			3.75		6.20		5.60		0.60		4.20		1.20					3.00		5.00	5.00				
UPW	1.25	1.25				6.20			5.00	1.20											5.00					
WB	1.25	1.25				4.40	2.20	2.20				2.20											5.00		5.00	
Total	108.75	26.25	11.25	48.75	22.50	177.80	61.20	42.80	54.00	10.00	9.80	99.20	15.40	5.60	20.40	10.00	11.80	2.60	28.00	5.40	85.00	35.00	30.00	5.00	15.00	

800 MHz – 21 % Unsold

900 MHz – 5.5 % Unsold

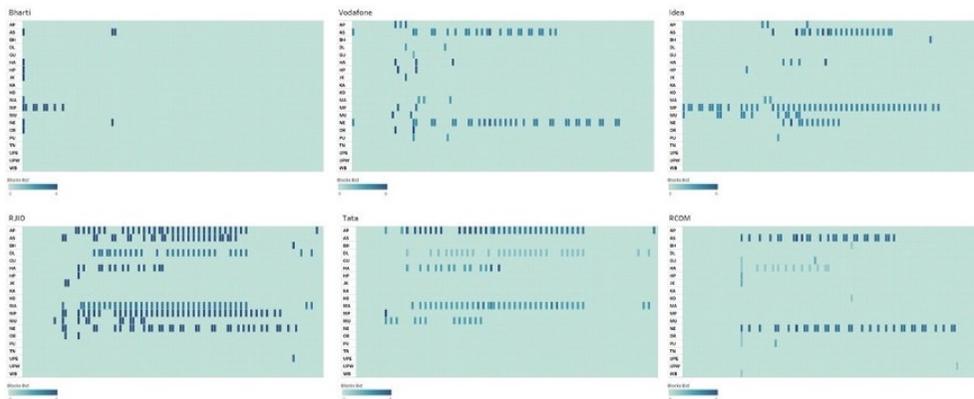
1800 MHz – 5.4 % Unsold

2100 MHz – 17.6 % Unsold

# 2G Auction Highlights (2015)

## Bidding Intensity

2015 Bidding Matrix (800 MHz)

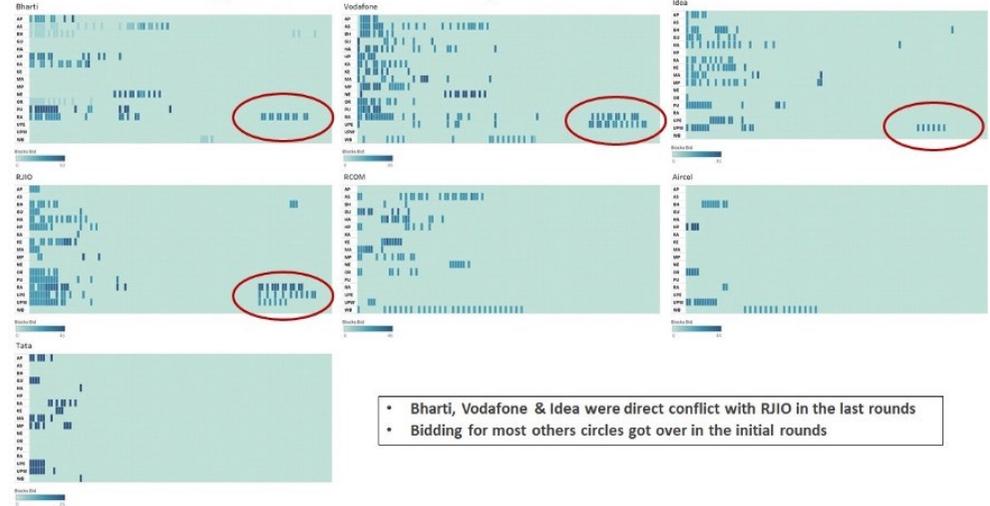


- RJIO & Tata were in tussle for AP, Delhi, and Maharashtra

- Vodafone & RCOM fought for NE & Assam
- Bharti got out in the initial rounds
- Idea focused on MP and also bid for NE and Assam

Bidding intensity was high but for few selected circles

2015 Bidding Matrix (900 MHz)



- Bharti, Vodafone & Idea were direct conflict with RJIO in the last rounds
- Bidding for most others circles got over in the initial rounds

**RJIO bumped the prices for RA, UPE and UPW many times the reserve price but did not win a single MHz of spectrum**

# 2G Auction Highlights (2015)

## Operators' Outflow

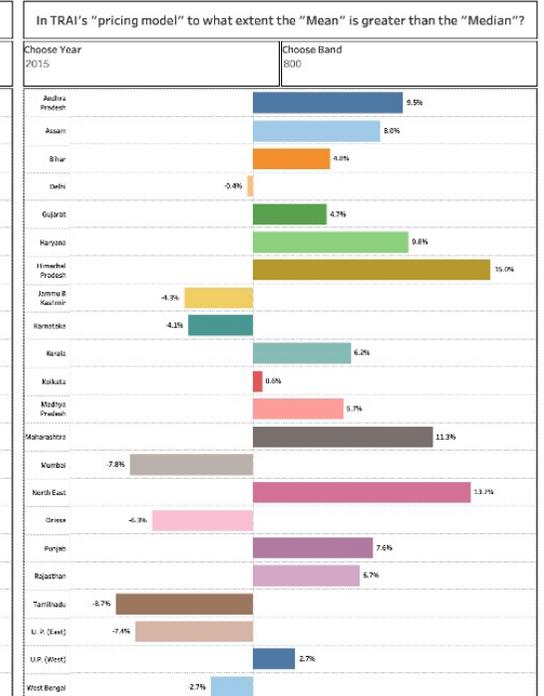
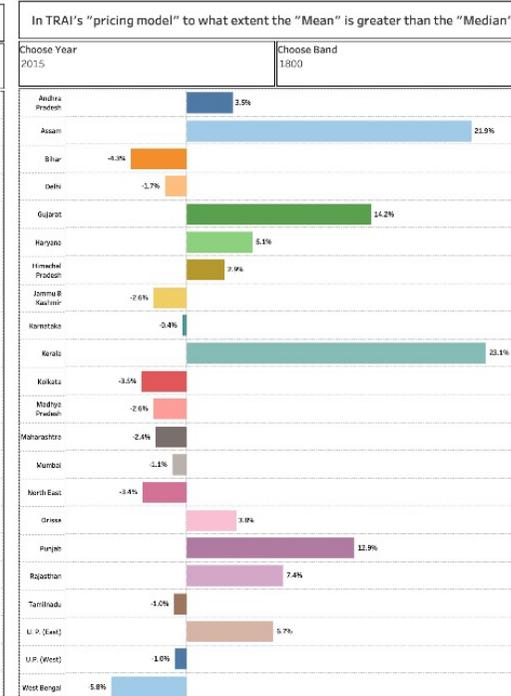
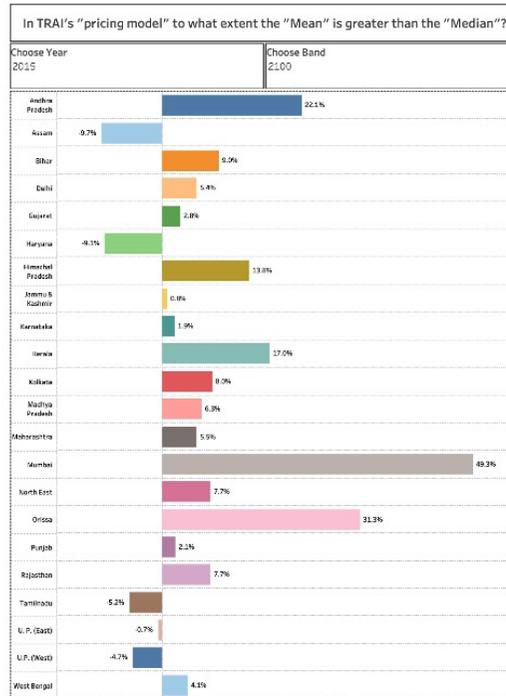
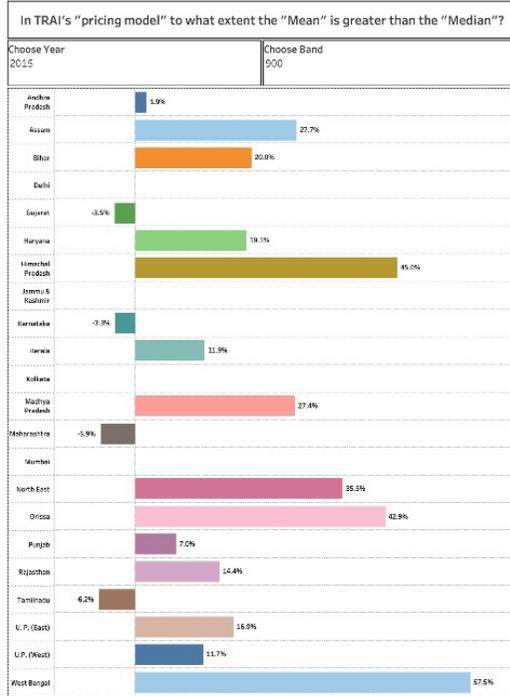
Circle	800	800	800	800	900	900	900	900	900	1800	1800	1800	1800	1800	2100	2100	2100	2100	Total	Total	Total	Total	Total	Total	Total	Grand
	RCOM	Tata	RJIO	Total	Bharti	Voda	Idea	RCOM	Total	Bharti	Voda	Idea	Aircel	RCOM	Bharti	Voda	Idea	Total	Bharti	Voda	Idea	Aircel	RCOM	Tata	RJO	Total
AP		2272		2272	6127		3404		9531	291									6418		3404			2904		12726
AS	411		411	822	1147				1147							193		193	1147	193			411		411	2162
BH			429	429	711				711										711						429	1140
DL		1060		1060																				1060		1060
GU	694			694		4038	3365		7403		809				1290			1290	1290	4847	3365		694			10197
HA	71	71	283	424		937	907		1845	158				28	230			230	388	937	907		99	71	469	2872
HP	49		98	147	425			287	712			76							425		76		336		184	1021
JK	71		141	212																			71		141	212
KA					4906		2788		7694			185		111		1642		1642	4906	1642	2973		111			9632
KE						2364	2216		4581		83					589		589		3036	2216					5253
KO	184			184						298							578	578	298		578		184		746	1805
MA		1999		1999		3865	6957		10822						1505			1505	1505	3865	6957			1999		14326
MP			2042	2042			2290	1548	3838						457			457	457		2290		1548		2042	6337
MU		1819	3637	5456																				1819	3637	5456
NE	127		127	254	457				457	18		11		55		55		55	474	55	11		182		127	849
OR	51		205	257	167	695			862	205		166		166	180			180	552	695	166		217		205	1835
PU	215			215	3608		2020		5628	71				43					3679		2020		257			5956
RA					4252	4535			8787							699		699	4252	5234					728	10214
TN												1440	2250		1720			1720	1720		1440	2250			135	5545
UPE			503	503		4343			4343		128				452			452	452	4472					823	5747
UPW	119			119			3693		3693			211				525		525		525	3904		119			4548
WB	71			71	457	457			913										457	457			71			984
<b>Total</b>	<b>2062</b>	<b>7220</b>	<b>7876</b>	<b>17159</b>	<b>22255</b>	<b>21235</b>	<b>27640</b>	<b>1835</b>	<b>72965</b>	<b>1042</b>	<b>1021</b>	<b>2089</b>	<b>2250</b>	<b>402</b>	<b>5834</b>	<b>3704</b>	<b>578</b>	<b>10115</b>	<b>29130</b>	<b>25960</b>	<b>30307</b>	<b>2250</b>	<b>4299</b>	<b>7851</b>	<b>10078</b>	<b>109875</b>

Total Outflow Was Rs 109875 Cr

# 2G Auction Key Issues (2015)

- Predatory & Irrational Bidding by Competitors
  - **Some Players bid** with an intent “**Not to Win**” but to raise the price for incumbents
- No Alternate Spectrum Band Was Offered For 900 MHz
  - Incumbents with expiring license had no leverage
- Auction Prices Were Not Close to the Valuations
  - TRAI ground up valuation numbers were much less
- TRAI used ‘Mean’ while aggregating prices emanating from various models
  - TRAI should have used “Median” as it did in 2014 auction
- DoT offered only 2x5 MHz of 2100 MHz band into auction
  - Spectrum was available as Defence had vacate 15 MHz using swapping mechanism
- DoT further raised reserve price beyond what was recommended by TRAI

# 2G Auction Key Issues (2015)



In Most Band Circles Median Values Are Significantly Lower Than The Mean Values

# 4G Auction Background (2016)

- 27<sup>th</sup> Jan 2016 - TRAI Recommended Reserve Price for Auctions
- 8<sup>th</sup> Aug 2016 – DOT Issued NIA for Auctions
- 1<sup>st</sup> Oct 2016 – 4G Auction Started
- 6<sup>th</sup> Oct 2016 – 4G Auction Ended
  
- TRAI's Reserve Price Modeling
  - RP was set as MAX of two figures
    - 80% of the Average Valuation
    - 2015 AP/2014 AP (Duly Indexed)
  - RP was set as 80% of Avg Val in LSA
    - where no spectrum was offered in 2014 & 2015
  - RP was set as MIN of the figures
    - 80% of Average Valuation
    - RP of 2015 where spectrum offered in 2015 but was unsold

# 4G Auction Highlights (2016)

## TRAI Calculation of RP (1800 MHz)

TRAI's 1800 MHz Reserve Price Model for 2016 Auction												
1	2	3	4	5	6	7	8	9	10	11	12	13
LSA	Spectrum Offerd in Last Auction (Y/N) [Mar 2015]	Spectrum Offerd in Mar 2015 (Sold/Unsold)	1800 MHz AP Mar 2015	1800 MHz AP Duly Indexed Feb 2014	Producer Surplus Model	Production Function Model	Revenue Surplus Model	Average Value (4 to 8)	Median Value (4 to 8)	80% of Average Value (9)	Reserve Price = MAX(4,5,11)	Remarks
Delhi	N	NA		398.71	185.02	204.21	208.4	249.09	204.21	199.27	399	
Mumbai	N	NA		297.94	233.62	142.15	142.93	204.16	142.93	163.33	298	
Kolkata	Y	Sold	149.1		98.02	48.51	57.44	88.27	57.44	70.61	149	
Andhra Pradesh	Y	Sold	242.8		133.85	134.07	234.14	186.22	134.07	148.97	243	
Gujarat	Y	Sold	238		246.98	130.58	150.18	191.44	150.18	153.15	238	
Karnataka	Y	Sold	185		191.56	129.21	212.6	179.59	191.56	143.67	185	
Maharashtra	N	NA		318.04	248.04	171.84	249.34	246.82	248.04	197.45	318	
Tamilnadu	Y	Sold	225		128.61	191.23	290.19	208.76	191.23	167.01	225	
Haryana	Y	Sold	46.6		76.24	25.54	49.03	49.35	49.03	39.48	47	
Kerala	Y	Sold	83.45		92.07	35.79	165.9	94.30	92.07	75.44	83	
Madhya Pradesh	N	NA		55.21	174.21	62.12	122.16	103.43	122.16	82.74	83	
Punjab	Y	Sold	71		180.68	36.23	97.1	96.25	97.10	77.00	77	
Rajasthan	Y	Sold	72.75		182.98	60.36	138.88	113.74	138.88	90.99	91	
U. P. (East)	Y	Sold	106.95		238.18	73.17	156.04	143.59	156.04	114.87	115	
U.P. (West)	Y	Sold	95.95		160.95	54.73	105.86	104.37	105.86	83.50	96	
West Bengal	N	NA		26.95	87.34	48.12	65.99	57.10	65.99	45.68	46	
Assam	N	NA		39.54	60.27	20.23	71.49	47.88	60.27	38.31	40	
Bihar	Y	Unsold		47.21	182.2	48.59	126.09	101.02	126.09	80.82	62	RP of Mar 15
Himachal Pradesh	Y	Sold	15.9		18.63	6.28	21.89	15.68	18.63	12.54	16	
Jammu & Kashmir	N	NA		6.68	48.27	15.43	59.79	32.54	48.27	26.03	26	50% discount
North East	Y	Sold	11		45.78	5.68	38.5	25.24	38.50	20.19	20	50% discount
Orissa	Y	Sold	33.1		83.86	15.2	58.33	47.62	58.33	38.10	38	
Pan India			1577	1190	3097	1659	2822	2586	2497	2069	2894	

DOT Accepted These Prices as Reserve Prices

Reserve Price is Just an Indexed Value of 2014 OR 2015 in 16 of the 22 Circles

# 4G Auction Highlights (2016)

## TRAI Calculation of RP (800 MHz)

TRAI's 800 MHz Reserve Price Model for 2016 Auction																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
LSA	Spectrum Offered in Last Auction (Y/N) (Mar 2015)	Spectrum Offered in Mar 2015 (Sold/Unsold)	800 MHz AP Mar 2015	Growth Data Usage Model	1.5 X Average Val of 1800 MHz	2 X Average Val of 1800 MHz	Producers Surplus Model	GSDP Per Capita, ARPU & AGR	ARPU, MOU/Sub & Residual Tele Density	ARPU GDP Growth & Subs	AGR	ARPU	900 MHz AP of 2015 OR 2014 Duly Indexed	Average Value (4 to 14)	80% of Average Value (15)	Reserve Price = MAX(4,16)	Remarks
Delhi	Y	Sold	847.70	476.39	598.07	797.42	417.67						811.62	658.15	526.52	848	
Mumbai	Y	Sold	727.50	332.62	446.91	595.88	393.02						616.79	518.79	415.03	728	
Kolkata	Y	Sold	147.00	113.45	223.65	298.20	207.45						213.19	200.49	160.39	160	
Andhra Pradesh	Y	Sold	605.98	194.10	364.20	485.60	83.67						680.75	402.38	321.91	606	
Gujarat	Y	Sold	277.74	144.22	357.00	476.00	208.85						673.00	356.14	284.91	285	
Karnataka	Y	Unsold		232.80	277.50	370.00	382.37	578.64	607.01	488.29	687.78	599.53	557.50	478.14	382.51	303	RP of Mar 15
Maharashtra	Y	Sold	799.42	206.05	477.06	636.08	136.30						773.00	504.65	403.72	799	
Tamilnadu	Y	Unsold		249.47	337.50	450.00	531.42	700.43	372.39	569.12	827.23	519.77		506.37	405.10	360	RP of Mar 15
Haryana	Y	Sold	56.57	29.42	74.03	98.71	17.95						151.20	71.31	57.05	57	
Kerala	N	NA		98.92	141.46	188.61	109.23	515.40	577.54	646.41	157.58	237.12	369.40	304.17	243.33	243	80% of Avg Val
Madhya Pradesh	Y	Sold	408.39	88.65	155.14	206.85	52.85						309.50	203.56	162.85	408	
Punjab	Y	Sold	85.85	68.78	144.38	192.50	41.28						360.75	148.92	119.14	119	
Rajasthan	N	NA		172.35	170.61	227.49	140.92	251.56	366.80	179.09	179.30	155.88	708.65	255.27	204.21	204	80% of Avg Val
U. P. (East)	Y	Sold	134.00	82.13	215.38	287.17	145.49						775.60	273.30	218.64	219	
U.P. (West)	Y	Sold	95.00	64.86	156.56	208.74	102.98						738.55	227.78	182.23	182	
West Bengal	Y	Sold	57.00	60.68	85.65	114.20	90.87						207.50	102.65	82.12	82	
Assam	Y	Sold	82.22	10.30	71.82	95.77	*						184.95	89.01	71.21	82	
Bihar	Y	Sold	85.85	71.24	151.53	202.05	66.56						444.30	170.26	136.20	136	
Himachal Pradesh	Y	Sold	19.57	14.02	23.85	31.80	33.12						57.45	29.97	23.97	24	
Jammu & Kashmir	Y	Sold	28.28	6.44	48.81	65.09	20.98							33.92	27.14	28	
North East	Y	Sold	25.38	7.76	37.86	50.48	*						51.90	34.68	27.74	28	
Orissa	Y	Sold	41.04	22.02	71.44	95.25	62.26						139.00	71.84	57.47	57	
Pan India			4524.49	2746.67	4630.41	6173.89	3245.24	2046.03	1923.74	1882.91	1851.89	1512.30	8824.60	5641.73	4513.38	5960	

DOT Accepted These Prices as Reserve Prices

Reserve Price is Just an Indexed Value of 2014 OR 2015 in 8 of the 22 Circles

# 4G Auction Highlights (2016)

## TRAI Calculation of RP (900 MHz)

TRAI's 900 MHz Reserve Price Model for 2016 Auction															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Spectrum Offer in Last Auction (Y/N) [Mar 2015]	Spectrum Offer in Mar 2015 (Sold/Unsold)	900 MHz AP Mar 2015 OR (Duly Indexed Feb 2014)	Economic Premium over 1800 MHz + Avg Val of 1800 MHz	1.5 X Average Val of 1800 MHz	2 X Average Val of 1800 MHz	PoP,AGR/PoP, Residual Tele Density and GSDP Growth	Data Usage MoU and GSDP Growth	ARPU Subs and GSDP Growth	AGR	ARPU	800 MHz AP Price (Mar 2015)	Average Value (4 to 13)	80% of Average Value (14)	Reserve Price = MAX(2,8)
Delhi	N	NA	811.62	513.46	598.07	797.42						847.70	713.65	570.92	812
Mumbai	N	NA	616.79	359.23	446.91	595.88						727.50	549.26	439.41	617
Kolkata	N	NA	213.19	194.39	223.65	298.20						147.00	215.29	172.23	213
Andhra Pradesh	Y	Sold	680.75	533.26	364.20	485.60						605.98	533.96	427.17	681
Gujarat	Y	Sold	673.00	451.04	357.00	476.00						277.74	446.96	357.56	673
Karnataka	Y	Sold	557.50	443.53	277.50	370.00							412.13	329.71	558
Maharashtra	Y	Sold	773.00	601.95	477.06	636.08						799.42	657.50	526.00	773
Tamilnadu	N	NA		491.06	337.50	450.00	558.88	905.74	774.01				586.20	468.96	469
Haryana	Y	Sold	151.20	164.46	74.03	98.71						56.57	108.99	87.20	151
Kerala	Y	Sold	369.40	311.21	141.46	188.61							252.67	202.14	369
Madhya Pradesh	Y	Sold	309.50	360.86	155.14	206.85						408.39	288.15	230.52	310
Punjab	Y	Sold	360.75	281.02	144.38	192.50						85.85	212.90	170.32	361
Rajasthan	Y	Sold	708.65	356.56	170.61	227.49							365.83	292.66	709
U. P. (East)	Y	Sold	775.60	466.20	215.38	287.17						134.00	375.67	300.54	776
U.P. (West)	Y	Sold	738.55	296.28	156.56	208.74						95.00	299.03	239.22	739
West Bengal	Y	Sold	207.50	283.34	85.65	114.20						57.00	149.54	119.63	208
Assam	Y	Sold	184.95	166.46	71.82	95.77						82.22	120.24	96.20	185
Bihar	Y	Sold	444.30	311.92	151.53	202.05						85.85	239.13	191.30	444
Himachal Pradesh	Y	Sold	57.45	66.28	23.85	31.80						19.57	39.79	31.83	57
Jammu & Kashmir	N	NA		129.84	48.81	65.09	220.72	142.52	226.29	89.01	241.12	28.28	132.41	105.93	106
North East	Y	Sold	51.90	122.22	37.86	50.48						25.38	57.57	46.05	52
Orissa	Y	Sold	139.00	173.85	71.44	95.25						41.04	104.12	83.29	139
Pan India			8824.60	7078.42	4630.41	6173.89	779.60	1048.26	1000.30	89.01	241.12	4524.49	6860.98	5488.78	9399.49

DOT Accepted These Prices as Reserve Prices

Reserve Price is Just an Indexed Value of 2015 in 6 of the 22 Circles

# 4G Auction Highlights (2016)

## TRAI Calculation of RP (2100 MHz)

TRAI's 2100 MHz Reserve Price Model for 2016 Auction											
1	2	3	4	5	6	7	8	9	10	11	12
LSA	Spectrum Offerd in Last Auction (Y/N) [Mar 2015]	Spectrum Offerd in Mar 2015 (Sold/Unsold)	2100 MHz AP of 2015 OR 2010 Duly Indexed	0.83 X Average Val of 1800 MHz	Producer Surplus Model	Growth Data Usage Model	Average Value (4 to 7)	Median Value (4 to 7)	80% of Average Value (8)	Reserve Price = MAX(4,10)	Remarks
Delhi	Y	Unsold	1057.45	330.93	246.93	1132.47	691.95	694.19	553.56	554	RP = 10 (no sale)
Mumbai	Y	Unsold	1035.15	247.29	261.89	761.16	576.37	511.53	461.10	461	RP = 10 (no sale)
Kolkata	Y	Sold	115.59	123.75	49.66	200.28	122.32	119.67	97.86	116	
Andhra Pradesh	Y	Unsold	437.71	201.52	193.28	526.52	339.76	319.62	271.81	272	RP = 10 (no sale)
Gujarat	Y	Sold	258.00	197.54	199.67	519.12	293.58	228.84	234.86	258	
Karnataka	Y	Sold	328.47	153.55	301.59	818.82	400.61	315.03	320.49	328	
Maharashtra	Y	Sold	301.00	263.97	254.92	886.45	426.58	282.49	341.26	341	
Tamilnadu	Y	Sold	344.00	186.75	303.96	816.56	412.82	323.98	330.26	344	
Haryana	Y	Sold	46.00	40.96	65.45	124.06	69.12	55.73	55.30	55	
Kerala	Y	Sold	117.71	78.27	272.73	417.56	221.57	195.22	177.26	177	
Madhya Pradesh	Y	Sold	91.35	85.84	157.27	280.45	153.73	124.31	122.98	123	
Punjab	N	NA	102.65	79.89	63.11	210.26	113.98	91.27	91.18	91	RP = 10 (Not offered)
Rajasthan	Y	Sold	139.82	94.41	162.05	250.15	161.61	150.94	129.29	140	
U. P. (East)	Y	Sold	90.30	119.18	132.50	207.90	137.47	125.84	109.98	110	
U.P. (West)	Y	Sold	105.07	86.63	158.61	206.28	139.15	131.84	111.32	111	
West Bengal	N	NA	39.53	47.39	69.48	101.70	64.53	58.44	51.62	52	
Assam	Y	Sold	38.64	39.74	59.37	90.67	57.10	49.56	45.68	46	
Bihar	N	NA	64.72	83.85	149.06	134.62	108.06	109.24	86.45	86	
Himachal Pradesh	N	NA	11.80	13.20	19.40	55.11	24.87	16.30	19.90	20	
Jammu & Kashmir	N	NA	9.56	27.01	31.63	41.33	27.38	29.32	21.90	11	50% Discount
North East	Y	Sold	11.07	20.95	32.10	59.78	30.97	26.53	24.78	12	50% Discount
Orissa	Y	Sold	36.05	39.53	72.94	41.73	47.56	40.63	38.05	38	
Pan India			4781.64	2562.15	3257.60	7882.98	4621.09	4000.47	3696.87	3747	

DOT Accepted These Prices as Reserve Prices

Reserve Price is Just an Indexed Value of 2010 OR 2015 in 18 of the 22 Circles

# 4G Auction Highlights (2016)

## TRAI Calculation of RP (700 MHz)

TRAI's 700 MHz Reserve Price Model for 2016 Auction	
1	2
<b>LSA</b>	<b>RP = 4 X 1800 MHz</b>
Delhi	1595
Mumbai	1192
Kolkata	596
Andhra Pradesh	971
Gujarat	952
Karnataka	740
Maharashtra	1272
Tamilnadu	900
Haryana	186
Kerala	334
Madhya Pradesh	331
Punjab	308
Rajasthan	364
U. P. (East)	459
U.P. (West)	384
West Bengal	183
Assam	158
Bihar	248
Himachal Pradesh	64
Jammu & Kashmir	104
North East	81
Orissa	152
<b>Pan India</b>	<b>11575</b>

**TRAI Committed a Serious Mistake in Pricing the 700 MHz, explained in the following Slides**

# 4G Auction Highlights (2016)

## Pricing Mistake of 700 MHz Band

Table Showing the Calculation Error

Page 104 of TRAI's Reco 23<sup>rd</sup> April 2012

Ratio : Unusually High

Euro/MHz/pop	Date of auction	800 MHz★	1800 MHz	Ratio (800/1800)
France	Dec-11	0.5809		
✗ Germany	May-10	✗ 0.6217	✗ 0.0218	28.52
Italy	Sep-11	0.6993	0.2252	3.11
Portugal	Dec-11	0.3616	0.2651	1.36
Spain	Jul-11	0.4043		
Sweden	2011	0.3174	0.1788	1.78
Simple Average		0.4809	0.1727	2.78

Exact Calculation : C = 2.78 ✗  
 Removing Germany : C = 2.12 ✓  
 TRAI's Calculation : C = 4.00 ✗

$$A / B = C$$

★ 800 MHz of Europe was linked with 700 MHz of India

TRAI Recommended 700 as **4 times** of 1800 Instead of **2 times**

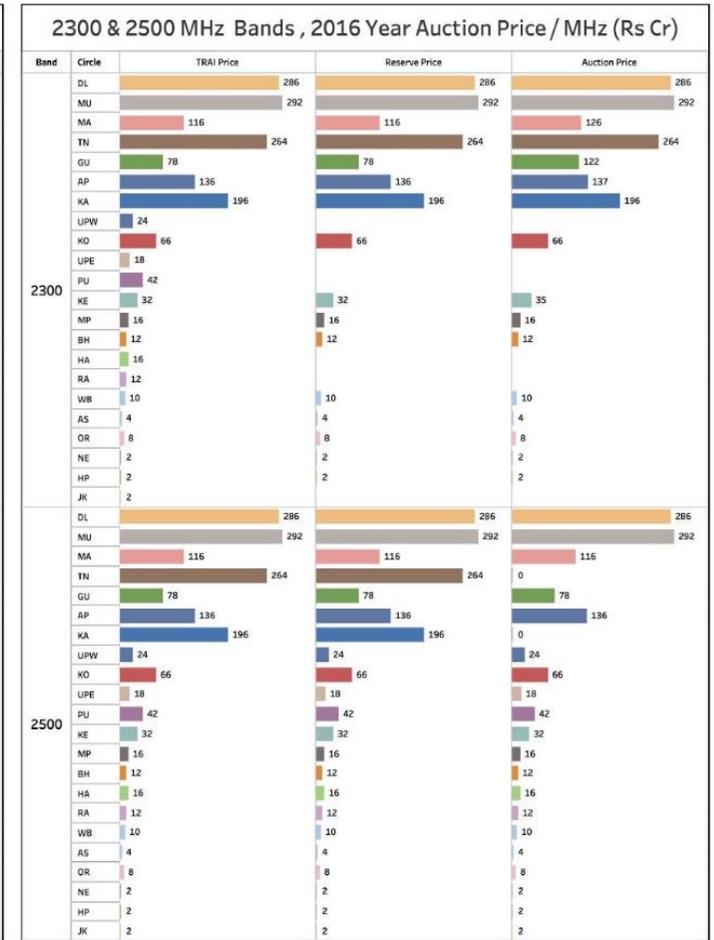
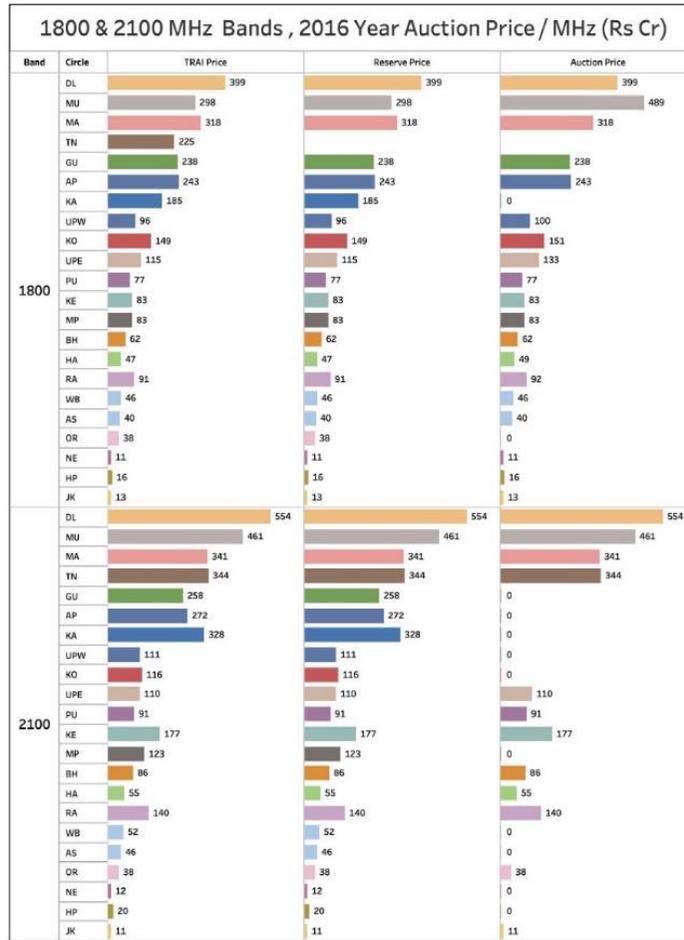
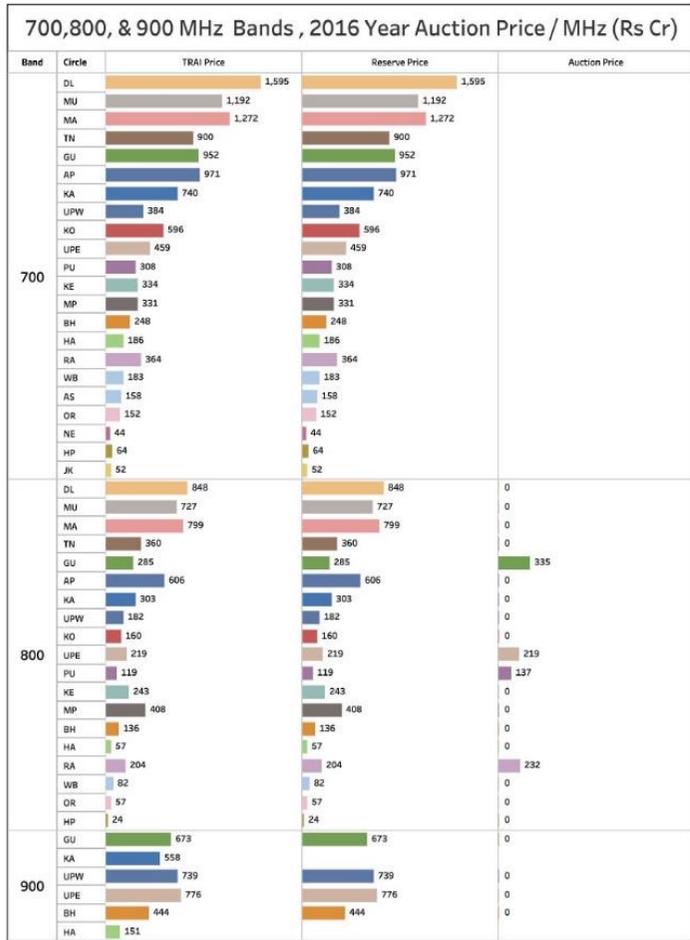
# 4G Auction Highlights (2016)

## TRAI Calculation of RP (2300 and 2500 MHz)

TRAI's 2300 & 2500 MHz Reserve Price Model for 2016 Auction				
1	2	3	4	5
LSA	2300 MHz AP May 2010 For FDD Equivalent	2300 MHz AP May 2010 For TDD Equivalent	2300 MHz AP of May 2010 Duly Indexed	Reserve Price = 80% of 4
Delhi	224.10	112.05	178.61	143
Mumbai	229.30	114.65	182.75	146
Kolkata	52.32	26.16	41.7	33
Andhra Pradesh	105.91	52.96	84.41	68
Gujarat	61.39	30.69	48.92	39
Karnataka	154.33	77.16	123	98
Maharashtra	91.56	45.78	72.98	58
Tamilnadu	206.95	103.47	164.93	132
Haryana	11.99	6.00	9.56	8
Kerala	25.87	12.93	20.62	16
Madhya Pradesh	12.47	6.23	9.94	8
Punjab	33.23	16.61	26.48	21
Rajasthan	9.73	4.87	7.76	6
U. P. (East)	14.25	7.13	11.36	9
U.P. (West)	18.39	9.19	14.65	12
West Bengal	7.10	3.55	5.66	5
Assam	3.30	1.65	2.63	2
Bihar	9.93	4.96	7.91	6
Himachal Pradesh	2.07	1.03	1.65	1
Jammu & Kashmir	2.13	1.06	1.7	1
North East	2.13	1.06	1.7	1
Orissa	6.36	3.18	5.07	4
Pan India	<b>1285</b>	<b>642</b>	<b>1024</b>	<b>819</b>

TRAI followed a different approach, why? –  
For consistency it should have used the indexed price of 2010 & 2015 auctions

# 4G Auction Highlights (2016)



700 & 900MHz – No Takers; 800 MHz – Only 4 Circles

1800 MHz– TN No Bid; 2100 MHz – 10 Circles No Bid

2300 MHz– 6 Circles No Bid; 2500 MHz – 2 Circles No Bid

# 4G Auction Highlights (2016)

## Spectrum Unsold

Circle	800		900		1800										2100					2300					2500													
	Offered	Sold	Unsold	Offered	Unsold	Offered	Sold	Sold	Sold	Sold	Sold	Sold	Sold	Sold	Sold	Unsold	Auction	Bharti	Voda	Idea	Auction	Auction	Bharti	Idea	RJIO	Auction	Auction	Voda	Idea	Auction								
AP	7.50		7.50			4.40								2.40		2.00	20.00				20.00	10.00			5.00		20.00			5.00	15.00	10.00	5.00	5.00	10.00	5.00	5.00	15.00
AS						19.80	3.80	8.00	5.00								3.00	15.00				15.00	10.00			5.00		20.00			5.00	10.00	5.00	5.00	10.00	5.00	5.00	10.00
BH	2.50		2.50	4.60	4.60	12.20			5.00	1.80					5.00	0.40	20.00	5.00		5.00	10.00	10.00			5.00		10.00			5.00	10.00		5.00	5.00	5.00	10.00	5.00	
DL	2.50		2.50			12.80		2.00								10.80	20.00	5.00			15.00	10.00			5.00		20.00	10.00			20.00	10.00			10.00	5.00	10.00	
GU	6.25	5.00	1.25	3.00	3.00	13.00		3.00	8.40							1.60	15.00				15.00	10.00			5.00		20.00	10.00			20.00	10.00	5.00	5.00	10.00	5.00	10.00	
HA	1.25		1.25			7.40	1.60		4.80						1.00	0.00	15.00		5.00		10.00						10.00				10.00	5.00	5.00	10.00	5.00	10.00	5.00	
HP	3.75		3.75			11.40			0.60						5.00	5.80	20.00				20.00	10.00			5.00		10.00				10.00		5.00	5.00	10.00	5.00		
JK						29.40	2.40		5.00			5.00			10.00	7.00	15.00	5.00			10.00						10.00				10.00		5.00	5.00	10.00	5.00		
KA	2.50		2.50			4.20										4.20	15.00				15.00	10.00			5.00		20.00				20.00			20.00	5.00	20.00		
KE						2.00		0.60								1.40	15.00	5.00			10.00	10.00			5.00		10.00				10.00	5.00	5.00	10.00	5.00	10.00		
KO	2.50		2.50			4.00	2.00	2.00									15.00				15.00	10.00			5.00		20.00	10.00			20.00	10.00			10.00	5.00	10.00	
MA	7.50		7.50			13.40	5.00		2.00				5.00			1.40	15.00		5.00		10.00	10.00			5.00	5.00	20.00	10.00			20.00	10.00	5.00	5.00	10.00	5.00		
MP	2.50		2.50			4.60			4.60							0.00	15.00				15.00	10.00			5.00		10.00				10.00		10.00	5.00	10.00	5.00		
MU	5.00		5.00			5.00							5.00				20.00			5.00	15.00	10.00			5.00		20.00	10.00			20.00	10.00	10.00	10.00	10.00	10.00		
NE						9.20	1.40	7.80								0.00	15.00				15.00	10.00			5.00		10.00				10.00	5.00	5.00	10.00	5.00	10.00		
OR	3.75		3.75			1.40										1.40	20.00		5.00		15.00	10.00			5.00		10.00				10.00	5.00	5.00	10.00	5.00	10.00		
PU	6.25	3.75	2.50	0.60	0.60	15.40	0.80	3.00	2.00					5.20	4.40	15.00			5.00		10.00	10.00			5.00		10.00				10.00	5.00		5.00	10.00	5.00		
RA	7.50	5.00	2.50			11.00	1.80	4.20	5.00								15.00	5.00	5.00	5.00	10.00						10.00				10.00	5.00		5.00	10.00	5.00		
TN	2.50		2.50														15.00			10.00	5.00	10.00			5.00		10.00				20.00			20.00	5.00	20.00		
UPE	3.75	1.25	2.50	0.60	0.60	5.40		2.00							3.40	0.00	15.00		5.00	5.00	5.00						10.00				10.00	5.00	5.00	10.00	5.00			
UPW	2.50		2.50	1.20	1.20	14.60		2.40	7.20						5.00	0.00	15.00				15.00						10.00				10.00	5.00	5.00	10.00	5.00			
WB	1.25		1.25			18.40		7.60	5.00						5.00	0.80	15.00				15.00	10.00			5.00		10.00				10.00	5.00	5.00	10.00	5.00			
Total	71.25	15.00	56.25	9.40	9.40	219.00	18.80	42.60	54.60	1.80	5.00	12.40	39.60	44.20			360.00	25.00	40.00	20.00	275.00	160.00	65.00	15.00	80.00		300.00	100.00	85.00	115.00								

800/900 MHz – 21/17 % Unsold

1800 MHz – 20 % Unsold

2100 MHz – 13 % Unsold

2300 MHz – 0 % Unsold

2500 MHz – 38 % Unsold

# 4G Auction Highlights (2016)

## Operators' Outflow

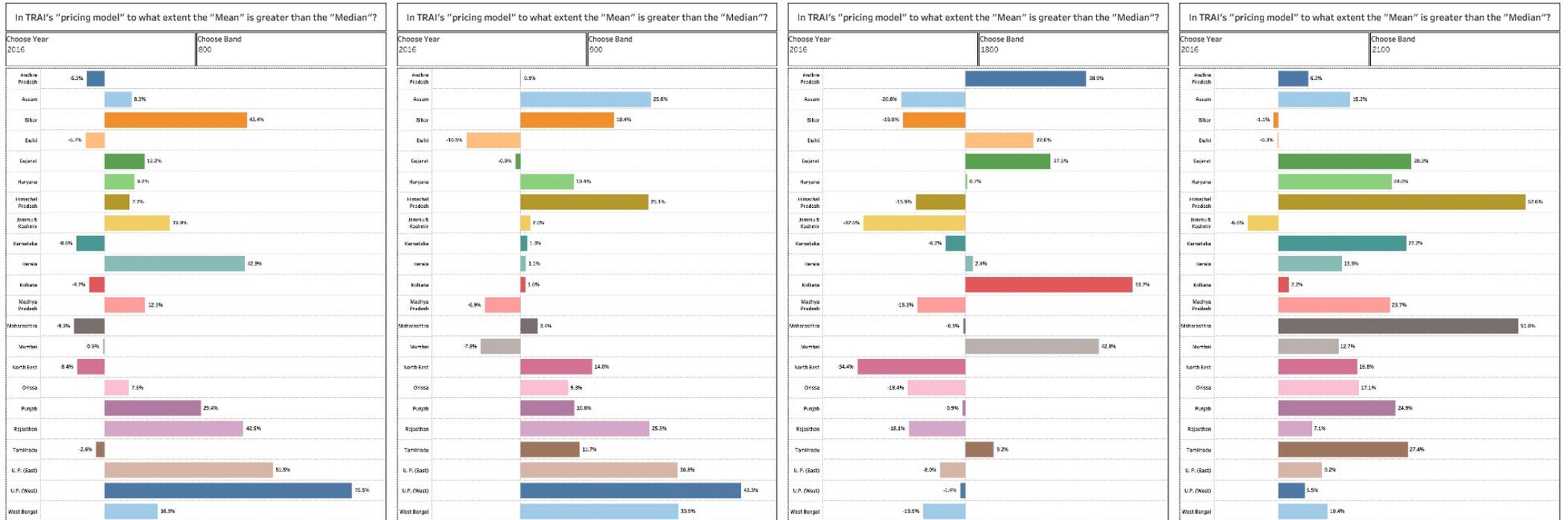
Circle	800		900	1800								2100				2300				2500			Total		Total		Total		Total		Grand	
	RJIO	Total	Total	Bharti	Voda	Idea	Aircel	RCOM	Tata	RJIO	Total	Bharti	Voda	Idea	Total	Bharti	Idea	RJIO	Total	Voda	Idea	Total	Bharti	Voda	Idea	Aircel	RCOM	Tata	RJIO	Total		
AP										583						683		683	1367		680	680	683					583	683			2630
AS				152	320	200										20	20	40	40	20	20	40	172	340	220				20		752	
BH						310	112				310	430		430	860	62		62	123		60	60	492		800	112			372	1775		
DL					798						798	2770			2770	1430		1430	2860	2860		2860	4200	3658					1430	9288		
GU	1677	1677			714	1999					2713					612		612	1224	780	390	1170	612	1494	2389				2289	6784		
HA				79		237				49	365		275	275					80	80	160	79	355	317				49	800			
HP						10				80	90				10		10	20		10	10	10		20				90	120			
JK				31		65		65		130	291	55		55							10	10	86		75	65		130	356			
KA															980		980	1960				980							980	1960		
KE					50						50	885		885		176	176	351	161	161	322	885	211	336				176	1608			
KO				302	302						605				330		330	660	660		660	632	962					330	1925			
MA				1590		636			1590		3816		1705	1705		631	631	1261	1160	580	1740	1590	2865	1847			1590	631	8522			
MP						382					382					82	82	164		160	160			624				82	706			
MU									2446		2446			2305	2305	1460		1460	2920	2920		2920	1460	2920	2305		2446	1460	10591			
NE				15	86						101				10		10	20	10	10	20	25	96	10				10	141			
OR												190		190	40		40	80	40	40	80	40	230	40				40	350			
PU	513	513		62	231	154				400	847		455	455					210		210	62	896	154				913	2025			
RA	1160	1160		165	386	460					1011	700	700	700	2100				60	60	120	865	1146	1220				1160	4391			
TN													3440	3440		1320		1320	2640				1320	3440				1320	6080			
UPE	274	274			266					453	719		550	550	1100				90	90	180		906	640				726	2273			
UPW					241	722					502	1464							120	120	240		361	842				502	1704			
WB					350	230					230	810				50		50	100	50	50	100	50	400	280				280	1010		
<b>Total</b>	<b>3623</b>	<b>3623</b>		<b>2397</b>	<b>3744</b>	<b>5404</b>	<b>112</b>	<b>65</b>	<b>4619</b>	<b>2154</b>	<b>18494</b>	<b>4840</b>	<b>7315</b>	<b>3985</b>	<b>16140</b>	<b>7007</b>	<b>888</b>	<b>7895</b>	<b>15790</b>	<b>9221</b>	<b>2521</b>	<b>11742</b>	<b>14244</b>	<b>20279</b>	<b>12798</b>	<b>112</b>	<b>65</b>	<b>4619</b>	<b>13672</b>	<b>65789</b>		

Total Outflow Was Rs 65789 Cr

# 4G Auction Key Issues (2016)

- Reserve price models resulted in too simplistic outcome
  - Leading to a conclusion that these complex models were not needed at all
- 700 MHz pricing was done in a casual manner
  - This pricing was against TRAI's own earlier recommendation
- TRAI completely ignored its own recommendation
  - It recommended the Reserve price to be distinct from the valuation of the spectrum
- TRAI used simple averages to arrive at spectrum valuation
  - Median was not considered to filter outliers

# 4G Auction Key Issues (2016)



In Most Band Circles Median Values Are Significantly Lower Than The Mean Values

# 4G Auction Background (2021)

- 1<sup>st</sup> Aug 2018 - TRAI Recommended Reserve Price for Auctions
  - 6<sup>th</sup> Jan 2021 – DOT Issued NIA for Auctions
  - 1<sup>st</sup> March 2021 – 4G Auction Started
  - 2<sup>nd</sup> March 2021 – 4G Auction Ended
- 
- TRAI's Reserve Price Modeling
    - Average Valuation MAX of two figures
      - Average Valuation Based on Simple Mean
      - Auctioned Determined Price of 2016 (Duly Indexed)

# 4G Auction Highlights (2021)

## TRAI Calculation of RP (1800 MHz)

TRAI's 1800 MHz Reserve Price Model for 2021 Auction												
1	2	3	4	5	6	7	8	9	10	11	12	13
LSA	Spectrum Offered in Last Auction (Y/N)	1800 MHz RP Oct 2016	1800 MHz AP of 2016 Duly Indexed	Producer Surplus Model	Production Function Model	Multiple Regression	Revenue Surplus Model	Average Value (4 to 8)	Median Value (4 to 8)	80% of Average Value [9]	Reserve Price	Remarks
Delhi	Y	398.71	457.42	336.03	206.13	713	127.76	368.07	336.03	294.45	457	
Mumbai	Y	297.94	560.82	260.52	139.15	439	93.06	298.51	260.52	238.81	561	
Kolkata	Y	149.10	173.28	75.07	36.41	95	28.24	81.60	75.07	65.28	173	
Andhra Pradesh	Y	242.80	278.58	147.62	91.03	489	161.96	233.64	161.96	186.91	279	
Gujarat	Y	238.00	272.85	208.18	73.33	423	84.23	212.32	208.18	169.85	273	
Karnataka	Y	185.00		162.55	95.56		152.45	136.85	152.45	109.48	109	
Maharashtra	Y	318.04	364.56	237.52	105.07	726	145.74	315.78	237.52	252.62	365	
Tamilnadu	N	225.00		131.38	93.94		148.26	124.53	131.38	99.62	100	
Haryana	Y	46.60	56.52	47.22	22.8	57	26.85	42.08	47.22	33.66	57	
Kerala	Y	83.45	95.15	101.58	46.93	192	125.25	112.18	101.58	89.75	95	
Madhya Pradesh	Y	82.74	95.15	167.09	64.25	112	71.42	101.98	95.15	81.59	95	
Punjab	Y	77.00	88.27	163.54	39.73	114	68.96	94.90	88.27	75.92	88	
Rajasthan	Y	90.99	105.36	153.34	65.97	110	64.24	99.78	105.36	79.83	105	
U. P. (East)	Y	114.87	152.64	218.56	80	95	81.61	125.56	95.00	100.45	153	
U.P. (West)	Y	95.95	114.99	109.73	60.03	79	50.96	82.94	79.00	66.35	115	
West Bengal	Y	45.68	52.73	59.55	46.53	48	35.81	48.52	48.00	38.82	53	
Assam	Y	39.54	45.86	47.63	26.62	45	38.36	40.69	45.00	32.56	46	
Bihar	Y	62.00	71.08	244.28	75.73	90	66.53	109.52	75.73	87.62	88	
Himachal Pradesh	Y	15.90	18.34	16	12.73	17	12.24	15.26	16.00	12.21	18	
Jammu & Kashmir	Y	26.03	14.9	32.37	22.78	14	21.6	21.13	21.60	16.90	15	Indexed 2016 AP
North East	Y	20.19	12.61	37.68	14.5	19	23.76	21.51	19.00	17.21	13	Indexed 2016 AP
Orissa	Y	38.10		46.5	30.97		23.85	33.77	30.97	27.02	27	
<b>Pan India</b>		<b>2894</b>	<b>3031</b>	<b>3004</b>	<b>1450</b>	<b>3877</b>	<b>1653</b>	<b>2721</b>	<b>2431</b>	<b>2177</b>	<b>3284</b>	
Rule - a) Sold in Last Auction? Then MAX(4,11)												
Rule - b) No Spectrum Offered in Last Auction? Then (11)												
Rule - c) Spectrum Offered & Unsold Then MIN(3,11)												

DOT Accepted These Prices as Reserve Prices

Reserve Price is Just an Indexed Value of 2016 in 18 of the 22 Circles

# 4G Auction Highlights (2021)

## TRAI Calculation of RP (900 MHz)

TRAI's 900 MHz Reserve Price Model for 2021 Auction										
1	2	3	4	5	6	7	8	9	10	11
LSA	Spectrum Offered in Last Auction (Y/N)	900 MHz RP Oct 2016	900 MHz AP Oct 2016 Duly Indexed	800 MHz AP Oct 2016 Duly Indexed	Economic Premium over 1800 MHz + Avg Val of 1800 MHz	1.5 X Average Val of 1800 MHz	2 X Average Val of 1800 MHz	Average Value (5 to 8)	80% of Average Value (9)	Reserve Price
Gujarat	Y	673.00		384.56	524.31	409.27	545.69	465.96	372.77	373
Karnataka	N	557.50			413.40	205.28	273.71	297.46	237.97	238
Tamilnadu	N	468.96			443.55	186.79	249.06	293.13	234.51	235
Haryana	N	151.20			184.56	84.78	113.04	127.46	101.97	102
U. P. (East)	Y	775.60		251.06	522.40	228.97	305.29	326.93	261.54	262
U.P. (West)	Y	738.55			388.18	172.48	229.97	263.54	210.83	211
Bihar	Y	444.30			370.07	164.29	219.05	251.14	200.91	201
<b>Pan India</b>				<b>635.62</b>	<b>2846.47</b>	<b>1451.86</b>	<b>1935.81</b>	<b>2025.62</b>	<b>1620.50</b>	<b>1620</b>
Rule - a) Sold in Last Auction? Then MAX(4,10)										
Rule - b) No Spectrum Offered in Last Auction? Then (10)										
Rule - c) Spectrum Offered & Unsold Then MIN(3,10)										

DOT Accepted These Prices as Reserve Prices

**Reserve Price got Reduced to 80% of Average Valuation (No Auction Price of 2016)**

# 4G Auction Highlights (2021)

## TRAI Calculation of RP (800 MHz)

TRAI's 800 MHz Reserve Price Model for 2021 Auction								
1	2	3	4	5	6	7	8	9
LSA	Spectrum Offerd in Last Auction (Y/N)	800 MHz RP Oct 2016	800 MHz AP of Oct 2016 Duly Indexed	1.5 X Average Val of 1800 MHz	2 X Average Val of 1800 MHz	Average Value (4 to 6)	80% of Average Value (7)	Reserve Price
Delhi	Y	847.70		686.13	914.84	800.49	640.39	640
Mumbai	Y	727.50		841.24	1121.65	981.45	785.16	728
Kolkata	Y	160.39		259.92	346.56	303.24	242.59	160
Andhra Pradesh	Y	605.98		417.87	557.16	487.52	390.01	390
Gujarat	Y	284.91	384.56	409.27	545.69	446.51	357.21	385
Karnataka	Y	303.00		205.28	273.71	239.50	191.60	192
Maharashtra	Y	799.42		546.84	729.12	637.98	510.38	510
Tamilnadu	Y	360.00		186.79	249.06	217.93	174.34	174
Haryana	Y	57.05		84.78	113.04	98.91	79.13	57
Kerala	N	243.33		168.28	224.37	196.33	157.06	157
Madhya Pradesh	Y	408.39		152.97	203.96	178.47	142.77	143
Punjab	Y	119.14	156.70	142.35	189.8	162.95	130.36	157
Rajasthan	Y	204.21	265.94	158.03	210.71	211.56	169.25	266
U. P. (East)	Y	218.64	251.06	228.97	305.29	261.77	209.42	251
U.P. (West)	Y	182.23		172.48	229.97	201.23	160.98	161
West Bengal	Y	82.12		79.1	105.47	92.29	73.83	74
Bihar	Y	136.20		164.29	219.05	191.67	153.34	136
Himachal Pradesh	Y	23.97		27.51	36.69	32.10	25.68	24
Orissa	Y	57.47		50.66	67.54	59.10	47.28	47
<b>Pan India</b>		<b>5821.65</b>	<b>1058.26</b>	<b>4982.76</b>	<b>6643.68</b>	<b>5800.96</b>	<b>4640.76</b>	<b>4652</b>
Rule - a) Sold in Last Auction? Then MAX(4,8)								
Rule - b) No Spectrum Offered in Last Auction? Then (8)								
Rule - c) Spectrum Offered & Unsold Then MIN(3,8)								

DOT Accepted These Prices as Reserve Prices

**Reserve Price got Depressed as in Many Circles Spectrum Offered Did not Sell**

# 4G Auction Highlights (2021)

## TRAI Calculation of RP (2100 MHz)

TRAI's 2100 MHz Reserve Price Model for 2021 Auction								
1	2	3	4	5	6	7	8	9
LSA	Spectrum Offered in Last Auction (Y/N)	2100 MHz RP Oct 2016	2100 MHz AP of Oct 2016 Duly Indexed	0.83 X Average Val of 1800 MHz	Average Value (4 to 5)	80% of Average Value (6)	Reserve Price	Remarks
Delhi	Y	553.56	635.11	379.66	507.39	405.91	635	
Mumbai	Y	461.10	528.5	465.48	496.99	397.59	529	
Kolkata	Y	115.59		143.82	143.82	115.06	115	
Andhra Pradesh	Y	271.81		231.22	231.22	184.98	185	
Gujarat	Y	258.00		226.46	226.46	181.17	181	
Karnataka	Y	328.47		113.59	113.59	90.87	91	
Maharashtra	Y	341.26	390.93	302.58	346.76	277.40	391	
Tamilnadu	Y	344.00	394.37	103.36	248.87	199.09	394	
Haryana	Y	55.30	63.05	46.91	54.98	43.98	63	
Kerala	Y	177.26	202.91	93.11	148.01	118.41	203	
Madhya Pradesh	Y	122.98		84.65	84.65	67.72	68	
Punjab	Y	91.18	104.32	78.77	91.55	73.24	104	
U. P. (East)	Y	109.98	126.11	126.7	126.41	101.12	126	
U.P. (West)	Y	111.32		95.44	95.44	76.35	76	
West Bengal	Y	51.62		43.77	43.77	35.02	35	
Assam	Y	45.68		38.06	38.06	30.45	30	
Bihar	Y	86.45	98.59	90.9	94.75	75.80	99	
Himachal Pradesh	Y	19.90		15.22	15.22	12.18	12	
Jammu & Kashmir	Y	10.95	12.61	17.54	15.08	12.06	13	
North East	Y	12.39		17.85	17.85	14.28	6	50% Discount
Orissa	Y	38.05	43.56	28.03	35.80	28.64	44	
<b>Pan India</b>		<b>3606.84</b>	<b>2600.06</b>	<b>2743.12</b>	<b>3176.63</b>	<b>2541.30</b>	<b>3400</b>	
Rule - a) Sold in Last Auction? Then MAX(4,7)								
Rule - b) No Spectrum Offered in Last Auction? Then (7)								
Rule - c) Spectrum Offered & Unsold Then MIN(3,7)								

DOT Accepted These Prices as Reserve Prices

**Reserve Price Became Equal to Indexed Value of 2016 in 11 of 22 Circles**

# 4G Auction Highlights (2021)

## TRAI Calculation of RP (2300 MHz)

TRAI's 2300 MHz Reserve Price Model for 2021 Auction				
1	2	3	4	5
LSA	2300 MHz AP Oct 2016 For FDD Equuvalent	2300 MHz AP May 2016 For TDD Equuvalent	2300 MHz RP Oct 2016	Reserve Price
Delhi	286.00	143.00	142.89	163.94
Mumbai	292.00	146.00	146.20	167.38
Kolkata	66.00	33.00	33.36	37.83
Andhra Pradesh	136.68	68.34	67.53	78.35
Gujarat	122.38	61.19	39.14	70.15
Karnataka	196.00	98.00	98.40	112.35
Maharashtra	126.12	63.06	58.38	72.29
Tamilnadu	264.00	132.00	131.94	151.33
Haryana			7.65	8
Kerala	35.13	17.57	16.50	20.14
Madhya Pradesh	16.40	8.20	7.95	9.4
Punjab			21.18	21
U. P. (East)			9.09	9
U.P. (West)			11.72	12
West Bengal	10.00	5.00	4.53	5.73
Assam	4.00	2.00	2.10	2.29
Bihar	12.30	6.15	6.33	7.05
Himachal Pradesh	2.00	1.00	1.32	1.15
Jammu & Kashmir			1.36	1
North East	2.00	1.00	1.36	1
Orissa	8.00	4.00	4.06	5
<b>Pan India</b>	<b>1579</b>	<b>790</b>	<b>813</b>	<b>956</b>
Rule - a) Last AP Duly Indexed				
Rule - b) Last Recommended RP where Spectrum Offered Not Sold				

DOT Accepted These Prices as Reserve Prices

**Reserve Price Became Equal to Indexed Value of 2016 in 16 of 22 Circles**

# 4G Auction Highlights (2021)

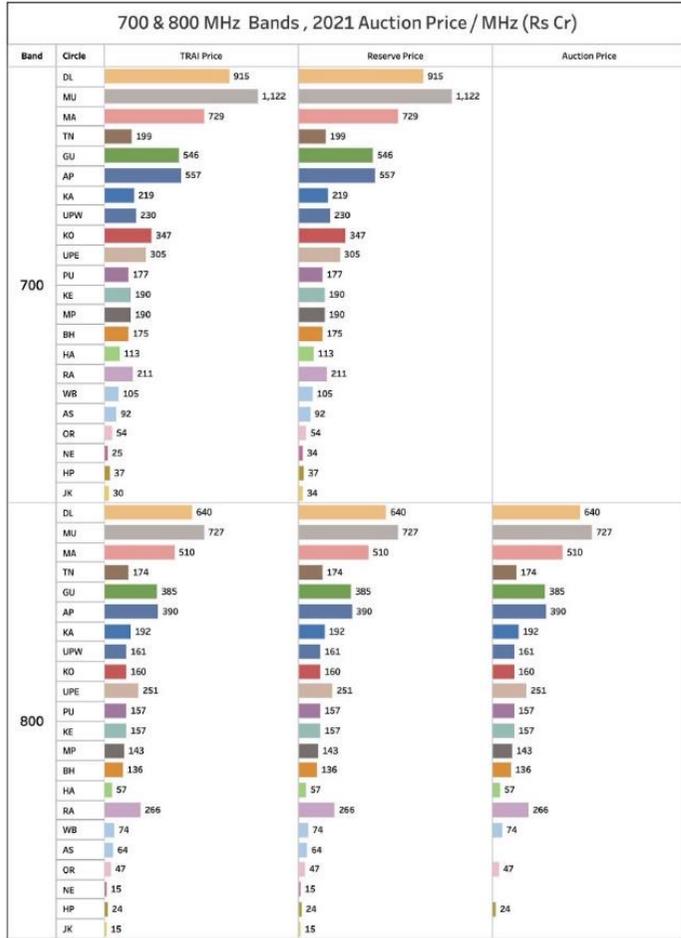
## TRAI Calculation of RP (2500 MHz)

TRAI's 2500 MHz Reserve Price Model for 2021 Auction					
1	2	3	4	5	5
LSA	2500 MHz AP Oct 2016 For FDD Equuvalent	2500 MHz AP May 2016 For TDD Equuvalent	2500 MHz RP Oct 2016	Reserve Price	Reserve Price Rounded
Delhi	286.00	143.00	142.89	163.94	164
Mumbai	292.00	146.00	146.20	167.38	167
Kolkata	66.00	33.00	33.36	37.83	38
Andhra Pradesh	136.00	68.00	67.53	77.96	78
Gujarat	78.00	39.00	39.14	44.71	45
Karnataka			98.40	98	98
Maharashtra	116.00	58.00	58.38	66.49	66
Tamilnadu			131.94	132	132
Haryana	16.00	8.00	7.65	9.12	9
Kerala	32.16	16.08	16.50	18.33	18
Madhya Pradesh	16.00	8.00	7.95	9.12	9
Punjab	42.00	21.00	21.18	24.07	24
U. P. (East)	18.00	9.00	9.09	10.26	10
U.P. (West)	24.00	12.00	11.72	13.68	14
West Bengal	10.00	5.00	4.53	5.70	6
Assam	4.00	2.00	2.10	2.28	2
Bihar	12.00	6.00	6.33	6.88	7
Himachal Pradesh	2.00	1.00	1.32	1.15	1
Jammu & Kashmir	2.00	1.00	1.36	1.15	1
North East	2.00	1.00	1.36	1.14	1
Orissa	8.00	4.00	4.06	4.56	5
<b>Pan India</b>	<b>1162</b>	<b>581</b>	<b>813</b>	<b>896</b>	<b>896</b>
Rule - a) Last AP Duly Indexed					
Rule - b) Last Recommended RP where Spectrum Offered Not Sold					
Cells marked yellow prices has been calculated by X 1.14, as it was not offered for auction					

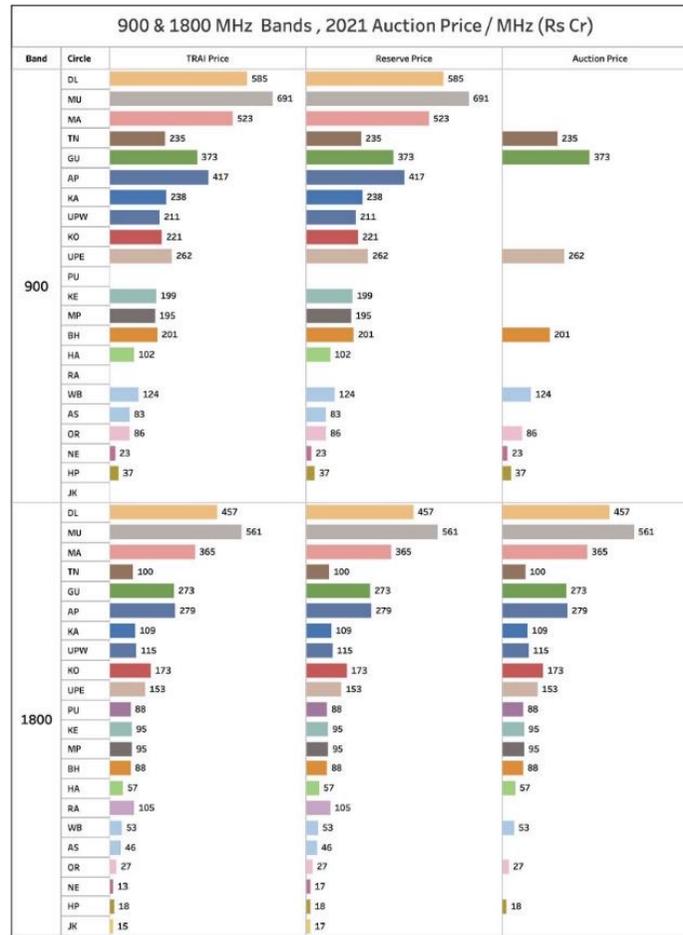
DOT Accepted These Prices as Reserve Prices

**Reserve Price Became Equal to Indexed Value of 2016 Auction in 14 of 22 Circles**

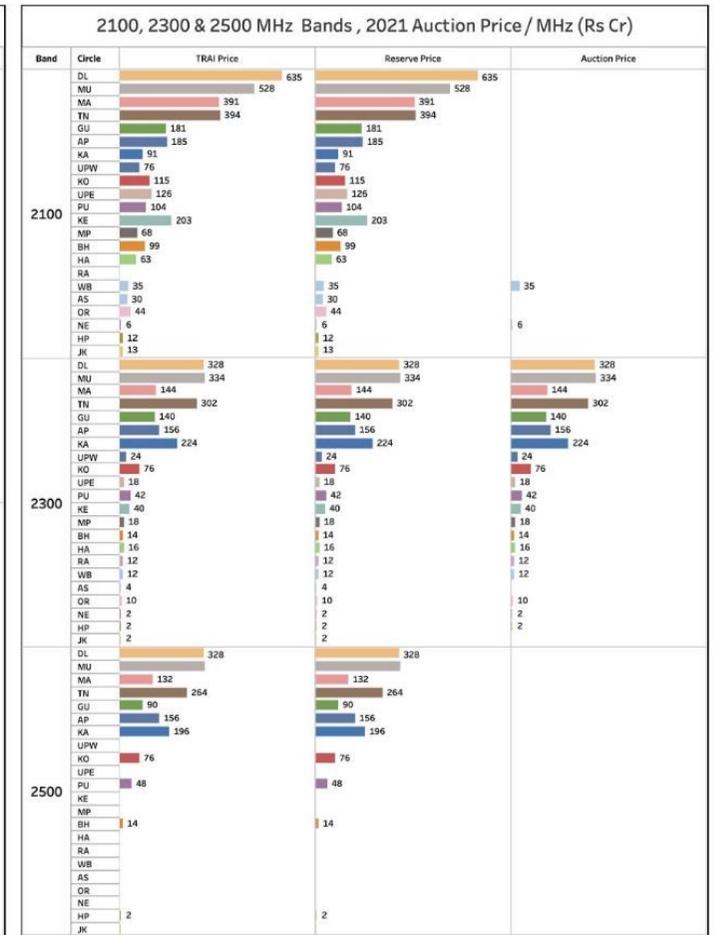
# 4G Auction Highlights (2021)



700 MHz – No Takers; 800 MHz – No Taker in 3 Circles



900MHz – Takers in 8 Circles; 1800 MHz – No Takers 4 Circles



2100 MHz – No Takers 19 Circles 2500 MHz – No Takers

# 4G Auction Highlights (2021)

## Spectrum Unsold

	700	700	800	800	800	800	900	900	900	900	1800	1800	1800	1800	1800	2100	2100	2100	2300	2300	2300	2300	2500	2500
	Offered	Unsold	Offered	Sold	Sold	Unsold	Offered	Sold	Sold	Unsold	Offered	Sold	Sold	Sold	Unsold	Offered	Sold	Unsold	Offered	Sold	Sold	Unsold	Offered	Unsold
Grde	Auction	Auction	Auction	Bharti	RJIO	Auction	Auction	Bharti	Vodaldea	Auction	Auction	Bharti	RJIO	Vodaldea	Auction	Auction	Bharti	Auction	Auction	Bharti	RJIO	Auction	Auction	Auction
AP	30	30	13.75	0	6.25	7.50	3.6	0	0	3.6	16.4	0	4.2	0	12.2	15	0	15	30	0	10	10	30	30
AS	30	30	2.5	0	0	2.50	5.8	0	0	5.8	6.8	0	4.6	0	2.2	10	5	5	30	10	10	0	0	0
BH	30	30	12.5	0	5	7.50	10.4	3.4	0	7	8.6	2.8	5	0	0.8	5	0	5	30	10	10	0	10	10
DL	30	30	12.5	0	8.75	3.75	2.2	0	0	2.2	25.4	0	4.6	0	20.8	15	0	15	30	0	10	10	20	20
GU	30	30	6.25	0	5	1.25	4.2	4.2	0	0	17.8	0	4	0	13.8	10	0	10	30	10	10	0	10	10
HA	30	30	10	3.75	5	1.25	0.8	0	0	0.8	23.2	0	5	0	18.2	5	0	5	40	30	30	0	0	0
HP	30	30	10	0	5	5.00	5.2	2.6	0	2.6	22.8	4.8	0	0	18	15	0	15	30	10	10	0	10	10
JK	30	30	2.5	0	0	2.50	0	0	0	0	14	10	0	0	4	5	0	5	40	30	30	0	10	10
KA	30	30	13.75	0	10	3.75	3.8	0	0	3.8	24.8	11.2	5	4	4.6	10	0	10	30	0	10	10	40	40
KE	30	30	13.75	0	10	3.75	4.6	0	0	4.6	18.2	5	0	0	13.2	5	0	5	30	10	10	0	0	0
KO	30	30	12.5	0	10	2.50	4.2	0	0	4.2	14.4	1	0	0	13.4	10	0	10	30	0	10	10	20	20
MA	30	30	12.5	2.5	10	0.00	5.8	0	0	5.8	18.8	0	5	0	13.8	10	0	10	30	10	10	0	0	0
MP	30	30	15	5	5	5.00	4.2	0	0	4.2	22.2	4.2	3.6	0	14.4	5	0	5	30	10	10	0	10	10
MU	30	30	10	0	7.5	2.50	2.2	0	0	2.2	15.6	0	3.4	0	12.2	10	0	10	30	0	10	10	20	20
NE	30	30	2.5	0	0	2.50	5	1.2	0	3.8	3.8	0	0	0	3.8	10	5	5	30	10	10	0	0	0
OR	30	30	11.25	0	5	6.25	5.2	3.8	0	1.4	7.6	2.6	5	0	0	10	0	10	30	10	10	0	0	0
PU	30	30	11.25	0	6.25	5.00	0	0	0	0	19.4	5	4.8	0	9.6	5	0	5	40	30	30	0	10	10
RA	30	30	7.5	0	5	2.50	0	0	0	0	16.8	0	0	0	16.8	0	0	0	40	30	30	0	0	0
TN	30	30	13.75	0	10	3.75	17.6	5	5	7.6	19.4	15	0	0	4.4	0	0	0	30	0	10	10	40	40
UPE	30	30	12.5	0	5	7.50	6.4	5	0	1.4	18.8	3.2	3.6	1.4	10.6	0	0	0	40	30	30	0	0	0
UPW	30	30	12.5	5	5	2.50	2.4	0	0	2.4	23.2	3	5	0.6	14.6	10	0	10	40	30	30	0	0	0
WB	30	30	11.25	0	10	1.25	5.2	2.8	0	2.4	7	3.8	0	0	3.2	10	5	5	30	10	10	0	0	0
	660	660	230	16.25	133.75	80	98.8	28	5	65.8	365	71.6	62.8	6	224.6	175	15	160	560	220	280	60	230	230

700 – 100% Unsold; 800 – 35% Unsold; 900 – 67% Unsold; 1800 – 62% Unsold; 2100 – 71% Unsold; 2300 – 11% Unsold; 2500 – 100% Unsold

# 4G Auction Highlights (2021)

## Operators' Outflow

Service area	800			900			1800				2100		2300			Grand Total
	Bharti	RJIO	Total	Bharti	Vodaldea	Total	Bharti	RJIO	Vodaldea	Total	Bharti	Total	Bharti	RJIO	Total	
AP		2,438	2,438					1,172		1,172				780	780	4,389
AS								212		212	150	150	20	20	40	402
BH		680	680	683		683	246	440		686			70	70	140	2,190
DL		5,600	5,600					2,102		2,102				1,640	1,640	9,342
GU		1,925	1,925	1,567		1,567		1,092		1,092			700	700	1,400	5,984
HA	214	285	499					285		285			160	160	320	1,104
HP		120	120	96		96	86			86			10	10	20	323
JK							170			170			20	20	40	210
KA		1,920	1,920				1,221	545	436	2,202				1,120	1,120	5,242
KE		1,570	1,570				475			475			200	200	400	2,445
KO		1,600	1,600				173			173				380	380	2,153
MA	1,275	5,100	6,375					1,825		1,825			720	720	1,440	9,640
MP	715	715	1,430				399	342		741			90	90	180	2,351
MU		5,453	5,453					1,907		1,907				1,670	1,670	9,030
NE				28		28					30	30	10	10	20	78
OR		235	235	327		327	70	135		205			50	50	100	867
PU		981	981				440	422		862			420	420	840	2,684
RA		1,330	1,330										120	120	240	1,570
TN		1,740	1,740	1,175	1,175	2,350	1,500			1,500				1,510	1,510	7,100
UPE		1,255	1,255	1,310		1,310	490	551	214	1,255			180	180	360	4,180
UPW	805	805	1,610				345	575	69	989			240	240	480	3,079
WB		740	740	347		347	201			201	175	175	60	60	120	1,584
<b>Grand Total</b>	<b>3,009</b>	<b>34,491</b>	<b>37,500</b>	<b>5,533</b>	<b>1,175</b>	<b>6,708</b>	<b>5,817</b>	<b>11,605</b>	<b>719</b>	<b>18,141</b>	<b>355</b>	<b>355</b>	<b>3,070</b>	<b>10,170</b>	<b>13,240</b>	<b>75,944</b>

Total Outflow Was Rs 75994 Cr

# TRAI Calculation of 3500 MHz Band

TRAI's 3500 MHz Reserve Price Model for 2021 Auction	
1	2
<b>LSA</b>	<b>Reserve Price = 30% of 1800</b>
Delhi	69
Mumbai	84
Kolkata	26
Andhra Pradesh	42
Gujarat	41
Karnataka	16
Maharashtra	55
Tamilnadu	15
Haryana	8
Kerala	14
Madhya Pradesh	14
Punjab	13
U. P. (East)	23
U.P. (West)	17
West Bengal	8
Assam	7
Bihar	13
Himachal Pradesh	3
Jammu & Kashmir	2
North East	2
Orissa	4
<b>Pan India</b>	<b>477</b>
Rule - Reserve Price is 30% of the RP of 1800 MHz corrected for unpaired by dividing by 2	

# Key Issues of 2021 Auction

- Reserve price models used resulted in too simplistic outcome
  - Most Models Resulted in Reserve Price as Indexed Value of Last auction
- TRAI used simple averages to arrive at spectrum valuation
  - Median was not considered to filter outliers

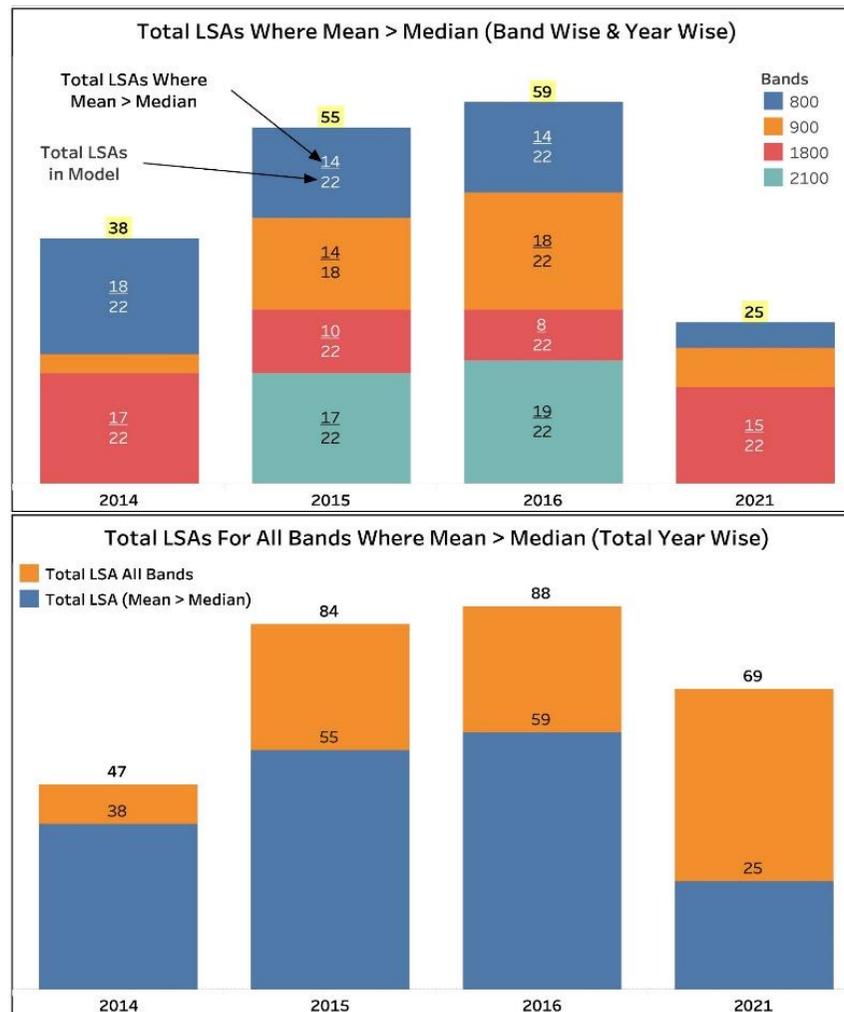
# **Key Issues Summary**

# Key Issues of all Auctions

- Pricing Models Mixed “Valuation” As “Reserve Price”
- Pricing Models Become too Simplistic
  - It threw up indexed value of past auction as RP
- Pricing Models did not filter Outliers
  - Mean was used instead of Median for Aggregation
- Pricing Models Kept Spectrum From Being Sold

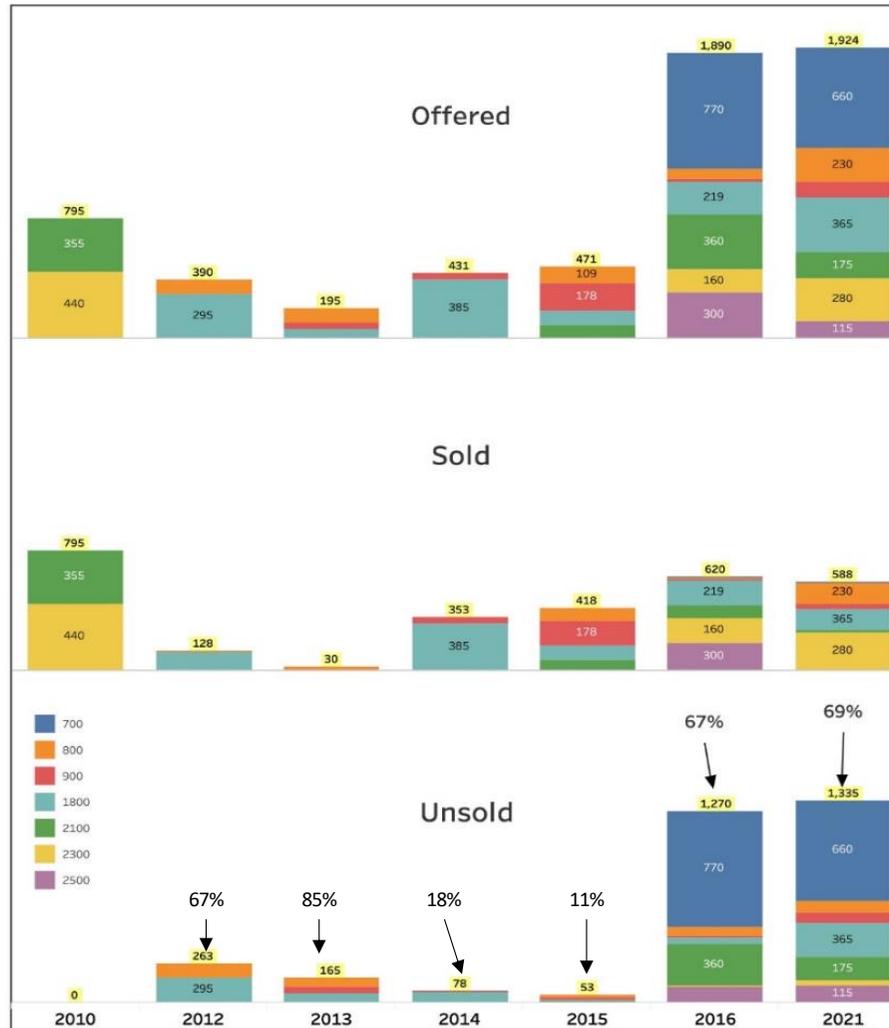
# TRAI's Pricing Models – Issues

## Mean vs Median



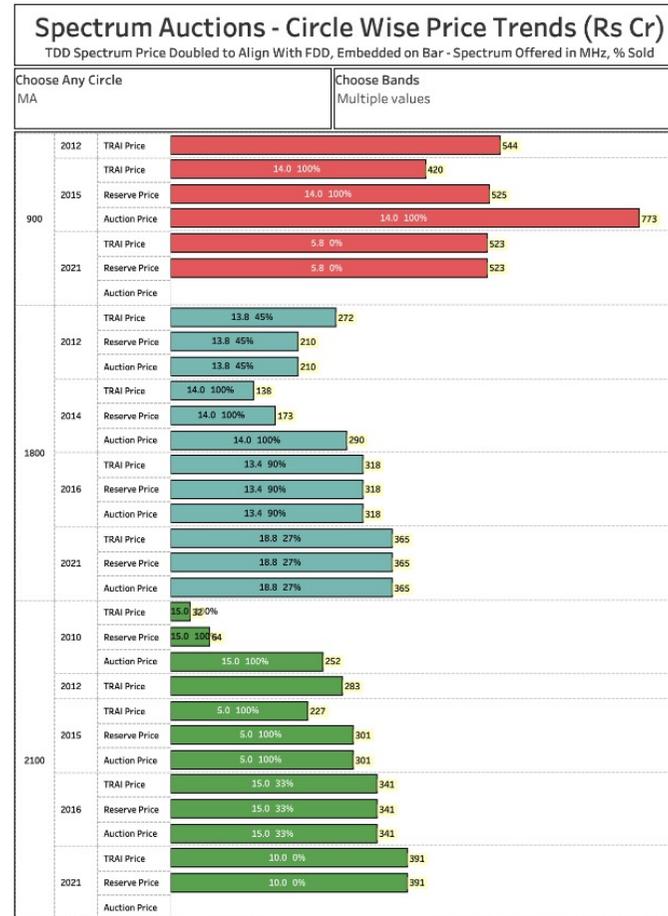
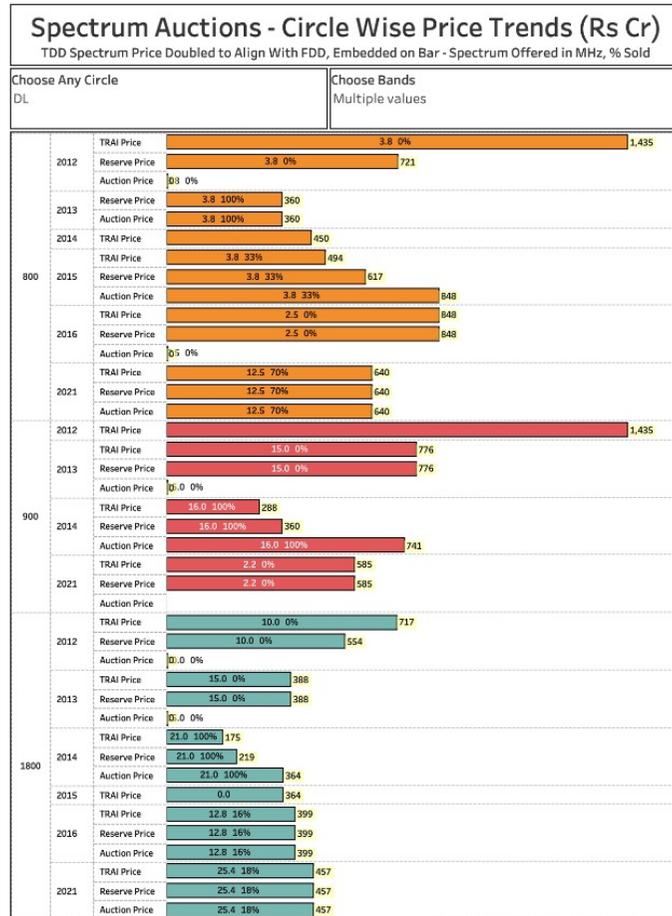
# TRAI's Pricing Models – Issues

Sold vs Unsold (MHz)



**Resulted in  
Huge Amount of  
Unsold  
Spectrum**

# TRAI's Pricing Models – Issues



**Last Price was considered as Market price even when a small fraction of spectrum got sold**

# **Pricing Model for 5G Spectrum**

# Calculation of Reserve Price : 1800 MHz Band

- Calculate valuation using ground up pricing models for various LSAs
  - e.g. Producer Surplus, Production Function, Revenue Surplus, Indexing, Multiple Regression, etc.
  - Use last auction discovered price as one of the pricing inputs
- Calculate the Average valuation using Median to filter outliers for each LSA
- Calculate pan-India valuation by adding valuation of individual LSAs
- Estimate LSA weight of each LSA using AGR/GDP
  - e.g. If pan-India AGR is 100 and AGR of Delhi is 10, then Weighted Average of Delhi = 0.1
- Calculate the valuation of individual LSAs
  - By multiplying with weights of pan-India valuation
- Calculate the Reserve Price by using a scaling factor (e.g. 0.8)

# Calculation of Reserve Price : 3500 MHz Band

- Estimate the usable bandwidth of 3500 MHz Band (3300-3670 MHz) : 370 MHz
- Estimate the usable bandwidth of 1800 MHz Band : 2 x 55 MHz
- Calculate the Bandwidth Ratio :  $(55 \times 2) / 370$
- Estimate the propagation ratio of 3500 MHz with 1800 MHz = 0.3
- Calculate LSA wise Reserve Price of 3500 MHz band using
  - Bandwidth Ratio
  - Propagation Ratio
  - Reserve Price of 1800 MHz
- Reserve Price of 3500 MHz =  $RP_{1800} \times \text{Bandwidth Ratio} \times \text{Propagation Ratio}$ 
  - =  $RP_{1800} \times ((55 \times 2) / 370) \times 0.3$
  - =  **$RP_{1800} \times (0.089)$**  (i.e. 11.2 times lower than  $RP_{1800}$ )

The Reserve price of 3500 MHz Band will be **3.7 times lower** than what was recommended in 2018

# Calculation of Reserve Price : 26-28 GHz Band

- Estimate the usable bandwidth of 26-28 GHz Band (24250-28500 MHz) : 4250 MHz
- Estimate the usable bandwidth of 3500 MHz Band : 370 MHz
- Calculate the Bandwidth Ratio : 370/3850
- Higher frequency band becomes more capacity driven
  - Propagation losses dropped
- Calculate LSA wise Reserve Price of 26-28 GHz band using
  - Bandwidth Ratio
  - Reserve Price of 3500 MHz
- Reserve Price of 26-28 GHz =  $RP_{3500} \times \text{Bandwidth Ratio}$

$$= RP_{3500} \times (370/4250)$$

$$= \mathbf{RP_{3500} \times 0.087} \quad (\text{i.e. 11.5 times lower than } RP_{3500})$$

The Reserve price of 26-28 GHz Band will be **11.5 times lower** than 3.5 GHz band on a Per MHz Basis

# Global Status

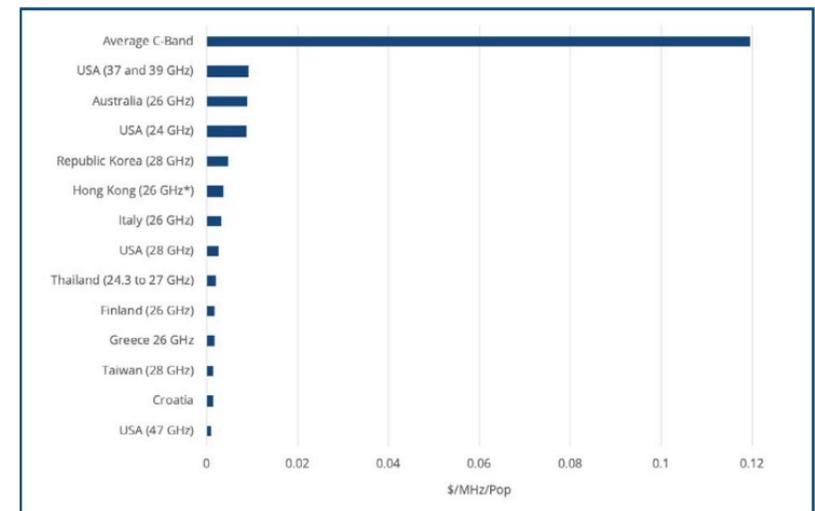
## C Band Spectrum Auctions

Sno	Country	\$/MHz/Pop	ARPU	\$/MHz/ARPU	Ratio : \$/MHz/ARPU
1	India (RP)	3.45	1.2	39675126.00	1
2	Australia	0.21	25.59	209260.48	0.0052743
3	Germany	0.19	13.32	1195116.29	0.0301226
4	Greece	0.04	13.65	30543.75	0.0007698
5	Hong Kong	0.13	15.42	63204.12	0.001593
6	Ireland	0.07	28.87	11972.46	0.0003018
7	Italy	0.42	13.52	1878251.99	0.0473408
8	Latvia	0.01	11.93	1581.05	0.0000399
9	Norway	0.01	32.98	1643.80	0.0000414
10	Singapore	0.08	17.65	26517.13	0.0006684
11	Slovakia	0.01	11.72	4658.40	0.0001174
12	Sweden	0.08	22.89	35296.69	0.0008896
13	UK	0.09	19.87	307485.71	0.0077501
14	US	0.875	39.64	7306440.96	0.1841567

C Band Reserve Price of India Compared to other recent auctions (\$/MHz/ARPU)

Source : ARPU details by GSMA

## mmWave Spectrum Auctions



Prices paid for mmWave spectrum in recent auctions/assignments (\$/MHz/Pop)

**mmWave Spectrum Price 12 time (approx.) lower than C Band**

Source : GSA - Spectrum Pricing Update, September 2021

**Thank You**