White Paper

Assumptions and outputs of the FL-LRIC model

November 17, 2008

Contents

1 Executive Summary

Spectrum Value Partners was engaged by the Cellular Operators Association of India ("COAI") in 2006 to determine the mobile termination charges based on a forward looking long-run incremental cost ("FL-LRIC") of terminating a minute of voice telephony on a mobile network in India. In 2008, SVP has been requested by COAI to develop the FL-LRIC model taking into account the changed dynamics of the telecom sector in India since 2006.

The model is developed based on a theoretical efficient operator. Data has been obtained from 4 operators (Bharti, Vodafone, Idea and Aircel) across 4 circles (Delhi, Maharashtra, Kerala and Orissa). This has been used to build the network of the efficient operator using a "hybrid" approach i.e. while the network design has been built bottom-up, we have also performed a reconciliation step to account for the prevalent prices of network equipment and the year on year changes in prices faced by operators. Moreover the model is developed in accordance with standard LRIC principles in accordance with international best practices i.e. use of a scorched node approach, a tilted annuity method of depreciation, use of a routing table. Further the cost elements considered for the purpose of the model are in line with other countries which have deployed the LRIC model.

The exhibits below summarise the output termination charges for the different regions and the weighted average termination charge for all - India.

Exhibit 1: LRIC + Common cost mark-up per circle

MTC (LRIC + Common cost mark-up) Rs / min					
Circles	**2008**	**2009**	**2010**	**2011**	**2012**
1 Metro	0.26	0.28	0.30	0.30	0.32
2 Circle A	0.30	0.38	0.40	0.37	0.35
3 Circle B	0.29	0.33	0.33	0.31	0.28
4 Circle C	0.44	0.48	0.50	0.50	0.48

Source: SVP LRIC model

Exhibit 2: Weighted average MTC

Weighted average MTC (Rs / Min)					
	2008	**2009**	**2010**	**2011**	**2012**
All - India	0.30	0.36	0.38	0.36	0.35

Exhibit 3: Average MTC for next 3 years

Average MTC for the next 3 years (Rs / min)	
3 Year look ahead MTC	0.35

The above figures constitute the real MTC and have not been adjusted for inflation.

2 Conceptual design principles for the LRIC model

We have defined the framework of the conceptual design principles to be used in developing the LRIC model. The principles highlighted are based on accepted best practices in countries where the regulator has adopted the LRIC methodology for the purpose of determination of the mobile interconnection charge.

2.1 Hybrid Forward Looking Model

A hybrid model overcomes the limitations of both the "top down" and "bottom- up" approaches and has therefore been adopted for the purpose of this exercise. The top down and bottom-up approaches for developing the LRIC model are detailed in the white paper.

The model is constructed for a time frame extending up to 2012. We have used 2007 as the base year to project the model up to 2012. All figures pertain to a Gregorian calendar year.

In developing the hybrid model we have carried out a reconciliation step which includes calibration of the cost components by checking the results of the bottom-up model against actual engineering and cost realities. Reconciliation is also done by taking unit costs information from actual operators (for e.g. an average of costs could be taken). The calibration step is detailed in section 3.7. Given the available information and the paucity of time, we believe that a more rigorous analysis is needed to carry out the calibration step in line with standard LRIC principles.

2.2 Based on a "theoretical efficient operator" adapted to local conditions

A typical bottom-up model would be based on a theoretical efficient operator constructed using efficient network design principles. The efficient operator approach is most consistent with the objective of price regulation. Further, it affords greater flexibility and can be applied to all actual market operators even though there may be fundamental cost differences between them. The approach involved in building a theoretical efficient operator bottom up is detailed further in section 3.1. 1.

2.3 Based on a partially competitive market

A LRIC model could be based on either a hypothetical fully competitive market or a partially competitive market.

- A fully contestable market has no barriers to entry and exit –a new entrant can enter the market and capture all of an incumbent's existing customers instantaneously if they offer a better deal
- A partially contestable market has barriers to entry and exit –new entrants into the market can only capture customers from the incumbent after some delay (for example the time necessary to roll out their network) and/or at some limited rate (for example because of the need to build up their reputation and brand image)

A fully competitive market models a long run scenario where all operators have achieved fair market share. However a partially competitive market is closer the market realities as new operators tend to take time to build market share. For the purposes of this model we have considered the partially competitive market.

2.4 Use of a scorched node approach

In developing the model, SVP has used a **"scorched node approach".** A "scorched-node" approach to building an efficient network takes the number and location of nodes of existing networks as given and then uses best available technologies to connect them. In our opinion, the scorched node approach is the most practical and reasonable method to build a LRIC model for the following reasons

- It provides a more accurate reflection of real world networks
- It does not penalize operators for making efficient decisions in the past which may have turned out to be suboptimal in the current situation

The scorched node approach is a well accepted best practice in countries which have deployed the LRIC worldwide including UK, Malaysia and Israel.

2.5 Geotypes

Geotypes are the areas that have similar population characteristics, traffic usage and radio propagation characteristics. It is a commonly adopted practise to define different geotypes with different traffic and radio propagation characteristics.

For the purpose of this model, we have used the following 4 main geotypes:

Exhibit 4: Definition of geotypes

Geotype	Unit	Population density
Dense-Urban	pop / sq Km	20,000
Urban	pop / sq Km	8,000
Sub-Urban	pop / sq Km	400
Rural	pop / sq Km	Below 400

Source: SVP LRIC model

The above definition is based on SVP's prior projects and experience in the telecom market in India. For each of the above geotypes, the following parameters have been modeled:

1. Cell Radii
2. Traffic volume
3. Busy hour traffic
4. Passive and active CAPEX needed for coverage and capacity
5. Passive and active network OPEX driven by the CAPEX requirements. Only network OPEX directly related to the services being modeled should be considered.

2.6 Depreciation method to be used

Economic depreciation is widely accepted as the depreciation methodology for LRIC models. We believe that the tilted annuity method is in line with economic depreciation. Hence for the Base Case LRIC we have used the tilted annuity method of depreciation.

2.7 Service portfolio modelled

For the purpose of the model, the following services have been defined

1. Inbound/Outbound Off-net voice

2. On-Net voice

3. SMS

4. Data

The objective is to arrive at the cost of termination of a single minute of voice traffic.

2.8 Key cost elements

The cost elements identified for the purpose of the model are based on international best practices.

Exhibit 5: Key cost elements used for the model

Cost category	Cost components
CAPEX	**Passive**
	GBT
	RTT
	Active
	TRX
	BTS
	BSC
	MSC
	GMSC
	Transmission
	BTS-BSC
	BSC-MSC
	MSC-MSC
	Other core components
	HLR
	IN
OPEX	**Passive Fixed OPEX (mainly site related costs)**
	O&M
	Admin expenses (manpower, fuel, logistics)
	Insurance
	Passive variable OPEX
	Landlord rents
	Fuel and power
	Active OPEX
	Utilities and maintenance of active components such as BSC
	Leased backbone
	Network sharing OPEX
	Network management service OPEX
	License fee
	Spectrum fee
Common Costs	**Personal, General and Administration**
	CAPEX Costs
	Depreciation on Furniture, vehicles, computers, buildings
	OPEX costs (rentals, utilities etc associated with office buildings)

Source: SVP LRIC model

Apart from the above it is an accepted best practise to include **capital expenditure related to Network Management Services (NMS) and billing systems** since a share of these costs can be attributed to wholesale services and consequently to mobile termination. At this point we are not in a position to assess the CAPEX costs associated with NMS and billing systems which are attributable to mobile termination services. The non-inclusion of these costs for the purpose of this model may be considered as a conservative assumption.

The OPEX costs considered here are all only network related OPEX directly applicable to the service being modelled. All other OPEX costs that are common across both wholesale and retail operations such as the head office costs are considered as common costs.

Further it is an accepted practice to apportion a fair share of the CEO's salary as part of the common costs. For the purpose of this model, we have built up the common costs using a circle/service area approach. Hence we have considered only the costs associated with the circle/service area office expenses in the determination of MTC. The assumption of not including the CEO salary towards common cost could be considered as a conservative assumption.

In some countries like the United Kingdom, Israel and Greece, the regulator has concluded that it is appropriate to include an allowance for the network externality in the mobile termination rate. The network externality represents a marginal social benefit due to the addition of a customer to the network. In effect, the operator could include some contribution to customer acquisition, retention and/or maintenance costs in the mobile termination rate. This would ensure that there is an incentive to attract new customers and maintain existing customers which results in an increase in social welfare. However due to the complexities involved in determining the network externality surcharge and the differing views on the same, we have not considered network externality charges for the purpose of this model.

2.9 Allocation of costs using routing factors

For the purpose of allocation of the costs to the different services we have used a routing table, with appropriate routing factors based on the network design. Routing factors allow the network costs to be allocated according to both the level of demand for a service and the extent to which the service uses the cost element in question. For the approach involved in constructing the routing table please refer section 3.5.5.

2.10 Treatment of common costs

In allocating the common costs to termination we have used an Equi-Proportional Mark-up (EPMU) basis which is consistent with international practices. The approach involved in determining the EPMU has been discussed in detail in section 4.2.

2.11 Addition of a mark-up to cover the cost of capital

It is typical to include a cost of capital return on the capital cost elements of the basic interconnect charge. The cost of capital must match the cash flows considered in the model and therefore a pre-tax cost of capital is preferred. The cost of capital is typically computed using a Capital Asset Pricing Methodology (CAPM).

In line with best practices we have added a cost of capital component to the depreciation component of the MTC. For a theoretical efficient operator, the average pre-tax WACC of actual operators computed using CAPM principles is to be used as a mark-up to the capital cost. The approach in calculation of the WACC for the purpose of this model is detailed in section 3.10.

3 Model Flow and Approach

The model has been designed using standard LRIC principles. Data has been collected from operators. We have then constructed a theoretical efficient operator.

3.1 Methodology for data collection

Circles modeled:

To determine the mobile termination costs for each circle category, a representative service area has been selected i.e. Delhi under the Metro Circle, Maharashtra under Circle A, Kerala under Circle B and Orissa under Circle C. Therefore for the purpose of this document and the financial model

1. Delhi = Metro
2. Maharashtra= Circle A
3. Kerala = Circle B
4. Orissa = Circle C

A key assumption behind the model is that these selected service areas are representative of the circle category. We are of the opinion that the service areas identified display characteristics of the circle category particularly with regard to population density, per capita income and geographical area.

The exhibit below shows the services are selected for each circle category.

Exhibit 6: Circles selected

Circle	Region selected
Metro	Delhi
Circle A	Maharashtra
Circle B	Kerala
Circle C	Orissa

Source: SVP LRIC model

Operator data:

The following operators were involved in this exercise:

- Bharti Airtel
- Vodafone
- Idea cellular
- Aircel

The following data was obtained from the operators involved in the exercise for each of the circles being modeled for 2007 and 2008:

- **Engineering:** Cell radii, Spectrum allocated, Number of network elements (BTS, BSC etc) in each circle, Transmission links (Both historical and current numbers) etc.
- **CAPEX:** Unit prices of various network elements, useful life and price trends.

- **OPEX:** Network OPEX incurred by operators both active and passive
- **Non-Financial:** Voice, SMS and Data usage trends (MoU, number of SMS and data downloaded)
- **Financial:** Pre-tax and post tax WACC

3.1.1 Theoretical efficient operator

The LIRC model assumes a theoretical hypothetical operator and it models the costs associated for mobile termination for this hypothetical operator. The profile of the hypothetical operator assumed is as follows:

- The operator is a **pan-India GSM operator**. The pan-India assumption is more reflective of the Indian market reality since most Indian operators already are or aspire to be Pan-India operators. Most of the new operators have been awarded a pan-India license as well. We have considered the hypothetical operator to be a GSM operator and not a dual-technology (both CDMA and GSM) operator since GSM technology is seen to be more prevalent in the market today and would see an increasing trend going forward.
- The operator has been **allocated spectrum in the 1800 MHz frequency band**. Although many existing operators have spectrum allocated to them in both 900 MHz and 1800 MHz frequency band, all future spectrum allocation would happen in the 1800 MHz band in India. Given this scenario we believe that most likely case for incremental CAPEX investment in the long run would be based only in 1800MHz frequency band.
- It is assumed that **no additional spectrum would be allotted** to the hypothetical operator in the near future. We have considered such a situation given the spectrum scarcity in the Indian telecom market currently.
- **Uses theoretical efficient principles for network planning** and roll out which includes:
    - Dimensioning of cell sites for coverage is done by taking cell radii that are based on global benchmarks adapted where relevant to the Indian scenario.
    - Dimensioning of sites for capacity is based purely on incremental traffic that needs to be served (over and above the capacity that could be served by coverage sites). And this dimensioning is based on international benchmarks for capacity and utilization parameters for the network elements (for e.g. throughput of a TRX).
    - It is assumed that the operator will increasingly adopt passive network sharing. Active sharing has not been considered since it is uncertainty as to the nature of sharing arrangements in India. Currently no country has adopted active sharing for 2G although there are examples of active sharing in 3G (e.g. Sweden).
    - The operator will plan for redundancy mainly for network elements which are sensitive to traffic. For example it would have a minimum of two switches (MSC, BSC etc) in each circle. To this extent the model adopts a conservative assumption on redundancy planning.

3.2 Model Flow

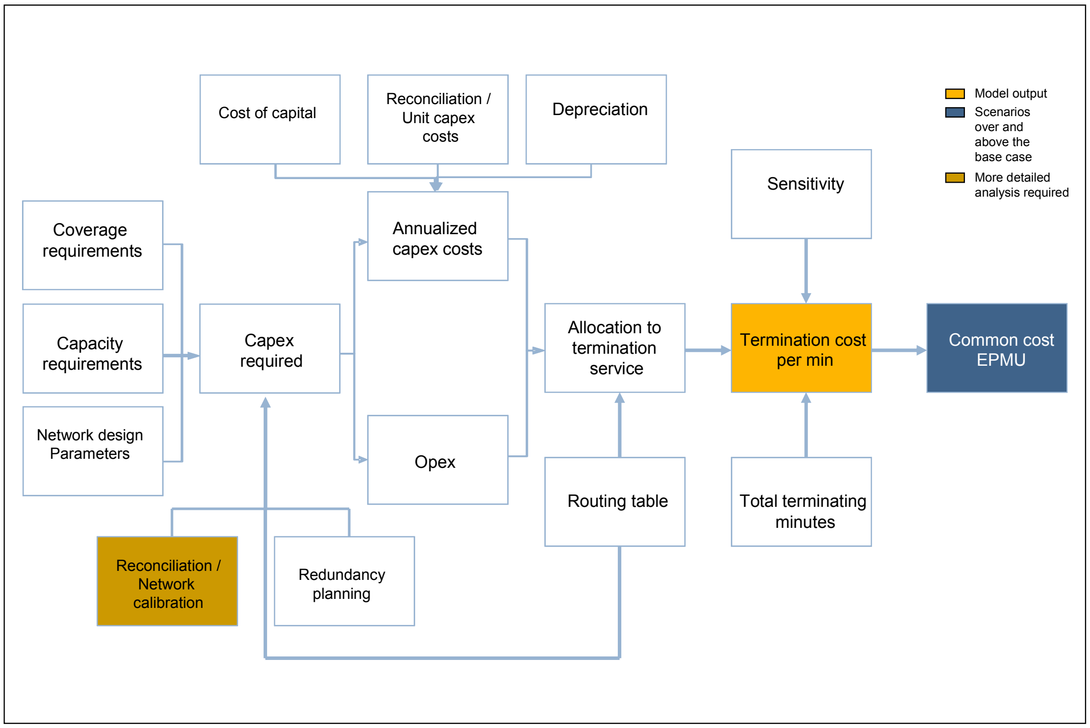
A FL-LRIC model is constructed by determining the costs associated with mobile termination, i.e. the costs of building a mobile network, to existing and future specifications (i.e. in terms of coverage and capacity) at current network unit prices whilst assessing forward looking requirements.

Generally FL-LRIC models are difficult and complex to implement as it is based on future estimates / projections which can be a source of contention. Therefore we have adopted a simplified methodology which can be easily understood by operators and regulators alike.

3.2.1 Schematic of overall Model flow

A high level schematic of the FL-LRIC methodology is detailed below. An explanation of the approach used in each aspect of the model follows in the subsequent sections

Exhibit 7: FL-LRIC Model Flow



3.3 Coverage requirements

Land area to be covered is determined by first categorizing each of the circles modeled (Delhi, Maharashtra, Kerela, and Orissa) into the different geotypes (Dense Urban, Urban, Sub Urban and Rural). Operator's projections on geographical coverage needed to achieve targeted population coverage has been used as a basis of calculating the actual land area to be covered in each geotype. The model uses the average of the geographical coverage projections given by operators to determine the coverage requirements for the hypothetical efficient operator. Using the above assumptions on geotypes each representative state being modelled was categorized into the various geotypes.

3.3.1 Categorization of circles

To accurately determine the number of cell sites required, the regions have to be further sub-divided into Dense-urban, urban, sub-urban and rural topologies based on the population density.

The following tables list the categorization:

Exhibit 8: Categorisation of sites for Delhi

Delhi	Density	Pop (m)	Area (km2)	Cell Type
North	15,651	1	60	U
North West	7,813	3	440	S
North East	35,410	2	60	D
West	19,831	3	129	U
Central	31,069	1	25	D
South West	5,021	2	420	S
South	10,896	3	250	U
East	27,480	2	64	D
New Delhi	6,150	0	35	S
Total	159320	17	1483	

Source: Census of India, Spectrum VP

Exhibit 9: Categorisation of sites for Maharashtra

Maharashtra	Density	Pop (m)	Area (km2)	Cell Type
Ahmadnagar	259	4	17,035	R
Akola	327	2	5,431	R
Amravati	232	3	12,234	R
Aurangabad	313	3	10,105	R
Bhandara	319	1	3,890	R
Bid	220	2	10,694	R
Buldana	251	2	9,681	R
Chandrapur	198	2	11,417	R
Dhule	231	2	8,060	R
Gadchiroli	73	1	14,482	R
Gondiya	241	1	5,431	R
Hingoli	238	1	4,526	R
Jalgoan	342	4	11,758	R
Jalna	228	2	7,714	R
Kolhapur	499	4	7,693	S
Latur	317	2	7,166	R
Nagpur	452	4	9,809	S
Nanded	297	3	10,543	R
Nandurbar	284	1	5,035	R
Nashik	350	5	15,538	R
Osmanabad	215	2	7,550	R
Parbhani	256	2	6,512	R
Pune	504	8	15,638	S
Raigarh	336	2	7,162	R
Ratnagiri	226	2	8,197	R
Satara	292	3	10,474	R
Sangli	328	3	8,577	R
Sindhudurg	181	1	5,221	R
Solapur	282	4	14,886	R
Thane	927	9	9,564	S
Wardha	214	1	6,310	R
Washim	216	1	5,150	R
Yavatmal	197	3	13,597	R
Total	9848	92.6	307,078	

Source: Census of India, Spectrum VP

Exhibit 10: Categorisation of sites for Kerela

Kerela	Density	Pop (m)	Area (km2)	Cell Type
Kesragod	644	1.3	1,992	S
Kannur	865	2.6	2,967	S
Kozhikode	1,308	3.1	2,344	S
wayanad	413	0.8	2,011	S
Malappuram	1,087	3.9	3,552	S
Thrissur	1,044	3.2	3,033	S
Palakkad	622	2.8	4,481	S
Ernakulam	1,121	3.3	2,951	S
Kottayam	942	2.1	2,209	S
Alapuzha	1,588	2.2	1,414	S
Idukki	268	1.2	4,479	R
Pathanam.	498	1.3	2,637	S
Kollam	1,105	2.8	2,492	S
Thiruvan.	1,571	3.4	2,192	S
Total	13076	33.9	38,754	

Source: Census of India, Spectrum VP

Exhibit 11: Categorisation of sites for Orissa

Orissa	Density	Pop (m)	Area (km2)	Cell Type
Anugul	193	1	6,365	R
Balangir	219	1	6,581	R
Baleswar	573	2	3,803	S
Bargarh	249	1	5,826	R
Baudh	129	0	3,109	R
Bhadrak	573	1	2,504	S
Cuttack	640	3	3,934	S
Debagarh	100	0	2,947	R
Dhenkanal	257	1	4,460	R
Gajapati	129	1	4,320	R
Ganjam	414	3	8,212	S
Jagatsinghapur	681	1	1,669	S
Jajapur	700	2	2,497	S
Jharsuguda	264	1	2,078	R
Kalahandi	181	1	7,945	R
Kandhamal	87	1	8,002	R
Kendrapara	529	1	2,646	S
Kendujhar	202	2	8,304	R
Khordha	718	2	2,814	S
Koraput	144	1	8,791	R
Malkangiri	94	1	5,789	R
Mayurbhanj	229	2	10,429	R
Nabarangapur	208	1	5,304	R
Nayagarh	239	1	3,892	R
Nuapada	148	1	3,846	R
Puri	465	2	3,477	S
Rayagada	126	1	7,097	R
Sambalpur	152	1	6,636	R
Sonapur	249	1	2,342	R
Sundargarh	202	2	9,732	R
Total	9094	39.59	155,350	

Source: Census of India, Spectrum VP

The circle wise area by topology is summarized below:

Exhibit 12: Circle wise % land area by geotype

% area	Dense-u.	Urban	Sub-urb.	Rural
Delhi (Metro)	10%	30%	60%	0%
Maharashtra (Circle A)	0.0%	0.0%	13.9%	86.1%
Kerela (Circle B)	0.0%	0.0%	88.4%	11.6%
Orissa (Circle C)	0.0%	0.0%	20.3%	79.7%

It should be noted that above categorization may not be necessarily reflective of the actual situation for e.g It is possible that in a state like Maharashtra there are pockets of dense-urban and urban areas (like Pune) but we believe that these would be negligible overall (maybe 1%) and would not have a significant impact on the model output. We believe that the above method of classification would lead to a conservative estimate of the final output since the cell radii used in case of Dense urban or Urban pockets are lower than those used for Sub urban or Rural.

3.3.2 Coverage scenarios

The model takes the average of the geographical coverage projections submitted by the operators involved in the study, as the coverage scenario for the hypothetical operator. The decisions pertaining to land area coverage would be an independent decision that might have other constraints influencing it (such as capital required etc). In order to take a scenario that is indicative of such constraints, the average of the projections submitted by operators has been taken. The table below summarizes the geographical coverage projection for the hypothetical operator:

Exhibit 13: % Geographical coverage projections for the hypothetical operator

% Coverage per circle	2007A	2008E	2009E	2010E	2011E	2012E
1 Metro	83%	90%	94%	97%	99%	99%
2 Circle A	11%	29%	48%	61%	83%	79%
3 Circle B	44%	55%	65%	74%	86%	86%
4 Circle C	18%	33%	45%	57%	78%	78%

Based on the above coverage requirements the total land area to be covered by the hypothetical operator in each circle by geotype is detailed below:

Exhibit 14: Land area to be covered per circle per geotype

Metro	2007A	2008E	2009E	2010E	2007A	2011E	2012E
1 Dense - Urban	114	123	134	140	144	146	148
2 Urban	335	363	396	413	424	431	435
3 Sub-Urban	684	741	807	843	865	879	888
4 Rural	0	0	0	0	0	0	0
Total	1,133	1,228	1,338	1,397	1,434	1,456	1,471
Circle A							
1 Dense - Urban	0	0	0	0	0	0	0
2 Urban	0	0	0	0	0	0	0
3 Sub-Urban	2,739	4,526	12,277	20,587	26,151	30,960	35,418
4 Rural	16,960	28,024	76,008	127,455	161,904	191,672	219,273
Total	19,699	32,550	88,285	148,042	188,055	222,632	254,691
Circle B							
1 Dense - Urban	0	0	0	0	0	0	0
2 Urban	0	0	0	0	0	0	0
3 Sub-Urban	9,426	14,925	18,970	22,397	25,310	27,881	29,595
4 Rural	1,232	1,950	2,479	2,927	3,308	3,644	3,868
Total	10,657	16,876	21,449	25,324	28,618	31,525	33,462
Circle C							
1 Dense - Urban	0	0	0	0	0	0	0
2 Urban	0	0	0	0	0	0	0
3 Sub-Urban	4,192	5,606	10,568	14,355	18,141	21,455	24,610
4 Rural	16,446	21,992	41,459	56,314	71,170	84,168	96,547
Total	20,638	27,598	52,027	70,669	89,311	105,623	121,158

Units: sq.Km

Source: SVP LRIC model

3.4 Capacity Requirements

In determining the capacity requirements we have modelled the traffic likely to flow through the theoretical operator's network on a monthly basis. For this purpose we have assumed the penetration levels in each circle and estimated that the theoretical operator would attain a fair market share. Minutes of Use (MOU) per subscriber on a monthly basis has been calculated based on the trend across the representative circles. The volume of traffic has been determined based on the minutes of use per subscriber and estimated subscriber base of the theoretical operator.

3.4.1 Population

In determining the population of each of the representative circles, we have used the 2001 census data and projected the population of each of the circles for the period from 2008 to 2012 using the national average for annual growth in population. Population of each of the circles for the period of the model is detailed below:

Exhibit 15: Population of circles

Population (million)	2007	2008	2009	2010	2011	2012
Metros	17	17	17	17	17	18
Circle A	93	94	95	96	97	98
Circle B	34	34	35	35	36	36
Circle C	40	40	40	41	41	42

Source: SVP LRIC model

3.4.2 Penetration of mobile services

In determining the penetration of GSM services in each of the circles we have considered the following:

1. Current level of penetration of GSM services in each of the circles
2. TRAI targets for the national penetration of mobile services (both GSM and CDMA) for 2010 and 2012
3. Consensus analyst estimates for the mobile subscriber base in India up to 2010

We have built a framework for determining the penetration of mobile services in each of the circles. This is detailed in the table below:

Exhibit 16: Framework for YOY growth in GSM penetration levels

Current penetration level		GSM Penetration growth rates						
Below	10%	56%	54%	52%	51%	49%	47%	45%
Below	22%	55%	53%	52%	29%	35%	33%	30%
Below	50%	45%	43%	41%	22%	28%	27%	25%
Below	75%	25%	21%	20%	12%	11%	7%	4%
Below	100%	15%	13%	11%	9%	6%	4%	2%
Below	125%	10%	9%	7%	6%	5%	3%	2%
Below	125%	8%	7%	6%	5%	3%	2%	1%

Source: SVP LRIC model

The above table considers the current penetration level as the basis for the future growth in penetration levels i.e. if the current penetration is low, the growth in penetration expected in future will be higher.

Based on the above framework, the penetration for 2008 to 2012 for each of the circles has been estimated in the following table:

Exhibit 17: Penetration of GSM services

Regionwise penetration	2007A	2008E	2009E	2010E	2011E	2012E
1 Metro	61%	73%	82%	91%	98%	101%
2 Circle A	14%	21%	27%	36%	48%	63%
3 Circle B	23%	32%	39%	50%	63%	79%
4 Circle C	9%	13%	17%	23%	31%	40%

Source: SVP LRIC model

It is believed that with some of the CDMA players offering GSM services there is a strong likelihood that the share of the CDMA subscriber base will decline over time.

Based on the above penetration rates, the GSM subscriber base for 2012 has been determined. The same is in the table below:

Exhibit 18: GSM subscriber base for the representative Circles

GSM Subscriber base per circle	2007A	2008E	2009E	2010E	2011E	2012E
1 Metro	10.1	12.3	13.9	15.7	17.0	17.8
2 Circle A	12.8	19.7	25.6	35.0	46.9	61.7
3 Circle B	7.7	11.0	13.5	17.6	22.5	28.5
4 Circle C	3.5	5.4	7.0	9.6	12.9	16.9

Source: SVP LRIC model

The above also keeps in mind the TRAI target of 750 million mobile subscribers in India by 2012.

3.4.3 Market share of the theoretical operator

The market share of the theoretical operator is based on the concept of an equivalent operator. An equivalent operator is one that has gained a fair market share over a period of time. For example there were four such equivalent operators in the year 2008 in each region corresponding to the four existing players in the regions. The model assumes that new operators would enter the market starting from 2009. Each new operator would take 4 years to reach its fair market share since this is the time it would take for them to build scale and gain market share. In the first year of entry the new operator would be equivalent to 0.25 of an existing operator and would grow by 0.25 every year. The market share of the theoretical calculated as 1 over the number of equivalent operators in each circle.

For the period from 2009 to 2012, we have determined the number of equivalent operators based on the following:

1. **Existing number of operators in each circle:**

   Currently there are 4 operators in each circle offering GSM services. The following table lists the operators in each circle:

Exhibit 19: Existing GSM operators in the representative circles

Circle	Operators	# of operators
1 Delhi	Bharti, Vodafone, MTNL, Idea	4
2 Maharashtra	Bharti, Vodafone, BSNL, Idea	4
3 Kerela	Bharti, Vodafone, BSNL, Idea	4
4 Orissa	Bharti, BSNL, RTL, Aircel	4

Each existing player is equal to 1 equivalent operator since they would have evolved over the years and now command a fair market share.

2. **New GSM operators who have been awarded licenses in each region:**

In 2008 a number of new operators were awarded pan-India GSM licenses. These operators are likely to start operations soon. The following table lists the number of new operators who have been awarded GSM license in each circle:

Exhibit 20: New operators who have been awarded GSM licenses in the circles considered

Circle	Operators	# of operators
1 Delhi	Swan, Datacom, Unitech, Loop	4
2 Maharashtra	Swan, Datacom, Unitech, Loop	4
3 Kerela	Swan, Datacom, Unitech, Loop	4
4 Orissa	Swan, Datacom, Stel, Unitech, Loop	5

Each new GSM entrant is assumed to be equal to 0.25 equivalent operator since they would take time to attaint the fair market share.

3. **CDMA players starting GSM services:**

Apart from new entrants, existing CDMA operators like Reliance and Tata Indicom are offering/likely to offer GSM services. It is expected that there will be a tendency amongst such operators to migrate some of their CDMA customers to GSM over time. These operators have a recognised brand and distribution network. It is likely that such operators will be able to achieve a fair market share within a shorter time frame. For the purpose of this model, we have assumed that CDMA operator offering GSM services would be equal to 0.5 of an equivalent operator in the first years of operations. It is also assumed that the CDMA operators would enter all the regions.

Among the existing CDMA operators both Reliance and TTSL have already announced their intentions to start GSM services. Among them Reliance already has GSM operations in Orissa and has been awarded spectrum in all other circles as well. However it is still unclear if TTSL would be awarded spectrum in the regions considered.

4. **Spectrum availability:**

Among the operators who are likely to enter the market (both CDMA and GSM) the actual entry would depend on the spectrum allocation. Once spectrum is awarded, a new operator would have roll-out obligations due to which it would have to roll out operations in the given region.

However it is unclear if the spectrum would be available for allocation to new operators since most of it still needs to be vacated by the Department of Defence. Given this situation we believe that although more number of players could enter the market based on the spectrum availability in reality only few would be awarded the spectrum. This can be considered as a conservative assumption since if spectrum were available more operators could enter leading to lower scale for the theoretical operator. The priority of allocation of spectrum for the DoT would be the Metros first followed by the circles since Metros would require spectrum immediately due to the capacity constraints. Hence it has been assumed that all additional spectrum available in Metros would be vacated sooner than in the other circles.

The Exhibit 21 indicates the additional spectrum available in each circle and the number of new players who are likely to be awarded spectrum. The theoretical maximum number of new operators is based on 4.4Mhz per player.

Exhibit 21: Spectrum availability and possible allocations

Ciricles	Additonal spectrum available (MHz)	Theoretical max number of new operators possibile based on spectrum availability	Number of new players (CDMA and GSM) who are in queue to be alloted spectrum	Number of players likely to be awarded spectrum
1 Metro (Delhi)	15	3	6	3
2 Circle A (Maharashtra)	45	10	6	4
3 Circle B (Kerela)	65	14	6	3
4 Circle C (Orissa)	60	13	7	3

The following table summarizes the number of operators who would enter each region in 2009 and the total number of operators in 2012:

Exhibit 22: Number of new operators entering each region

Circle	Existing number of operators	Number of new GSM Players likely to enter	Number of CDMA players likely to start GSM services	Total number of operators in 2012
1 Metro	4	2	1	7
2 Circle A	4	3	1	8
3 Circle B	4	2	1	7
4 Circle C	4	3	0	7

The number of equivalent operators each year based on the fact that each new GSM entrant would be equivalent to 0.25 of an operator and each CDMA player would be equivalent to 0.5 operator is indicated below:

Exhibit 23: Number of equivalent operators

Equivalent operators per circle	2007A	2008E	2009E	2010E	2011E	2012E
1 Metro	4.00	4.00	5.00	6.00	6.50	7.00
2 Circle A	4.00	4.00	5.25	6.50	7.25	8.00
3 Circle B	4.00	4.00	5.00	6.00	6.50	7.00
4 Circle C	4.00	4.00	4.75	5.50	6.25	7.00

Source: SVP LRIC model

A key assumption of the model is a steady state market situation where each equivalent operator commands a fair market share. Accordingly the market share of the theoretical operator for the period of the model is below:

Exhibit 24: Fair market share for the equivalent operators

Fair market share of operators	2007A	2008E	2009E	2010E	2011E	2012E
1 Metro	25%	25%	20%	17%	15%	14%
2 Circle A	25%	25%	19%	15%	14%	13%
3 Circle B	25%	25%	20%	17%	15%	14%
4 Circle C	25%	25%	21%	18%	16%	14%

Source: SVP LRIC model

Based on the above market share we have calculated the number of subscribers for the theoretical operator for each of the representative circles.

Exhibit 25: Subscriber base of the theoretical operator

Subscriber base for operator	2007A	2008E	2009E	2010E	2011E	2012E
1 Metro	2.53	3.00	2.79	2.62	2.63	2.55
2 Circle A	3.20	4.53	4.81	5.30	6.38	7.60
3 Circle B	1.91	2.55	2.68	2.90	3.43	4.03
4 Circle C	0.88	1.24	1.46	1.72	2.03	2.38

Source: SVP LRIC model

3.4.4 Minutes of Usage (MOU)

Based on TRAI data for 2007 we have projected the average minutes of use per subscriber on a monthly basis.

Exhibit 26: Monthly MOU per subscriber

MoU per sub per month	2007A	2008E	2009E	2010E	2011E	2012E	CAGR (07-12)
1 Metro	483	488	493	493	493	493	0.4%
2 Circle A	485	490	490	490	490	490	0.2%
3 Circle B	451	462	470	476	476	476	1.1%
4 Circle C	449	467	481	486	486	486	1.6%

Source: TRAI Quarterly Performance Monitoring Report, SVP LRIC model

Based on recent quarterly data in 2008, it is believed that the MOU growth will stabilize in the period from 2008-2012 particularly in metros and Circle A. A small growth will be seen in Circle B and Circle C.

The annual growth rate in MOU has been estimated considering the following factors

1. TRAI data for 2008 suggests that the MOU has reached the peak level particularly in Metros and Circle A. As a result a further increase in MOU is unlikely. The table below indicates the MOU for 2007 and two quarters of 2008. It can be seen that there has been virtually no growth in MOUs in Metros and Circle A. A marginal increase is seen in Circle B and C. This can be attributed to the fact that incremental subscribers are likely to come from less affluent areas resulting in a lower MOU. Further as rural penetration increases it is expected that the incremental subscribers will use their

mobile phone mainly for incoming calls. In fact recent data from TRAI suggests a stabilization of MOUs on a quarterly basis between 2007 and 2008 (Refer Exhibit 25).

Exhibit 27: Monthly MOU per subscriber as per TRAI

TRAI (Voice and SMS usage trends)	Q1 2007	Q2 2007	Q3 2007	Q4 2007	Q1 2008	Q2 2008	Growth (Q2 08-Q1 08)
Blended GSM MoU							
Metro	471	489	490	482	506	505	0%
Circle A	499	493	476	470	500	502	0%
Circle B	451	464	440	448	479	507	6%
Circle C	448	434	446	469	496	513	3%

2. As further reduction in tariffs in India is unlikely, the MOUs are likely to stabilize in the near term.

3. India has one of the highest MOU in the world. MOU is significantly higher than many other Asian countries. It is unlikely that such trend of high MOU will continue in future. As can be seen from the table below, India's MOU is higher than Asian countries like China, Bangladesh and Malaysia and other emerging countries like Egypt.

Exhibit 28: Monthly MOU per subscriber for relevant markets

Benchmarks on MoU trend in similar countries						
MOU per subscriber	Penetration	2002	2006	Q1 2007	Q2 2007	Q3 2007
Emerging Asia						
Bangladesh	22%		218	230	245	243
China	40%	194	337	365	395	395
Malaysia	82%	282	164	185	179	186
Pakistan	44%		145	132	141	142
Taiwan	104%	168	207	202	209	209
Thailand			289	425	389	354
India	22%	204	448	474	472	457
Emerging Europe and North Africa						
Egypt	36%	160	130	137	137	143
Poland	105%	89	90	92	99	99
Hungary	105%	80	148	149	155	158
Morocco	63%		71	53	50	56
Brazil	60%	103	76	75	79	82
Chile	86%	120	112	121	122	122
Colombia	73%	78	115	117	117	122

Source: Merrill Lynch Global Wireless Matrix Q3 2008, SVP Analysis

3.4.5 Split of Minutes of Usage

Based on actual data obtained from the operators and the PwC GSM benchmark study we have estimated the split of MOU for on-net and off-net calls. The table below indicates the split of MOU based on data for 2007

Exhibit 29: Split of MOU

Split of MOU taken	2007 A	2008 E	2009 E	2010 E	2011 E	2012 E
%on-net	14%	15%	16%	16%	17%	18%
%off-net out	29%	29%	29%	29%	29%	29%
%off-net in	57%	56%	56%	55%	54%	53%

Source: Operator data, SVP analysis, PwC GSM benchmark study

3.4.6 Non-billable minutes

Non-billable minutes can be attributed to call set-up time; ringing time and call disconnect time. As these are not reflected in the MOU but nevertheless result in usage of network elements, an allowance for the same needs to be considered. We have estimated non-billable minutes as 10% of the total minutes of usage (billable and non-billable).

3.4.7 SMS and Data converted to Minutes of Usage

We have also estimated the number of SMS and data downloads per subscriber in a circle. Based on recent data published by TRAI we have seen a declining trend in SMS across circles, as outgoing calls become cheaper. Hence a decline of 2% in SMS per month has been assumed across all circles.

Exhibit 30: SMS converted to MOU

Circle	SMS converted to Minutes of Use					
	2007 A	2008 E	2009 E	2010 E	2011 E	2012 E
Metro	0.51	0.51	0.51	0.51	0.51	0.51
Circle A	0.68	0.68	0.68	0.68	0.68	0.68
Circle B	0.28	0.28	0.28	0.28	0.28	0.28
Circle C	0.15	0.15	0.15	0.15	0.15	0.15

Source: Operator data, SVP analysis

There is an increasing trend towards usage of data services. Based on the PwC GSM benchmark study for 2006 and 2007 we have projected the number of megabytes of data downloads across the 4 circles. The same has been converted into MOU as detailed in the table below.

Exhibit 31: Data converted to MOU

Circle	Data converted to Minutes of Use					
	2007 A	2008 E	2009 E	2010 E	2011 E	2012 E
Metro	23.19	26.67	30.67	35.27	40.56	46.64
Circle A	4.64	5.10	5.61	6.17	6.79	7.47
Circle B	1.55	1.58	1.61	1.64	1.67	1.71
Circle C	1.55	1.58	1.61	1.64	1.67	1.71

Source: PwC GSM Benchmarking study, SVP MTC model

3.4.8 Total MOU per subscriber per month

The total MOU has been calculated by aggregating the voice, data and SMS minutes of use for each of the individual circles.

Exhibit 32: Total MOU per month

Total MoU per sub per month	2007A	2008E	2009E	2010E	2011E	2012E
1 Metro	560	569	579	583	589	595
2 Circle A	544	550	551	551	552	552
3 Circle B	503	515	524	530	530	531
4 Circle C	501	521	536	542	542	542

Source: PwC GSM Benchmarking study, SVP MTC model

3.5 Network design parameters

Network design parameters are used to dimension the network and to determine the total incremental CAPEX to be incurred on an annual basis. The model uses appropriate global benchmarks (which are based on theoretical first principles) in consonance with the efficient operator hypothesis. However it is recognized that there could be practical difficulties faced by Indian operators in achieving these benchmarks. Hence we have suitably adjusted the global benchmark to take into account India specific conditions and realities. However a complete and more accurate estimation of such adjustments would need a further detailed analysis. Please refer to the section on network calibration.

3.5.1 Cell Radii

The cell radii parameter is used to determine the number of coverage sites required based on the land coverage projections for the hypothetical operator. The model uses global benchmarks on cell radii for both 900 MHz and 1800 MHz spectrum band with adjustments to reflect local Indian conditions. The following table details the cell radii which has been used based on the geotypes identified.

Exhibit 33: Cell radii taken vs. Adjusted Benchmarks

Cell Radii	Cell radii taken		Benchmarks		% variance
	900MHz	1800MHz	900MHz	1800MHz	(1800Mhz)
Dense-urban	686	470	599	410	15%
Urban	1256	860	978	670	28%
Sub-urban	3183	2180	3957	2710	-20%
Rural	7300	5000	12819	8780	-43%

Source: Bear Stearns global benchmarks, Spectrum VP, Units: Meters

The rationale for the adjustment of benchmarks is as follows:

1. The dense-urban and urban areas in India have lesser number of high rise buildings and skyscrapers as compared to corresponding areas in Europe and US. Hence the signal fading is much lower in India as compared to European countries and the US which form a substantial part of the database for compilation of these benchmarks. Hence a higher cell radius is taken for dense urban and urban areas in India.

2. In India, sub-urban and rural areas have a higher population density as compared to the corresponding areas in Europe and US. Hence for India the cell radius in these areas should be lower than the global benchmarks

Based on the data submitted to SVP by the operators, a variation was noticed in the cell radius between the different circles. For example operators use 3 times larger cell radii in Circle A as compared to what is used in Metros. SVP is of the opinion that such decisions are taken at the cost of compromising the Quality of Service (QoS). Since the hypothetical efficient operator that is being modelled should provide the best quality of service we believe that the cell radius should be determined only based on geotype without any adjustments between circles. This would ensure the achievement of the benchmarks set by TRAI.

SVP also notices significant differences between the cell radii taken in the model (based on adjusted global benchmarks) and the data on cell radii provided by operators for each of the service areas. In most cases the cell radii as given by operators is significantly lower.

The following table summarizes the difference between the operator average and the benchmarks taken for one circle (Delhi):

Exhibit 34: Cell radii taken vs. Operators (Delhi Circle)

Cell Radii	Op. Average	Benchmark	% Variance
Dense-urban	0.36	0.47	31%
Urban	0.68	0.86	26%
Sub-urban	1.47	2.18	49%
Rural	3.05	5.00	64%

Source: Operators, Spectrum VP, Units: Meters

This could be reflective of the practical constraints faced by operators in India today. However a more detailed and careful analysis needs to be carried out to determine the extent of the calibration needed to adjust this parameter for market realities. The current model does not perform this calibration due to the limited time frame that was available to conduct this exercise.

3.5.2 Network sharing

It is assumed that the efficient operator would increasingly use passive network sharing to roll out new sites especially in circles B and C to be more cost effective. In line with the current situation, it has been assumed that the operator would share passive infrastructure in order to expand rapidly. Hence the CAPEX incurred to roll out network infrastructure would be shared with other companies and not incurred solely by the hypothetical operator. Only the CAPEX required for sites that are owned and not shared with others would be incurred by the operator.

We have used aggressive yet realistic assumptions on the extent to which site sharing would be used. However it should be noted that due to the impending roll out of 3G services, it is unclear as to the extent of sharing that would be done since 3G equipment would also be used in the same tower. Hence operators would want to place their 3G equipment in the available space within the same tower rather than share it with other companies. The following table details the projections regarding the sharing of passive infrastructure over the time frame envisaged by the model.

Exhibit 35: Passive cell sites shared

% Passive cell sites shared	2007A	2008E	2012E
1 GBT	49%	55%	70%
2 RTT	62%	43%	65%
3 RTP	77%	26%	40%

Source: PWC GSM operators benchmarking study 2008, Spectrum VP

Active network sharing has not been taken into consideration since it is still not a reality in India. Also there are no examples of such an arrangement for 2G in any country (there are however active sharing arrangement for 3G in countries like Sweden). Due to the uncertainty regarding the extent to which operators would engage in active sharing we have not taken the same into consideration.

3.5.3 RAN parameters

Spectrum Available: The model takes the maximum spectrum available in metros and the average of the spectrum allocated to operators in other circles (A, B and C) as the spectrum available for the hypothetical operator. The hypothetical operator is thus assumed to have an optimal spectrum allotment based on recent such allocations. For the purposes of the model we have taken the total spectrum available in both the 900Mhz and the 1800Mhz band. In reality the amount of spectrum only in the 1800Mhz band is much lower. The following table summarizes the spectrum availability situation in various circles:

Exhibit 36: Available spectrum across circles

Available Spectrum	
1 Metro	10.0
2 Circle A	8.2
3 Circle B	8.2
4 Circle C	8.2

Source: Operators data Units: MHz

Since this model does not consider additional spectrum allocation, it must be kept in mind that there would be additional cost associated with any such allotment in future. The same has not been considered for the purpose of this model.

% effective use of carriers due to non-optimal site location: This parameter accounts for the fact that operators might not be able to place their sites in optimal locations and hence might not be able to use all the available carriers due to interference from surrounding areas. A 95% effective use has been considered in the model. This is based on global benchmarks. However we realize that in reality in India this parameter could be lower due to certain practical limitations. However a more detailed analysis needs to be carried out to determine the extent to which this parameter needs to be calibrated.

Number of TRX per site: Based on the spectrum available and the carrier use efficiency the number of TRX per site has been determined. The following table summarizes this:

Exhibit 37: Number of TRX per site

Number of TRX per site	
1 Metro	10
2 Circle A	8
3 Circle B	8
4 Circle C	8

Source: SVP LRIC model

The number of TRX per site is later used to calculate the TRX throughput and the total number of sites required for capacity.

3.5.4 Transmission link parameters

Transmission links are used to connect the various network elements together. Typically either a Microwave or a fiber link is used. The model assumes all BTS-BSC links to be E1 links and all core transmission links (BSC-

MSC and MSC-MSC) to be either STM 1 or STM4. The model further assumes (based on the information made available by operators) that all STM1 links are microwave and all STM 4 links are fiber.

The following table summarizes the capacity of the various transmission links considered:

Exhibit 38: Capacity of transmission links

Capacity of transmission links	
E1	2.0
STM1	155
STM4	620

Units: Mbps

The model assumes that most of the backhaul transmission links (BTS-BSC) would be fibre and more fibre would be used in Metros and Circle A as compared to Circle B and C due to capacity requirements in these circles. The below table indicates the % fibre in across the circles for backhaul and backbone links:

Exhibit 39: % fibre for transmission links in different circles

%Fibre for different circles	
Backhaul (BTS-BSC)	
Metro	10%
Circle A	10%
Circle B	5%
Circle C	5%
Backbone (BSC-MSC, MSC.MSC)	
Metro	90%
Circle A	90%
Circle B	70%
Circle C	25%

The model take the average number of hops per link and average length of fibre per links based on the data submitted by operators and SVP's judgment of the Indian telecom market. The below table summarizes these:

Exhibit 40: Backhaul and Backbone links configurations

Backhaul and Backbone link configurations	
BTS-BSC (backhaul)	
Average number of links per BTS	1
Average length of fibre link (Km)	2
Average hops per MW link (Hops)	3
BSC-MSC	
Average number of links per BSC	1
Average length of fibre link (Km)	10
Average hops per MW link (Hops)	4
MSC-MSC	
Average number of links per MSC	1
Average length of fibre link (Km)	20
Average hops per MW link (Hops)	4

3.5.5 Routing table

The routing table is used in the model for two purposes:

1. To determine the traffic (minutes) flowing through each of the network elements which would be used to dimension the network based on the capacity and utilization of each element.

2. For allocating the total OPEX and CAPEX costs obtained to the termination service based on the proportion of terminating minutes flowing through the network elements.

The following table presents the routing table used:

Exhibit 41: Routing table

Service	BTS	BTS-BSC	BSC	BSC-MSC	MSC	MSC GMSC	GMSC	SMSC	GSN	NMS	HLR	IN
Voice												
- On-net	2	2	2	2	1.65	0.27	0.27			1	1	1
- Off-net incoming	1	1	1	1	1	1	1			1	0	0.9
- Off-net outgoing	1	1	1	1	1	1	1			1	1	0.1
SMS												
- On-net	0.01	0.01	0.01	0.01			0.01	0		0.01	1	0
- On-net	0.01	0.01	0.01	0.01			0.01	1		0.01	0	0.9
GPRS												
- Data downloads	1	1							1	1	1	1

Source: SVP LRIC Model, Operators

The above is a simplified routing table that reflects the underlying network architecture assumed. This has been developed based on intuitive scenarios for the flow of various services on the network elements and based on inputs from the operators on the actual scenario seen.

For on-net calls we have developed the usage for two scenarios: one for the intra circle on-net call which would not use a GMSC and the second for inter-circle on-net calls which would use a GMSC, MSC-GMSC link etc. We have determined the final on-net routing factor for MSC and GMSC based on the weighted average usage of these network elements (14% inter-circle calls as compared to 86% intra-circle calls).

The routing table captures SMS and data usage accurately only to the extent of the network elements that are considered in the model. For example even though data might use a GSN, SGSN, PCU and other core GPRS network elements it is not included in the table since they are not involved during voice termination and are not part of the network elements considered in the model.

Based on the routing table we have determined the allocation factors for each network element with regard to the termination service. The tables below indicate the allocation factors which have been used for each of the circles:

Exhibit 42: Metros-Allocation fractions to mobile termination services

Network element	Allocation fraction to mobile termination minutes					
	2007 E	2008 E	2009 E	2010 E	2011 E	2012 E
BTS	48%	47%	46%	44%	43%	45%
BTS-BSC	48%	47%	46%	44%	43%	45%
BSC	50%	49%	48%	47%	46%	45%
BSC-MSC	50%	49%	48%	47%	46%	45%
MSC	52%	51%	50%	49%	48%	47%
MSC-GMSC	64%	63%	63%	62%	61%	61%
GMSC (POI)	64%	63%	63%	62%	61%	61%
NMS	55%	53%	52%	51%	50%	53%
HLR	75%	74%	72%	70%	68%	74%
IN	13%	12%	12%	11%	11%	11%

Source: SVP LRIC model

Exhibit 43: Circle A-Allocation fractions to mobile termination services

Network element	Allocation fraction to mobile termination minutes					
	2007 E	2008 E	2009 E	2010 E	2011 E	2012 E
BTS	50%	49%	48%	46%	45%	45%
BTS-BSC	50%	49%	48%	46%	45%	45%
BSC	50%	49%	48%	47%	46%	45%
BSC-MSC	50%	49%	48%	47%	46%	45%
MSC	52%	51%	50%	49%	48%	47%
MSC-GMSC	64%	63%	63%	62%	61%	61%
GMSC (POI)	64%	63%	63%	62%	61%	61%
NMS	57%	56%	55%	54%	53%	53%
HLR	79%	78%	77%	76%	74%	74%
IN	13%	12%	12%	11%	11%	11%

Source: SVP LRIC model

Exhibit 44: Circle B-Allocation fractions to mobile termination services

Network element	Allocation fraction to mobile termination minutes					
	2007 E	2008 E	2009 E	2010 E	2011 E	2012 E
BTS	50%	49%	48%	47%	46%	45%
BTS-BSC	50%	49%	48%	47%	46%	45%
BSC	50%	49%	48%	47%	46%	45%
BSC-MSC	50%	49%	48%	47%	46%	45%
MSC	52%	51%	50%	49%	48%	47%
MSC-GMSC	64%	63%	63%	62%	61%	61%
GMSC (POI)	64%	63%	63%	62%	61%	61%
NMS	57%	56%	55%	54%	54%	53%
HLR	80%	79%	78%	77%	75%	74%
IN	13%	12%	12%	11%	11%	11%

Exhibit 45: Circle C-Allocation fractions to mobile termination services

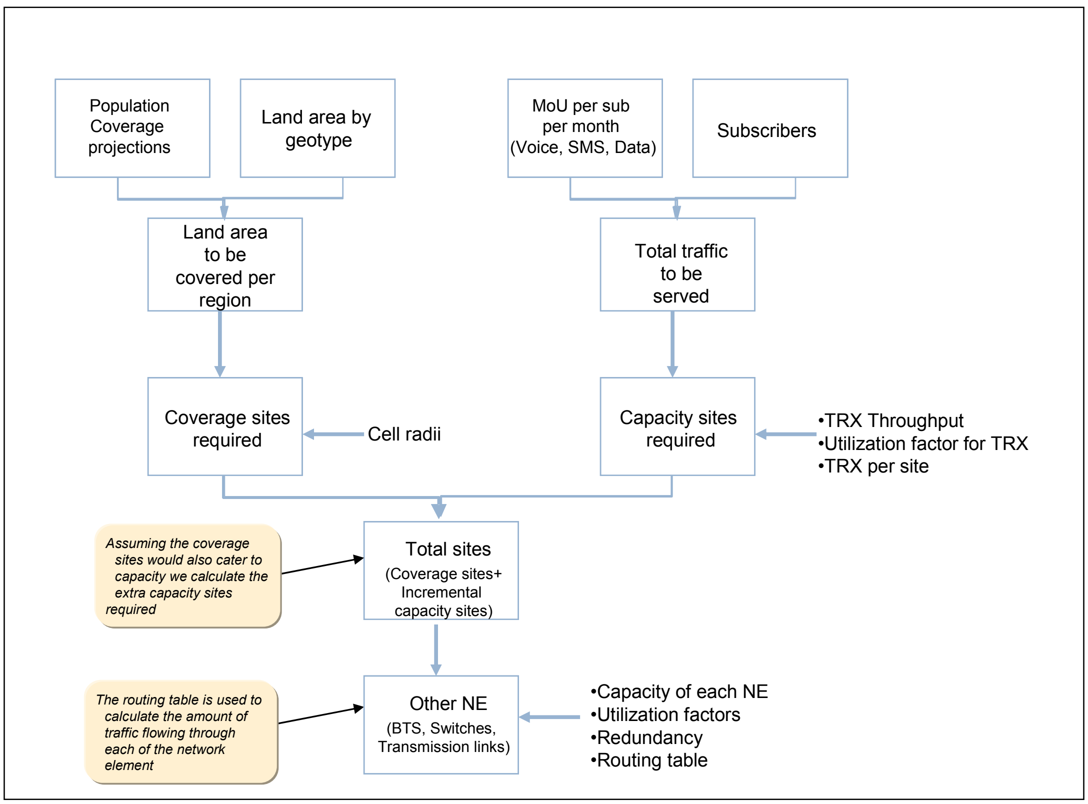
Network element	Allocation fraction to mobile termination minutes					
	2007 E	2008 E	2009 E	2010 E	2011 E	2012 E
BTS	50%	46%	45%	44%	43%	43%
BTS-BSC	50%	46%	45%	44%	43%	43%
BSC	50%	49%	48%	47%	46%	45%
BSC-MSC	50%	49%	48%	47%	46%	45%
MSC	52%	51%	50%	49%	48%	47%
MSC-GMSC	64%	63%	63%	62%	61%	61%
GMSC (POI)	64%	63%	63%	62%	61%	61%
NMS	57%	52%	51%	50%	49%	50%
HLR	80%	70%	69%	68%	67%	65%
IN	13%	12%	12%	11%	11%	10%

Source: SVP LRIC model

3.6 CAPEX requirement

The following diagram presents a simplified flow diagram of the process followed in the model to determine the CAPEX outlay for the hypothetical operator

Exhibit 46: Flow diagram to calculate the CAPEX required



Source: SVP LRIC model

3.6.1 Sites Required

The model first determines the number of coverage sites required based on the land coverage projections by circle and geotype as described earlier and the cell radii of each geotype. Then the capacity sites are determined based on the total traffic (MOU converted into erlangs) that needs to be served and the through put per TRX and number of TRX per site.

The model assumes coverage sites built would also be used to serve the traffic. This is a reasonable assumption based on the fact that an efficient operator would not roll out new sites if there is no traffic to be served by them. Hence the model takes the coverage sites to be incremental in nature in the long run. The model then calculates the incremental capacity over and above the coverage sites that are required which are purely capacity sites.

The following exhibits summarize the number of coverage, capacity and total sites:

Exhibit 47: Cumulative sites required for coverage

Sites required for coverage	2007E	2008E	2009E	2010E	2011E	2012E
1 Metro	1,179	1,284	1,342	1,376	1,399	1,413
2 Circle A	797	2,160	3,622	4,600	5,446	6,230
3 Circle B	1,555	1,976	2,332	2,636	2,904	3,081
4 Circle C	836	1,576	2,141	2,705	3,199	3,668

Source: SVP LRIC Model

Exhibit 48: Incremental sites require for capacity

Incremental sites required for capacity	2007E	2008E	2009E	2010E	2011E	2012E
1 Metro	463	277	0	0	0	0
2 Circle A	899	105	0	0	0	0
3 Circle B	0	169	0	0	0	38
4 Circle C	0	0	0	0	0	0

Source: SVP LRIC Model

Exhibit 49: Cumulative sites required for coverage and capacity

Sites for coverage + Capacity	2007E	2008E	2009E	2010E	2011E	2012E
1 Metro	1,642	2,024	2,082	2,116	2,139	2,153
2 Circle A	2,649	4,117	5,579	6,557	7,403	8,187
3 Circle B	1,555	2,145	2,501	2,805	3,073	3,288
4 Circle C	836	1,576	2,141	2,705	3,199	3,668

Source: SVP LRIC Model

The total number of sites required is then broken into the various categories of passive sites of Ground based tower (GBT), Roof top tower (RTT) and Roof top pole (RTP). The following table indicates the split assumed between the various categories:

Exhibit 50: Split between passive cell sites in various circles

GBT vs RTT split between circles	GBT	RTT	RTP
1 Metro	9%	34%	57%
2 Circle A	50%	30%	20%
3 Circle B	71%	27%	2%
4 Circle C	69%	29%	2%

Source: PWC GSM operators benchmarking study 2008

Metros are more likely to have real estate scarcity particularly in prime locations and hence RTT or RTP are preferred in these circles. Whereas in circle C which is mainly rural it would be easier to erect GBTs rather than RTT or RTP due to availability of real estate and also due to the lack of high rise buildings on which to erect the roof top tower/pole.

3.6.2 Network elements required

BTS and TRX:

The number of TRX and BTS required is directly calculated based on the number of sites required In India. Based on the operator's data we have seen that there is one BTS in every site and hence the same has been considered in the model.

Exhibit 51: Number of TRX required

Number of TRX required	2007E	2008E	2009E	2010E	2011E	2012E
1 Metro	16,420	20,240	20,820	21,160	21,390	21,530
2 Circle A	21,192	32,936	44,632	52,456	59,224	65,496
3 Circle B	12,440	17,160	20,008	22,440	24,584	26,304
4 Circle C	6,688	12,608	17,128	21,640	25,592	29,344

Source: SVP LRIC Model

Switches and transmission links:

The Network elements (NE) such as the BTS; BSC, MSC and the transmission links are all derived based on the traffic that flows through them (determined through the routing table) and the capacity of each network element. The model does not take into consideration different configurations of the same network element (such as a MSC with two different configurations) which is a practical reality while rolling out networks. Rather the model assumes a standard configuration of these network elements based on the information received from the operators. This is true to the scorched node approach in building the LRIC model where existing standard configurations of network equipments are taken as given instead of rebuilding them based on newer and more efficient configurations. It should be noted that all the network elements are dimensioned based on traffic with adjustments done where necessary. This should result in a truly efficient network.

Exhibit 52: Number of BSC required

Number of BSC required	2007E	2008E	2009E	2010E	2011E	2012E
1 Metro	25	31	31	32	32	32
2 Circle A	32	49	67	78	88	98
3 Circle B	19	26	30	34	37	40
4 Circle C	10	19	26	33	38	44

Source: SVP LRIC Model

Exhibit 53: Number of MSC required

Number of MSC required	2007E	2008E	2009E	2010E	2011E	2012E
1 Metro	7	9	8	7	7	7
2 Circle A	9	14	13	15	18	21
3 Circle B	6	8	8	8	10	11
4 Circle C	3	4	4	5	6	7

Exhibit 54: Total backhaul (BTS-BSC) links required

Backhaul (BTS-BSC) links	2007E	2008E	2009E	2010E	2011E	2012E
1 Metro	2,361	2,916	2,912	2,905	2,943	2,890
2 Circle A	3,533	5,501	6,962	8,095	9,267	10,403
3 Circle B	2,044	2,867	3,233	3,612	4,035	4,425
4 Circle C	1,060	1,936	2,550	3,196	3,782	4,357

Source: SVP LRIC Model

Exhibit 55: Total backbone (BSC-MSC) links required

Backbone links	2007E	2008E	2009E	2010E	2011E	2012E
1 Metro	28	34	34	35	35	35
2 Circle A	36	54	72	84	95	106
3 Circle B	22	29	34	38	41	45
4 Circle C	12	22	30	37	43	50

Source: SVP LRIC Model

Other core network elements:

Other core network elements such as HLR and IN are dimensioned based on subscribers. The capacity of each of these elements is typically determined based on the number of subscribers a unit can serve.

Exhibit 56: Total HLR required

Total HLR required	2007E	2008E	2009E	2010E	2011E	2012E
1 Metro	11	13	12	11	11	11
2 Circle A	13	20	20	22	26	31
3 Circle B	8	11	11	12	14	17
4 Circle C	4	6	6	7	9	10

Source: SVP LRIC Model

Exhibit 57: Total IN required

Total IN required	2007E	2008E	2009E	2010E	2011E	2012E
1 Metro	4	5	4	4	4	4
2 Circle A	5	8	7	8	10	12
3 Circle B	3	4	4	5	5	6
4 Circle C	2	2	3	3	3	4

Source: SVP LRIC Model

3.6.3 Redundancy planning:

Network redundancy planning is a key consideration in the network architecture for all operators today. The model factors in network redundancy only for key traffic sensitive network elements. The following is the approach to redundancy planning:

- For all switches (BSC, MSC) the model assumes a minimum of two in every circle (i.e. in case the model predicts only one switch in a particular circle then the same is adjusted up to two units but if the model predicts two or more switches then no adjustment is made). This is because in case one switch goes down there is at-least one backup switch to route the traffic. In reality more units might be required for redundancy but due to lack of more detailed analysis at this stage we have adopted a simplified approach.

- For transmission links between the various network elements the model first calculates the minimum number of links required (for e.g. a minimum of one link per element like one per BTS, BSC etc.). We have considered redundancy of an extra link only for those links that are important to serve the traffic .This is calculated by dividing the total traffic flowing through the link (determined through the routing table) by the capacity of the link. To the extent, redundancy planning has been determined only for the traffic sensitive elements, the model has used conservative assumptions in consonance with the efficient operator hypothesis.

3.6.4 Network calibration:

It should be noted that the above method of dimensioning the network is based only on traffic flowing through each network element. Although it is the most efficient method of dimensioning the network it fails to take into account practical difficulties faced by operators in rolling out the network (e.g. geographical limitations). A network calibration step is normally performed in LRIC models to ensure that such limitations are taken into consideration. The approach to network calibration considered in the model is as follows:

- The TRX and BTS CAPEX inventories are not adjusted since these are the most cost sensitive network elements and hence should be most accurately determined based on traffic.

- For the switches (BSC, MSC) the model uses the link ratios (e.g. number of BTS connected to a BSC etc) from the actual operators. An average of all the link ratios from the all operators received is taken. These link ratios are then applied to determine the number of switches required. The rationale behind this approach is that an actual operator might be facing a practical limitation leading them to install more units of switches.

The following table summarizes the various link ratios used:

Exhibit 58: BTS per BSC

Average number of BTS per BSC	
1 Base	40
2 High	100
3 Low	30
4 Average (Taken)	57

Source: Operator data, SVP analysis

Exhibit 59: BSC per MSC

Average number of BSC per MSC	
1 Base	5.8
2 High	9
3 Low	1.4
4 Average (Taken)	5

Source: Operator data, SVP analysis

A more detailed analysis (beyond the scope of this exercise) is required to determine the actual limitations faced by operators in rolling out sites which would give a more accurate estimate of the amount of calibration to be done.

3.7 Unit CAPEX and OPEX costs and Depreciation

We have used operator data to determine unit prices of passive and active network equipment. Further OPEX costs have been determined based on SVP's past experience and data provided by the operators.

3.7.1 Unit prices of network equipment

We have used operator data for 2007 to arrive at the prices of active and passive network equipment of the theoretical operator. The unit prices for passive network equipment are calculated based on the lowest prices provided by operators. The table below indicates the unit prices of passive network equipment. The annual increase in prices has been estimated based on an examination of the steel price index. Between 1994 and 2007, the iron steel price index has increased by a CAGR of 8%. However in the period between 2002 to 2007 the annual increase in the index has been approximately 14%. For the purpose of this model, we have assumed an annual increase of 7.5% in real terms for the prices of passive equipment since steel accounts for approximately 70% of the cost of these components. Other components of the capital cost of these equipment include duties and taxes, logistics costs and installation costs. Other costs which are included in the capital costs like taxes, logistics and installation costs have also shown an increasing trend in recent years.

Exhibit 60: Estimated unit prices of Passive Network Equipment

Rs. 000	2007	2008	2009	2010	2011	2012
GBT	2,109	2,267	2,437	2,620	2,817	3,028
RTT	1,202	1,292	1,389	1,494	1,606	1,726
RTP	1,159	1,246	1,339	1,440	1,548	1,664

Source: SVP LRIC model

The unit prices of active network equipment are detailed in Exhibit 62. The unit prices are based on average prices provided by operators. Since the prices of such equipment are determined in a global market, it is unlikely that there would be significant variations in the prices across operators.

In recent years an annual decline in prices of active network equipment in the range of 6-7% has been seen. However this is likely to be offset to a certain extent as a result of increase in duties and taxes, transportation and installation costs. As a result, we have assumed a yearly decrease of 5% in the prices of active network equipment in real terms (without adjusting for inflation).

Exhibit 61: Estimated unit prices of Active Network Equipment

Cost component	Network Equipment	Unit	2007	2008	2012	CAGR 08-12
RAN	TRX	Rs.000	41	39	31	-5%
	BTS	Rs.000	1,234	1,172	955	-5%
BSC			64,682	61,448	50,049	-5%
Transmission	Fibre	Rs.000/Km	522	496	404	-5%
	Microwave	Rs.000/Km	355	337	274	-5%
Core	MSC / VLR	Rs.000	97,041	92,189	75,089	-5%
	HLR	Rs.000	43,168	41,010	33,403	-5%
	IN	Rs.000	77,968	74,070	60,330	-5%

Source: SVP LRIC model

3.7.2 Useful lives

For the purpose of calculating depreciation we have used the average useful lives of assets based on information provided by operators. The useful life is the period of time at the end of which the economic value of the asset is equal to zero. The useful lives of the assets considered in the model are detailed in the table below:

Exhibit 62: Useful lives of capital equipment

Useful life of capital equipment (Yrs)	
Passive	
GBT	15
RTT	15
RTP	15
Active	
TRX	8
BTS	8
BSC	8
MSC	8
GSN	8
Transmission	
Fibre	8
Microwave	10
Other core network elements	
HLR	5
VLR	10
IN	10

Source: SVP LRIC model

3.7.3 Annualized CAPEX cost

We have used the tilted annuity method of depreciation as this is most consistent with the principle of economic depreciation which is the accepted depreciation methodology for LRIC models. The annual depreciation under this method is calculated using the formula:

C(t) =I(t=0) [(r-1) (1+i) ^ (t-1)/(1-((1+i)/(1+r)^n))]

Where

C(t) = Capital charge in year t

I (t=0) = Initial value of the asset

r = WACC
n = Asset life

I = Tilt factor

The depreciation computed as per the tilted annuity method is in the table below:

Exhibit 63: Tilted annuity depreciation

Tilted annuity depreciation (Rs. Million)						
Circles	**2007E**	**2008**	**2009**	**2010**	**2011**	**2012**
1 Metro	2,469	2,926	2,843	2,769	2,689	2,603
2 Circle A	3,567	5,296	6,491	7,264	7,965	8,586
3 Circle B	2,150	2,840	3,076	3,300	3,525	3,707
4 Circle C	1,219	2,008	2,431	2,958	3,377	3,697

Source: SVP LRIC model

3.8 OPEX costs

In determining the network related OPEX costs, we have extensively used benchmarks of cost data from projects we have done with telecom operators and tower companies. We have used this information to sense check the data provided by operators and ensure that the costs pertain to that of a theoretical efficient operator.

3.8.1 Fixed and Variable OPEX-owned sites

The OPEX costs considered in the model are only the network related OPEX costs. The main constituent of this cost is the site OPEX both fixed OPEX such as operations and maintenance, administration expenses, Insurance and variable OPEX such as land lord rents, fuel and power etc. We have used benchmarks based on the industry trends in India and our previous projects to determine the fixed and variable OPEX costs.

The following table gives the split of the fixed OPEX costs considered:

Exhibit 64: Fixed OPEX costs

Passive - Fixed opex costs	*Source*	Units	**GBT**	**RTT**	**RTP**
Operations and maintenance	*Spectrum VP*		3,700	3,700	3,700
Includes:					
DG (CAMC)		Rs / month	2,500	2,500	2,500
AC (CAMC)		Rs / month	583	583	583
Spares		Rs / month	417	417	417
SMPS + Battery		Rs / month	200	200	200
Admin expenses, Misc. & Others (Includes fuel handling charges)			4,074	4,074	4,074
Fuel logistics	*Spectrum VP*	Rs / month	500	500	500
Manpower		Rs / month	1,250	1,250	1,250
Gen & Admin		Rs / month	1,908	1,908	1,908
Vehicles/Motorcycles		Rs / month	417	417	417
Insurance	*Spectrum VP*	Rs / month	1,093	765	765
Total fixed opex per site		Rs / month	**8,868**	**8,539**	**8,539**
YoY change in fixed opex		%		5%	

Source: Operators, SVP analysis

The year on year increase in costs is the real increase in costs. Since the above costs items do not show a significant variation due to demand and supply issues the model assumes only a moderate growth rate in real terms of 5%. This increase in costs has also been verified with the information made available by operators.

The above information on costs is based on Spectrum Value Partners prior projects with telecom operators and tower companies in India.

The following table provides the split of the variable OPEX costs considered:

Exhibit 65: Variable OPEX costs

Passive - Variable opex costs	*Source / Taken*	Units	GBT	RTT	RTP
Landlord rents					
1 Metro	*Taken*	Rs / month	10,250	11,406	10,400
	Spectrum VP	Rs / month	10,250	11,406	10,400
	Operator Average	Rs / month	20,432	16,258	8,285
2 Circle A	*Taken*	Rs / month	8,962	9,586	8,620
	Spectrum VP	Rs / month	8,962	9,586	8,620
	Operator Average	Rs / month	16,685	14,312	8,413
3 Circle B	*Taken*	Rs / month	6,600	6,709	5,750
	Spectrum VP	Rs / month	6,600	6,709	5,750
	Operator Average	Rs / month	16,544	13,599	6,907
4 Circle C	*Taken*	Rs / month	4,641	7,240	6,245
	Spectrum VP	Rs / month	4,641	7,240	6,245
	Operator Average	Rs / month	15,190	13,772	6,373
Fuel and power					
1 Metro	*Spectrum VP*	Rs / month	19,129	19,129	19,129
2 Circle A	*Spectrum VP*	Rs / month	18,750	18,750	18,750
3 Circle B	*Spectrum VP*	Rs / month	18,347	18,347	18,347
4 Circle C	*Spectrum VP*	Rs / month	18,750	18,750	18,750

Source: Operators, SVP analysis

The above cost information is based on both SVP benchmark cost data from past projects in India. The average of operator's data is used where appropriate. This is true to the reconciliation step in LRIC models which reconcile the unit costs with the average of operators to account for vendor negotiation power and relationship that some operators maintain.

For variable OPEX a year on year change of 6% is assumed in real terms. Landlord rents have shown dramatic increases in the recent years due to escalating real estate prices. Our model estimates around 8% YoY increase in real terms for landlord rents. For fuel and power, our model estimates a YoY growth of around 5% in real terms; although in the short term there could be wider fluctuations. For the total variable OPEX growth the model assumes the average of the two growth rates.

3.8.2 Fixed and Variable OPEX shared sites

For shared sites a reduction in fixed and variable OPEX is considered due to sharing of the costs incurred. A CAPEX recovery charge is also considered as part of the rental that the hypothetical operator would incur. The applicable percentages are given below:

Exhibit 66: Reduction in fixed and variable OPEX due to network sharing

Reduction due to network sharing	
% Reduction in passive fixed opex	50%
% Reduction in passive variable opex	20%
% Rental charged for capex recovery	10%

Source: Operators, SVP analysis

The actual reduction in the OPEX would depend on the number of tenants in the shared site. The model assumes only one extra tenant per site. In reality there could be more but the impact on the final output would be minimal.

The CAPEX recovery charge is yearly and forms part of the yearly rental that would be charged. It is assumed that the contracts signed would be valid for 5 years which is typically the time period seen in India.

3.8.3 Active OPEX

The model assumes all active OPEX (e.g. maintenance of switches and transmission links) to be 30% of the total OPEX. This is based on SVP benchmark cost data from previous projects in India and is consistent with information submitted by operators for this exercise.

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3.8.4 Spectrum and License fee

The model considers only the revenue share part of spectrum and license fee. These costs are directly related to mobile termination since each extra call that gets terminated would lead to revenues and a part of that is paid out as spectrum or license fee to the government. The fee is calculated on the adjusted gross revenues of an operator which is net of the interconnection payouts. We have noticed that on an average in India the net revenue due to mobile termination is positive (i.e. the industry average indicates that revenues from mobile termination minus the payouts due to mobile termination are positive). The model considers only that part of the revenue share that is attributable to mobile termination.

The adjusted gross revenue is calculated by multiplying the net service ARPU (net service revenue / subscribers) for each circle with the total subscribers in that circle for the hypothetical operator. The net service revenue is gross revenue minus the interconnection payouts and roaming charges.

The percentage of spectrum and license fee attributable to the mobile termination is calculated as follows:

- 14% of the gross revenue is the interconnection payouts to the other operators.
- 5 % of the gross revenue is the out roaming airtime payouts
- Hence 81% of gross revenue is the net service revenue (Net service revenue = Gross revenue – Interconnection payouts .- out roaming payouts)
- The gross service revenue for the operator = Net service revenue / 81%
- 4.1 % of the gross service revenue is the net receipts due to mobile termination.
- Hence the % of spectrum and license fee attributable to mobile termination is = 4.1% / 89% = 5%

Spectrum and license fee costs are hence directly allocated to mobile termination at 5% and these costs are not allocated using the routing table.

Spectrum Fee:

The model takes into consideration both the spectrum usage charge and the MW usage charge. The applicable percentages are given below:

Exhibit 67: Spectrum usage charge

Spectrum fee		Spectrum	Fees
2% of AGR for spectrum usage upto 4.4 + 4.4 MHz	MHz	4.4	2%
3% of AGR for spectrum usage upto 6.2 + 6.2 MHz	MHz	6.2	3%
4% of AGR for spectrum usage upto 10 + 10 MHz	MHz	10	4%
5% of AGR for spectrum usage upto 12.5 + 12.5 MHz	MHz	12.5	5%
6% of AGR for spectrum usage upto 15 + 15 MHz.	MHz	15	6%

Source: TRAI

Exhibit 68: MW access fee

Spectrum fee for MW access	%	0.5%

The following table summarizes the spectrum fee per circle per month.

Exhibit 69: Total spectrum fee per month per circle

Spectrum fee per circle (m Rs / Month)	2007E	2008E	2009E	2010E	2011E	2012E
1 Metro	2	3	2	2	2	2
2 Circle A	1	2	2	2	2	3
3 Circle B	1	1	1	1	1	1
4 Circle C	0	1	1	1	1	1

Source: Operators, SVP analysis

There are discussions currently on increasing the spectrum fee for allotments beyond 6.2 MHz. As there is uncertainty regarding the increased fee for such allotments, we have not considered the same for the purpose this model. The inclusion of this cost is likely to have a potential impact on the costs attributable to mobile termination. As we are unable at this point to quantify the impact of these additional costs, the non-inclusion of the same may be considered as a conservative assumption.

License Fee:

The model considers the license fee (revenue share) paid out by operators as a percentage of the AGR. Following are the charges applicable for the same:

Exhibit 70: License fee % of AGR applicable

% of AGR for License fee	
1 Metro	10%
2 Circle A	10%
3 Circle B	8%
4 Circle C	6%

Source: DoT

The following table summarizes the license fee costs applicable to mobile termination:

Exhibit 71: Total License fee per month per circle

License Fee per circle (m Rs / Month)	2007E	2008E	2009E	2010E	2011E	2012E
1 Metro	5	6	5	4	4	4
2 Circle A	4	6	6	6	7	8
3 Circle B	2	3	2	2	3	3
4 Circle C	1	1	1	1	1	2

Source: Operators, SVP analysis

The model does not consider the entry fee paid by operators to start operations which is usually amortised over a number of years. This is due to the fact that the entry fee is not directly applicable for mobile termination and is incurred even if mobile termination service is not paid.

3.9 Mark-up for common costs

Common costs are costs that are common to both the retail and the wholesale business. These are not directly attributable to the services modeled but are never the less incurred. Normally head office costs (land and building, utilities, personnel), Corporate office costs (HR, Legal, regulatory) are included as part of the common costs.

Most LRIC models include a common cost mark up over and above the incremental costs for termination found through forward looking projections. Common costs are included mainly because the costs are related to infrastructure that is integral to providing the mobile termination service. Without incurring these costs it would not be possible for any operator to effectively provide wholesale termination or interconnection service.

The model determines the common cost incurred in the following manner:

- One head office per circle is assumed and the costs associated with it are considered as common costs. The model does not consider the corporate headquarters (HR, Legal, regulatory etc) costs as common costs since these costs would be shared across all the circles/regions and it becomes there is inadequate information to arrive at a suitable basis for apportionment of these costs across circles..
- The actual cost data submitted by operators has been considered for the purpose of calculation of common costs. Due to the wide variation observed in the costs submitted by operators the model takes the lowest value.

- An Equi-Proportional-Mark-Up (EPMU) method is adopted for allocation of common costs. This is done by determining the proportion of direct costs that have already been allocated to the termination service and allocating the common costs based on the same proportion. The following formula details how the EPMU mark-ups are arrived at:

  EPMU Markup = Direct incremental costs for mobile termination / Total direct incremental costs

  Common costs markup = EMPU Mark-up x Common costs per circle

  Per minute common cost mark-up = Common cost mark up / Total terminating minutes

The following table summarizes the per-minute EPMU mark up due to common costs incurred per circle:

Exhibit 72: Per min common costs mark-up per circle

Common costs mark-up (Rs / Min)						
Circles	**2007E**	**2008**	**2009**	**2010**	**2011**	**2012**
1 Metro	0.03	0.03	0.03	0.04	0.04	0.04
2 Circle A	0.04	0.03	0.03	0.03	0.03	0.03
3 Circle B	0.03	0.03	0.03	0.03	0.03	0.03
4 Circle C	0.06	0.05	0.05	0.05	0.04	0.04

Source: SVP LRIC Model

3.10 Computation of WACC

Weighted Average Cost of Capital for the theoretical efficient operator has been computed based on standard Capital Asset Pricing Method (CAPM) principles.

The risk free rate is based on the current prevailing rate as on November 1, 2008 for 10 year government securities. We have calculated the beta for the efficient operator based on average betas of listed telecom operators in India.

We have assumed a debt equity ratio of 50% and a tax rate of 33.67%. Based on the same, the post-tax WACC has been calculated as follows

Post tax WACC = Ke X E/(D+E) + Kd X (1-Tax rate) X D/(D+E) = 11.2%

Pre tax WACC = Post Tax WACC/(1-Tax Rate)=11.2%/(1-34%) =17%

Exhibit 73: Computation of WACC

Computation of WACC	%
Risk Free Rate	8%
Market Risk Premium	7%
Beta	
- Bharti Airtel	0.8
- Idea	1.3
- Reliance	1.3
Assumed Average Beta for theoretical efficient operator	1.13
Cost of equity (Ke)	16%
Assumed debt/(debt + equity) ratio	50%
Cost of debt (kd)	11%
Assumed tax rate	34%
WACC for theoretical efficient operator (based on betas) post-tax	**11.2%**
WACC for theoretical efficient operator (based on betas) pre-tax	**17.0%**

4 Outputs of the Model

Based on the assumptions underlying the base case we have determined the Weighted Average LRIC. The Outputs of the model are presented in real terms and do not consider the impact of inflation. We have also identified certain parameters to which the model is highly sensitive. The impact of a change in these parameters on the base case has been assessed. Further it is recognised that there are certain additional considerations like incremental CAPEX associated with 3G, Mobile Number portability and Broadband Wireless Access and costs of NMS and billing systems which need to be factored into the determination of the MTC. For the purpose of this exercise the impact of these factors have not been considered.

4.1 Assumptions underlying the base case

The Base Case adopts conservative assumptions which are in line with the current market realities

The key assumptions underlying the base case are listed below:

1. Global benchmarks adjusted to local conditions have been used in determining the cell radii for various geotypes
2. Redundancy planning has been built into the network design
3. Tilted annuity method of depreciation is followed
4. No network calibration has been carried out
5. Cost of capital has been added as a mark-up to the depreciation on capital equipment

4.2 Base case outputs

The following table presents the base case LRIC based MTC per circle. This is the output without any mark-up added to it.

Exhibit 74: LRIC output MTC per circle

LRIC output Per circle (Without common cost) Rs / Min					
Circles	**2008**	**2009**	**2010**	**2011**	**2012**
1 Metro	0.23	0.25	0.26	0.26	0.28
2 Circle A	0.27	0.35	0.36	0.34	0.32
3 Circle B	0.27	0.30	0.30	0.28	0.26
4 Circle C	0.38	0.43	0.45	0.45	0.44

Source: SVP LRIC model

The table below presents the common costs mark-up per circle to be added to the LRIC output to account for common cost recovery.

Exhibit 75: Common cost mark-up per circle

Common costs mark-up (Rs / Min)					
Circles	**2008**	**2009**	**2010**	**2011**	**2012**
1 Metro	0.03	0.03	0.04	0.04	0.04
2 Circle A	0.03	0.03	0.03	0.03	0.03
3 Circle B	0.03	0.03	0.03	0.03	0.03
4 Circle C	0.05	0.05	0.05	0.04	0.04

Source: SVP LRIC model

The LRIC + common cost mark-up is as shown in the below table:

Exhibit 76: LRIC + Common cost mark-up

MTC (LRIC + Common cost mark-up) Rs / min					
Circles	**2008**	**2009**	**2010**	**2011**	**2012**
1 Metro	0.26	0.28	0.30	0.30	0.32
2 Circle A	0.30	0.38	0.40	0.37	0.35
3 Circle B	0.29	0.33	0.33	0.31	0.28
4 Circle C	0.44	0.48	0.50	0.50	0.48

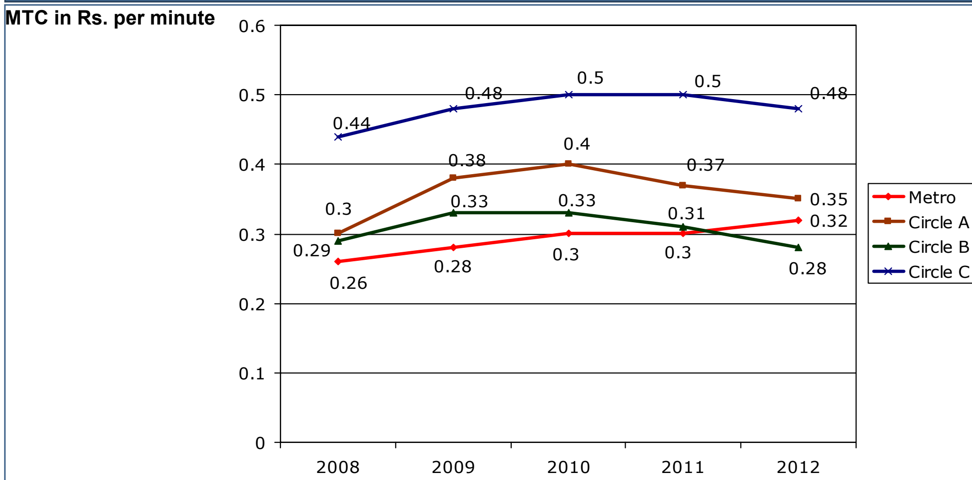
Source: SVP LRIC model

By weighing the individual circle MTC with the traffic in each circle we have determined the Weighted Average MTC for each of the years of the model. Further we have calculated a 3 Year look-ahead Average LRIC+ based on a simple average of the MTC for 2008-2010.

The Weighted Average MTC for each of the years of the model is detailed in the charts below. The 3 Year Average MTC calculated on the basis of the LRIC+ model is Rs 0.35 per minute. It is important to note that the outputs in the table constitute the real MTC and need to be adjusted for inflation to arrive at the nominal MTC. The weighted average and the 3 year look ahead average outputs are summarized in the charts below:

Exhibit 77: Weighted average LRIC

Base Case Outputs (LRIC + Common cost mark-ups)



	2008	2009	2010	2011	2012
All India Weighted Average MTC (based on traffic of each circle)	0.30	0.36	0.38	0.36	0.35

3 Year Average LRIC **(In real terms)***	0.35

Source: SVP LRIC model

4.3 Inflation adjusted base case output

The results shown above are represented in real terms. To arrive at the nominal value of the MTC the output need to be adjusted with wholesale price index inflation. The following table presents the weighted average outputs and the 3 year average output in nominal terms:

Exhibit 78: Increase in Wholesale Price Index over the Base Year -2007

Wholesale Price Index inflation (%)					
	2008	2009	2010	2011	2012
All - India	10%	18%	24%	30%	35%

Source: SVP Analysis, Office of Economic Advisor, Ministry of Industry, India, EIU

Base Year 2007=100

Exhibit 79: Weighted average MTC nominal (Rs / Min)

Weighted average MTC Nominal (Rs / Min)					
	2008	2009	2010	2011	2012
All - India	0.33	0.42	0.47	0.47	0.47

Exhibit 80: 3 year look ahead MTC nominal (Rs / Min)

Average MTC for the next 3 years (Rs / min)	
3 Year look ahead MTC	0.41

Source: SVP LRIC model

4.4 Additional considerations

There are certain additional considerations which have not been factored into the model. These considerations are listed below:

Calibration

As mentioned earlier, Network calibration is a key aspect of designing a LRIC model. Such calibration requires a detailed analysis of the constraints if any faced by operators in network design and deployment. The objective of calibration is to enhance the robustness and predictive ability of the model. For the LRIC model developed by SVP, we have used global benchmarks wherever possible. It is recognized that there may be topographical limitations in India which might constrain operators from attaining the global benchmarks particularly with regard to certain network design parameters like cell radii and carrier use frequency. To this extent the model adopts conservative assumptions in developing the network design for the theoretical efficient operator.

Investment in 3G

The auctioning process for granting licenses for 3G services is expected to be completed in 2009. At present there is uncertainty as to both the timing of launch of such services and the uptake in the near to medium term. Due to such uncertainty we have not considered any investment in 3G services in this model.

Additional CAPEX for Mobile Number Portability

It is expected that in 2009, Mobile Number Portability will become a reality in India. This would involve additional CAPEX/OPEX for operators. At present the quantum and nature of such investment cannot be assessed. In the absence of such assessment, the extent to which such increased CAPEX/OPEX can be attributable to Mobile Termination services cannot be determined. Hence we have not considered investment in Mobile Number Portability for the purpose of this model.

CAPEX cost associated with billing Systems and Network Management Services (NMS)

The CAPEX costs associated with Billing Systems and Network Management Services are a recognised cost element in a LRIC model. However in the absence of information regarding the quantum of such costs, we have not considered the same for the purpose of this model.

5 Key conclusions

SVP has determined the Mobile Termination Charge using a Forward Looking LRIC model. The endeavour has been to construct a "theoretical efficient operator" in accordance with Standard LRIC principles which have been accepted by regulators in other countries which have deployed this model. The determination of MTC based on a theoretical efficient operator eliminates biases due to individual differences between existing operators and possible new entrants with regard to network design and the costs associated with the same. Further we have used conservative assumptions at each stage in determining the MTC.

Based on the outputs of the model, the following conclusions can be drawn

1. The base case LRIC estimates the weighted average MTC for 2008 (3 year look ahead average) at Rs.0.35 per minute. This is the LRIC in real terms and does not account for inflation. With inflation the MTC is estimated at Rs.41.

2. For Circle C, the Base Case LRIC is significantly above the current level of MTC. This needs to be considered in the light of the fact that future growth in penetration is likely to emanate from less affluent areas particularly Circle B and Circle C. An MTC below cost is unlikely to provide the necessary incentive to operators to expand in rural areas. Other Asian countries like Malaysia and emerging markets like Brazil have recognized the importance of MTC as a tool to bridge the rural-urban divide and have provided for an increasing MTC.

3. There appears to be a variation in the Base Case LRIC for each of the individual circles. Such variations are expected given that the circles are at different stages of maturity in terms of mobile penetration and volume of traffic. Further there is a trend towards convergence of the LRIC over time.

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