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## Scope & Deployment of Small Cells in India

**Ula Javed**

Student, Symbiosis Institute of Telecom Management (SITM), Pune, India

**Shirish Patel**

Student, Symbiosis Institute of Telecom Management (SITM), Pune, India

**Nilesh Tayade**

Student, Symbiosis Institute of Telecom Management (SITM), Pune, India

**Abstract:**

With 4G rolling out by Dec-2015 in India, Telco's will see a steep increase in the data consumption by subscribers. Small cells network will help Telco's and subscribers to overcome the connectivity and coverage issues and scale up the network element capabilities in transferring data and various services, with reduced deployment cost of network infrastructure. By 2019, the expected revenue growth of small cells is expected to be more than 130% to \$8-15 bn.

The methodology adopted was conducting survey in an area near Pune with high call drops and bad QoS. Based on their responses, the report was analyzed to propose a solution of deploying small cells to improve connectivity and user experience in such geographies. Het-Nets will be able to solve the future requirements of increased capacity and higher data speed.

Operators will benefit from better value proposition, reduced churn rates, CapEx and OpEx requirements. Small cells will also help in deploying successfully various government projects.

**Keywords:** Small cells, offloading, call drops, HetNet

**1. Introduction**

According to the statistics as on March 2015, there are 302.35 million internet wireless subscribers in India. Today around 70% of mobile voice connections and 80% of mobile data connections take place indoors.

The major problems that current service providers are facing includes:

- expensive deployment cost of network infrastructure like macro-cells (high CapEX, OpEx)
- Sky rocketing price of acquiring additional spectrum
- huge power consumption by macro cells
- Low signal strength received in indoors which leads to less connectivity and less coverage resulting into customer dissatisfaction, increasing subscriber churn rate and huge revenue loss for Telco's.

With 4G rolling out by December 2015 in India, Telcos will see a steep increase in the data consumption by subscribers. Therefore, it is very important for service providers to cater to this exponential growth of data and to ensure that areas with problems like no or low coverage should be resolved. As we know high frequency results in low coverage area so with 4G which is supposed to work primarily on a high frequency band of 2300MHz, it will be required to deploy a macro-cell at every half a kilometer which will incur high CapEx and OpEx.

As per the 2011 census, out of the 5.93 lakh inhabited villages in the country about 50,000 villages are not covered with Telecom connectivity. One alternative of providing connectivity and improving coverage could be deploying more number of macro-cells which will be a very costly affair. Moreover with the vision of projects like Digital India, National Optical Fiber Network (NOFN), Pradhan Mantri Jan Dhan Yojana (in integration with Mobile Money), smart cities etc., it has become very important to provide connectivity in every part of the country and improve the coverage.

A Small Cell solution can improve Mobile Operators value proposition and ensure that problems of poor and no connectivity are resolved. First of all, churn can be reduced through a better user experience, achieved by increased coverage (and relevant real-time service quality) and improved data throughput. Moreover deployment of small cells will be a cost effective solution for operators as it works on existing licensed band with the operator and unlicensed band and there is no need for additional spectrum acquisition. Since Small Cell deployment cost is lower than macro cell, offloading traffic from 3G networks enable CapEx and OpEx reduction. Also there are no health hazards connected with small cells.

## 2. Problem Area

### 2.1. Big Shift to Data

Mobile networks in India have shifted to become primarily data from being predominantly voice networks

With low cost gadgets available in the market more and more people across the country have switched over from their feature phones to these gadgets supporting data services. This has led to a huge increase in data consumption by mobile users over the last year.

The main factors affecting the growth in data usage are the kind of devices available in the market, together with increased data coverage.

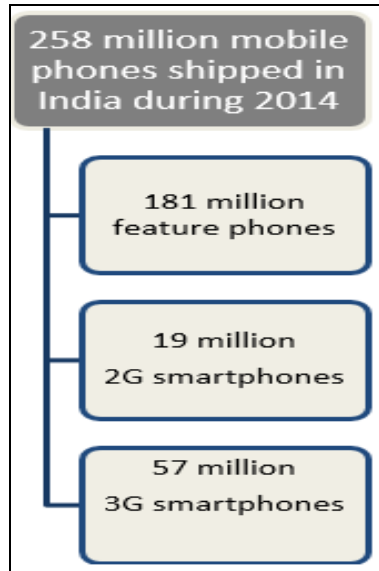


Figure 1

Source: Mbit Index study, Nokia Networks, India

The use of 3G devices capable of supporting a surfing speed of up to 21.1 Mbps increased from 23% in 2013 to 54% in 2014. There could be a huge opportunity window for the telcos in the time to come with around 5.5 million devices capable of supporting 4G networks. Therefore telecom operators have to focus on improving the network coverage in order to retain the subscribers and to lure more subscribers.

### 2.2. Infrastructure Cost

Various costs are involved in deployment of 1 telecom tower -raw land, building of a tower that can run between Rs 40 lakhs-1 crore .Apart from this there can be monthly rentals and cost of technicians. Offloading traffic from 3G networks enable a CapEx and OpEx reduction since Small Cell deployment cost is lower than macro cell.

### 2.3. Power Consumption

It is estimated that in India almost 70% telecom towers are located in areas with more than 8 hours of grid outage and almost 20% are located in off grid areas. So for continuous supply of power to telecom towers annually more than 2.6 billion liter diesel is consumed resulting in emission of 7 million metric tons of CO<sub>2</sub>. So an alternative option can be deployment of small cells that have an advantage of low power consumption.

### 2.4. Call drops and QoS

According to a report from TRAI, service providers like Aircel, Vodafone, Telewings and BSNL lack in achieving benchmarks in most of the parameters and show underperformance in these parameters and thus measures should be taken to improve coverage and capacity in order to reduce the churn rate.

Parameter	Benchmark	Service Provider	Service Area	Performance
Traffic Channel Congestion	$\leq 2\%$	Aircel	NE	3.64
			WB	2.56
		BSNL	NE	4.67
		Vodafone	J&K	2.26
Call Drop Rate	$\leq 2\%$	Aircel	ASM	2.03
			HR	3.20
			NE	2.67
		BSNL	ASM	2.45
			BH	3.31
			NE	4.53
Connection with good quality voice	$\geq 95\%$	Aircel	ASM	90.10
			BH	94.99
			J&K	92.91
			NE	92.50
		BSNL	NE	92.29
		Telewings	BH	93.34
			UPE	92.85
			UPW	94.57

Table 1: Performance of Indian Service provider

#### 2.4.1. Some studies on wireless usage show

- 70% of mobile voice connections take place indoors
- 80% of mobile data connections take place indoors

To cater this exponential increase network needs to get closer to end user via DAS, Small Cells and Wi-Fi Operators should take measures for solving for Capacity, not just Coverage.

### 3. Drivers of Small Cells

- Growth in mobile data- Due to boom in smartphones and growing adoption of OTT (Over-the-top) services by consumers, Telcos around the world are witnessing huge data traffic volumes .
- Spectrum benefits of small cells
  1. Benefits apply across wide range of spectrum bands :
    - Performance is spectrum band agnostic
    - Standardised in all existing mobile bands from 700 MHz to 2.6GHz
    - Tolerant to interference from wide range of sources (e.g. Digital TV)
  2. Reuse existing bands
    - Rapid refarming without full clearance. E.g.: UMTS femtocells on GSM macro
    - Future potential for LTE refarming on 3G spectrum.
  3. Spectrum and economic efficiencies
    - Dense reuse and high interference protection give very high capacity
    - These capacity gains apply in low and high freq bands
    - Deep indoor coverage with lower cost and reduced environmental impact
  4. Innovation & competition
    - Scope for new operators in limited spectrum
    - 'Inside-out' femtocell-led deployments
    - New services and better customer experience
- Attractive Economics of Offload- To meet the exponentially increasing capacity targets, mobile operators cannot only rely on new spectrum or new technology. Also considering limited spectrum and the cost involved to deploy a macro cell it has become difficult to increase the density of macro cells. Small cells are crucial to expand the capacity of mobile networks in high-traffic areas.
- Big Shift to Indoor Consumption- Mobile traffic is significantly growing, with a shift from outdoor to indoor consumption. Because of the lack of available spectrum, adding new macro cells will not achieve the needed scaling of mobile networks. Therefore, End-to-end Small Cell solutions which are focused on improving coverage and increasing overall mobile network capacity in highly crowded spots can be used as a way to scale mobile networks.

#### 4. Why Small Cells

Increased number of users, devices and applications are straining the current infrastructure as a result of which mobile network operators are not able to provide services that the subscribers expect which leads to growth in the subscriber churn rate.

High Traffic Load	High Capacity Needs	High Capacity Density
<ul style="list-style-type: none"> <li>• Growing smartphone penetration</li> <li>• More applications</li> <li>• High per subscriber traffic</li> <li>• Multi device subscribers</li> </ul>	<ul style="list-style-type: none"> <li>• More Basestations</li> <li>• More Spectrum</li> <li>• New Technologies</li> <li>• Multiple interfaces</li> <li>• Effective traffic management</li> </ul>	<ul style="list-style-type: none"> <li>• Traffic load unevenly distributed across</li> <li>• 2 directions               <ul style="list-style-type: none"> <li>- Dense metro areas</li> <li>- Indoor coverage (home, offices)</li> </ul> </li> </ul>

Figure 2: Capacity Density

Due to exponential increase in traffic load, mobile operators have to change the way they plan, deploy and operate mobile networks, and charge for access. Until recently, mobile networks mostly expanded horizontally to reach new areas or to improve indoor coverage. The new wave of expansion is orthogonal and aimed at providing depth of coverage – that is, more capacity in already covered areas. The initial horizontal expansion of mobile networks was achieved mostly through the deployment of additional macro cells. This is no longer sufficient to get depth of coverage. So for providing the additional capacity at low cost, we need small cells.

Small cells are low-power access points, providing improved cellular coverage, capacity and applications for homes and enterprises as well as in urban (metro) and rural public spaces. Small cells are the logical extension of backhaul which serves the purpose of providing the data access to the users with greater coverage. Small cell is an umbrella term for low-powered radio access nodes that operate in licensed and unlicensed spectrum that have a range of 10 meter to several hundred meters. These cells are managed by operators at customer sites. These contrast with a typical mobile macrocell which might have a range of up to several tens of kilometers. They allow service providers to extend service coverage inside of your home - especially where access would otherwise be limited or unavailable - without the need for expensive cellular towers. It also decreases backhaul costs since it routes your mobile phone traffic through the IP network. The term covers femtocells, picocells, microcells and metrocells. In broad terms, these small cells increase in size (physical, emitted power and number of users supported) from femtocells (the smallest) to microcells (the largest).

1. Femtocell- Initially used to describe consumer units intended for residential homes, the term has expanded to encompass higher capacity units for enterprise, rural and metropolitan areas.

Key attributes of femtocells include:

- Due to short transmit-receive distance the transmit power is lower which result into prolonged handset life.
- Reduced backhaul cost
- Self-optimization
- Ease of deployment
- Supports 2 to 5 mobile phones in a residential setting
- Higher SINR and higher spectral efficiency
- Dedicated BS to home subscribers also referred to as “home base station” / “3G access point”

2. Picocell: Key Features of picocells include:

- Small -sized base-stations
- Low power
- Used in enterprise or public indoor areas
- Limited interference impact on macro users
- Self-optimization feature
- Allows co-channel deployments
- Can be deployed anywhere at minimal cost
- Required for network coverage extension

- 3. Microcell: It is a short range base station which enhances coverage for both indoor and outdoor users where macro coverage is limited.
- 4. Metrocell: It serves up to 32 simultaneous calls and is meant for both indoor and outdoor coverage. It is designed for high capacity metropolitan areas.
- 5. HetNet (Heterogeneous Network): A network where a mixture of macrocells, small cells and in some cases Wi-Fi access points, are employed together to provide coverage with handoff capabilities between them.

**5. Small Cell Strategy**

Detailed deployment plan should be focused on increase in capacity & coverage, Quality of Service (QoS) and cost reduction. So, before deployment of small cells on a large scale, it is very important to consider the following factors:

- Type of small cell – Indoor small cells (low range), Enterprise small cells (medium range) and Metro Cells (high range).
- Location for small cells deployment-whether it is for home or enterprise or outdoor. For outdoor metro cells the operators might have to take necessary approvals or they can do partnership and take permission of local governing bodies and municipal corporations, for using the infrastructure, street lamps, and traffic signals and so on.
- Planning the required capacity and bandwidth for back-hauling.
- Finally choosing dedicated or shared UMTS carrier would be a big concern with limited spectrum as it is natural resource which is scarce. If an operator has spectrum then dedicated carrier is best approach for small cells deployment choosing dedicated or shared UMTS carrier would be a big concern if you have Limited spectrum over UMTS is the major problem for operators as it is natural resource which scarce, and to choose between dedicated or shared UMTS carrier.
- If an operator has spectrum then dedicated carrier is best approach for small cells deployment.

**6. Case Study**

Lavale is small village located in Mulshi Taluka of Pune district, Maharashtra with total 1537 families residing. The Lavale village has population of 6732. A huge hillock separates Lavale village from Pune city. It has become an education hub with Symbiosis International University Campus and FLAME college campus. It also houses the Lupin Pharmaceuticals Industry.

The village has a lot of small restaurants too apart from small shops .It is seeing a lot of new businesses getting opened up. The telecom infrastructure is not very well developed here. We have conducted an independent survey on call drops in Lavale to see the scope of deployment of small cells here. The survey was conducted in colleges in Lavale and in local residents. The respondents were asked questions related to the call drops and service quality.

77.8% respondents were in the age group of 20-25 years. The top 3 current telecom service providers in the village were Idea having 59.6% of the total subscribers, Airtel with 28.3 % and Vodafone with 19.2% of the total subscriber base

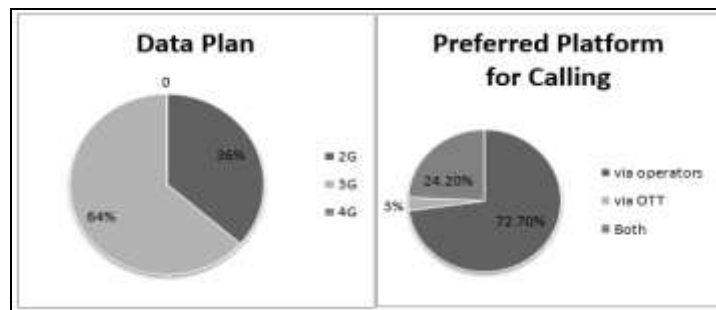


Figure 3: Data Plan and preferred platform for calling used by Subscribers

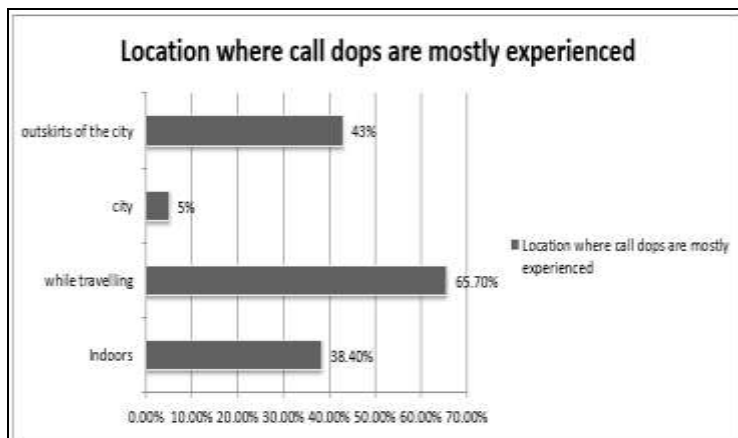


Figure 4: Location with frequent call drops

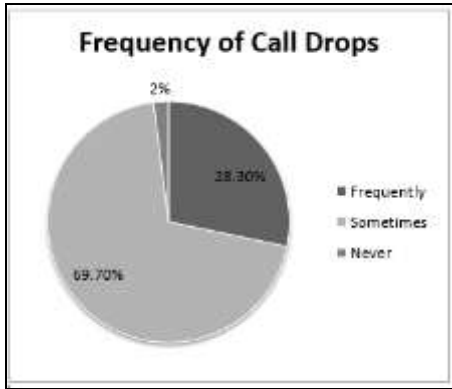


Figure 5: Frequency of Call Drops



Figure 9: Quality of Service

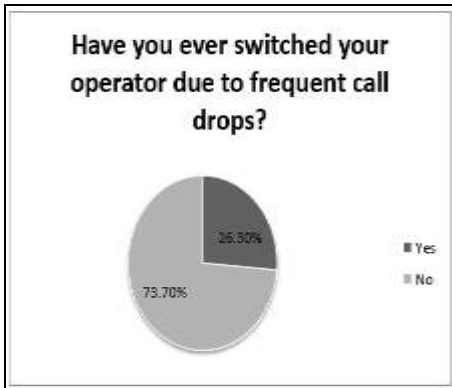


Figure 61: Subscriber churn due to call drops

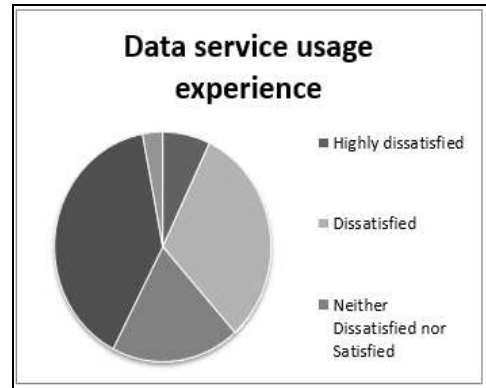


Figure 10: Data Service usage Experience

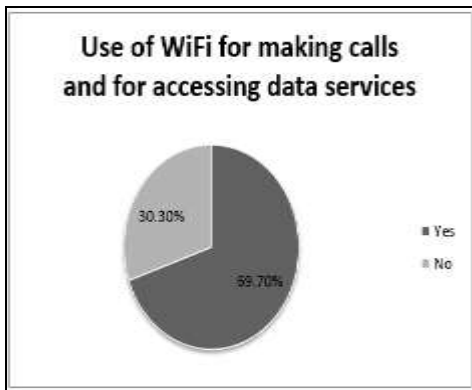


Figure 72: Wi-Fi Usage

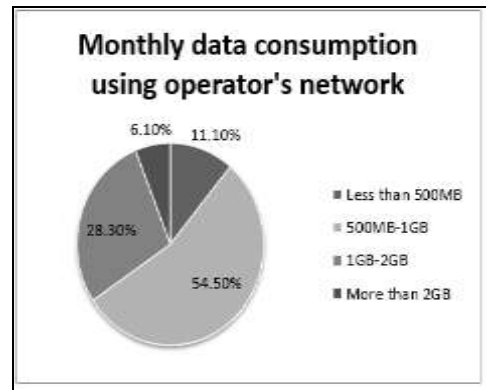


Figure 11: Data Consumption on Operators network

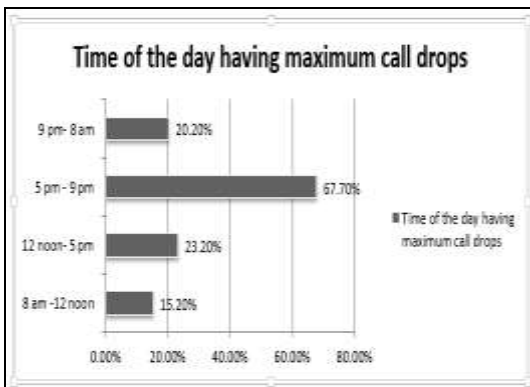


Figure 8: Time of the day with maximum call drops

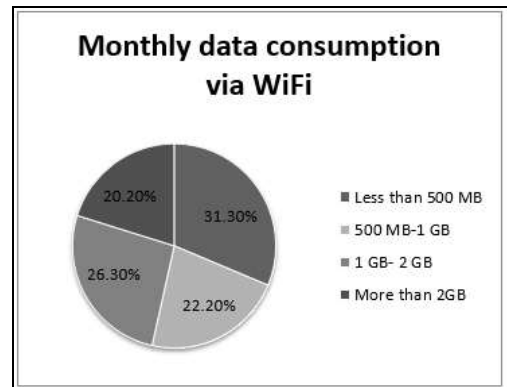


Figure 12: WiFi Data Consumption

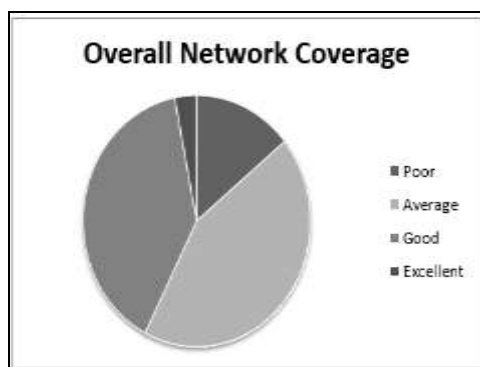


Figure 13: Network Coverage

According to the survey done on call drops in Lavale, it has been found that there are frequent call drops around 5 pm to 9 pm specially during travelling followed by outskirts of the city and indoors. 63.6 % of total subscribers use 3G data plan but they were not very satisfied with the experience of using data services. The network coverage and overall quality of the service was rated average by the users. Mostly the respondents were young users with high data usage of 500MB- 1GB. Also signals are received only for two to three operators. The users do not receive high 3G mobile broadband speeds, particularly indoors. This is due to the non-availability of proper telecom infrastructure.

In order to solve the coverage issue and to improve the quality of service for both voice and data installing more mobile towers in order to cater to the growing population is not a good idea. The total cost of energy to operate a telecom site is major cause of concern for Telecom Tower Infrastructure Providers. The rising operating costs, the logistical issues, the deregulation in price in the near future and the environmental cost of using diesel, all together are pushing the telecom industry to look for alternative solutions. In order to address these problem and to provide better coverage and capacity at low cost the operators could try the installation of small cells in the village. Unlike large cell towers, these devices can be unobtrusively installed in public telephone boxes, street lights, and community halls and suchlike.

### 7. Small Cells and Digital India Mapping

The 'Digital India' campaign of the Government was launched on July 1, 2015 by the Prime minister, Narendra Modi. The INR 1.13 lakh crore is aimed at creating a digitally empowered society and knowledge economy. The project has the potential to bridge the digital divide and benefit billions of people through digital solutions in education, banking, healthcare, irrigation and agriculture sectors.

Broad key areas of – (i) Digital Infrastructure as a utility to every citizen, (ii) Governance and services on demand, and (iii) Digital Empowerment of citizens.

The programme aims to provide broadband highways, universal access to mobile connectivity, public internet access programme, e-governance: reforming government through technology, eKranti – electronic delivery of services, IT for jobs, information for all and electronics manufacturing: target net zero imports.

Under 'Digital India' the Government endeavours to provide broadband connectivity in all panchayats, Wi-Fi in all schools and universities and public Wi-Fi hotspots in all important cities by 2019.

The ambitious project comes with its set of challenges, but main challenge is digital infrastructure and shortage of spectrum

### 8. Conclusion

Deploying small cells will be a win-win strategy for the subscribers as well as for the operators. The benefit of small cells like higher quality, lower cost and faster service is not only limited to customers but also to operators because they need to handle reduced amount of traffic on expensive macro cell network. Thus Heterogeneous Networks (HetNets), comprising of a mix of small cells and other technologies, can solve the future requirement of increase in capacity and higher data speed.

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