

## Demystifying WiMAX

Four years of operation, more than 500 deployments across 148 countries and only 6.5mn subscribers, is not a very good situation to be in for the global WiMAX industry. Despite this, in India the demand for WiMAX spectrum is equally fierce as was in the case of 3G spectrum. At the end of day 12, pan India WiMAX spectrum auction amount reached Rs106bn, 6x the base price of Rs17.5bn. At the current prices, the government is likely to mobilise Rs320bn from this auction.

### Why operators need WiMAX?

Despite years of operations, the broadband penetration in the country is still languishing at 8.75mn subscribers as of end-Mar 2010. The number of subscribers accessing data on mobile is much higher at 150mn subscribers. The higher cost of laying fixed line network coupled with absence of unbundling of local loop has resulted in lower competition in the broadband space from private players, thereby restricting the growth of broadband. Therefore, it is evident that the broadband penetration in the country would take off only on the wireless platform. The 802.16d (fixed WiMAX) is a proven technology with more than 500 deployments globally. The cost of deployment is also much lower than the fixed line penetration. Hence, it will help operators to provide broadband services at much lower prices.

WiMAX allows faster data downloads at a speed of 40Mbps, which is much higher than the download speed available on 3G spectrum. Also, operators who have failed to get 3G spectrum in specific circles, would want to get WiMAX spectrum. Both LTE and IEEE 802.16m aim at meeting the IMT Advanced requirements which is to achieve 100Mbps for mobile application and 1Gbps for fixed-nomadic application. Given the uncertainty about predicting technologies as well as uncertainty about spectrum availability, we expect serious operators to opt for WiMAX spectrum.

### What goes against WiMAX?

Given that 802.16m is still being developed as a future of WiMAX, we believe that WiMAX in India would be used to provide retail broadband and enterprise leased line services on 802.16e platform. These services are already being provided on other platforms such as DSL, local cable and CDMA data cards, which restricts the revenue earning potential from this spectrum on an immediate basis.

Globally, operators have already made huge investments in HSDPA networks and hence the natural progression would be towards LTE. For WiMAX, however, operators need to make fresh investments. Also, to provide coverage on a WiMAX network in metro areas (Mumbai/ Delhi) the no. of sites required would be much higher, leading to higher capex. However, some industry participants believe that 3G and WiMAX are not competing but complimentary technologies and both can co-exist, where 3G would be used for voice and WiMAX for data.

### Our View

Though securing spectrum may be a good bet from a long term perspective, we remain concerned about operators' ability to generate significant revenue compared to the cost of spectrum acquisition. We believe that this investment will generate back-ended payoffs only if WiMAX succeeds as a superior technology platform over LTE. Given the domestic deployment challenges facing WiMAX, we remain cautious on this. In the short term, we anticipate higher debt burden for telecom companies. Hence, we maintain our negative stance on the sector.

## WiMAX auction Day 12:

### Exhibit 1: BWA Auction Amount: Day 12

Service Area	Base Price (Rs mn)	Aggregate Demand @ Round 92	Excess Demand @ Round 92	Provision Winning Price (Rs mn)	% Change over Base Price
Delhi	1,600	3	1	17,583	998.9
Mumbai	1,600	3	1	18,043	1,027.7
Maharashtra	1,600	1	-1	9,156	472.3
Gujarat	1,600	1	-1	5,726	257.9
Andhra Pradesh	1,600	2	0	9,124	470.2
Karnataka	1,600	3	1	12,775	698.4
Tamil Nadu	1,600	3	1	16,145	909.1
Kolkata	600	2	0	4,929	721.5
Kerala	600	3	1	2,038	239.7
Punjab	600	2	0	3,130	421.7
Haryana	600	3	1	936	56.0
Uttar Pradesh (East)	600	1	-1	1,240	106.7
Uttar Pradesh (West)	600	1	-1	1,785	197.5
Rajasthan	600	3	1	791	31.9
Madhya Pradesh	600	2	0	984	63.9
West Bengal	600	2	0	643	7.2
Himachal Pradesh	150	3	1	164	9.1
Bihar	150	5	3	507	237.9
Orissa	150	3	1	258	72.3
Assam	150	4	2	230	53.3
North East	150	3	1	167	11.3
Jammu and Kashmir	150	3	1	167	11.3
<b>Total</b>	<b>17,500</b>			<b>106,521</b>	<b>508.7</b>

Source: DoT, Ambit Capital research

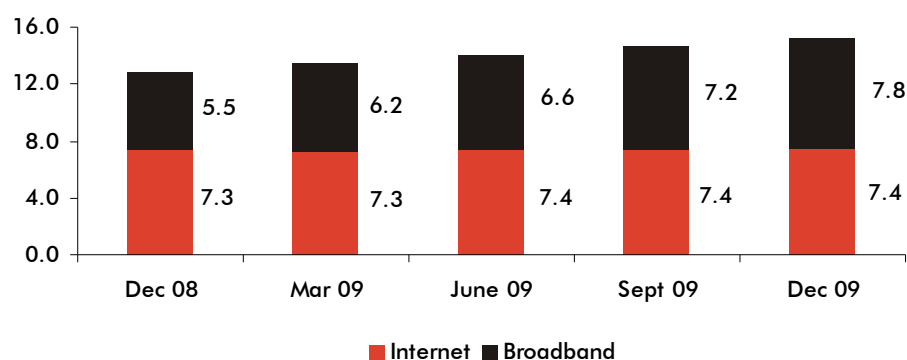
## Overview of Indian broadband industry

The Indian broadband industry is at a nascent stage with total broadband subscriber base of 8.75mn as of end-Mar 2010. The industry is dominated by DSL (digital subscriber line) which has 86% market share. In the DSL segment, BSNL/ MTNL, Bharti and RCom dominate the market.

State owned BSNL/ MTNL own more than 80% of the wireline subscribers in the country. Higher cost of fixed line deployment and absence of unbundling of local loop (ULL) has restricted the growth of broadband services in the country.

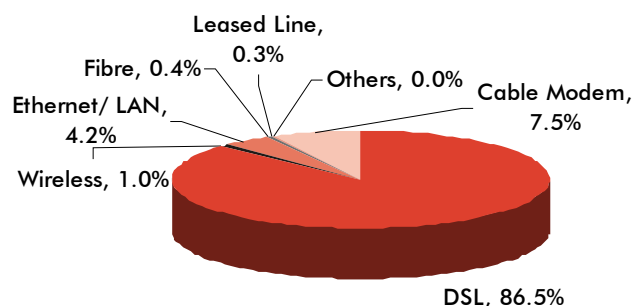
As an alternative to wireline network, globally telecom operators have started deploying WiMAX to provide low cost broadband services. The success of WiMAX, however, depends on lower customer premise equipment (CPE) cost coupled with sufficient spectrum and affordable pricing.

**Exhibit 2: Internet & Broadband Subscriber Base (mn)**



Source: TRAI, Industry, Ambit Capital research

**Exhibit 3: Technology-wise BB Subscriber Break Up (7.8mn)**

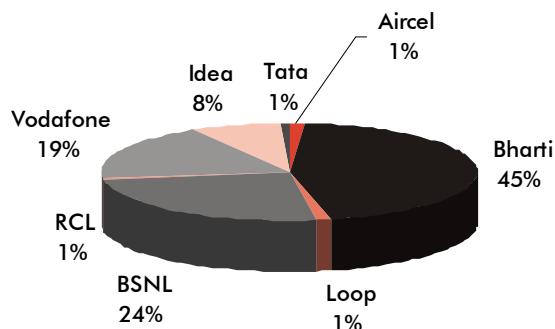


Source: TRAI, Industry, Ambit Capital research

## Internet to proliferate on mobile platform

As of Dec 2009, total internet (internet + broadband) subscriber base stood at 15.2mn, compared with the total fixed line subscriber base of 37mn, indicating a penetration of 41%. On the other hand, the no. of subscribers using data on the mobile network stood at 149mn during the same period. Given the higher mobile penetration and lower handset cost (compared to PCs) we expect internet/broadband services to pick up in India mainly on mobile platform.

### Exhibit 4: Subscriber base of data services on mobile (149mn)



Source: TRAI, Ambit Capital research

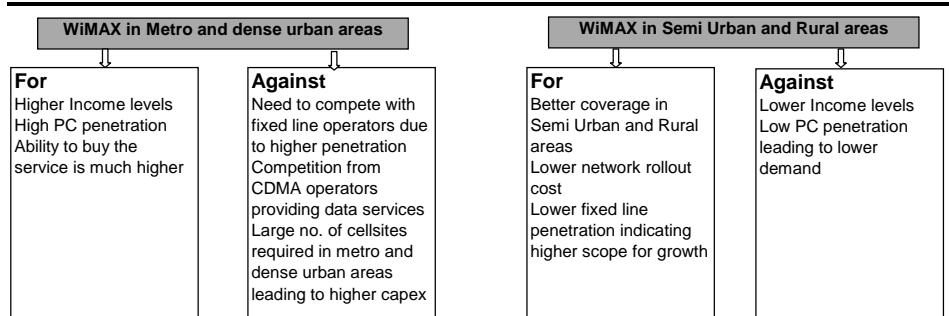
Globally, most of the WiMAX deployments have taken place on the fixed WiMAX platform (802.16d). Though, mobile WiMAX (802.16e) has also gathered steam recently, voice over mobile WiMAX is not yet proven. As a result, WiMAX is currently being used to provide data services on PCs, laptop and mobile handsets.

In India, some of the operators are currently providing WiMAX services but they are mainly on the fixed platform. We will see the advent of mobile WiMAX in India post the auction in 2.3GHz band.

## WiMAX in India

WiMAX works on non line of sight technology (NLOS) and can cover an area of 10km radius in semi-urban and rural territories. However, when deployed in high density areas like Mumbai and Delhi, the coverage of a cell site declines.

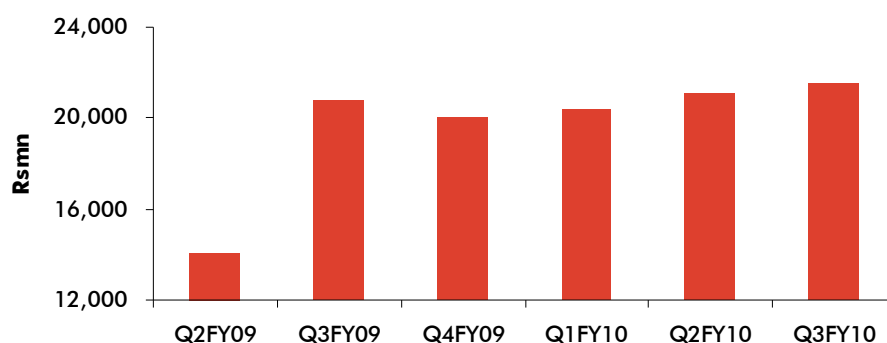
In India, the PC penetration is highly skewed towards metro and urban areas whereas in semi-urban and rural areas it is very minimal. The fixed line penetration is also very high in metro areas compared with semi urban and rural areas. In our view, this does not augur well for growth of WiMAX services in the country. In areas where WiMAX can work effectively (semi urban and rural) people do not have access device (PCs). On the other hand, in metro areas such as Mumbai and Delhi, an operator needs to deploy more no. of cell sites to provide coverage than that required in rural areas. It is believed that in dense urban areas, the no. of cell sites required to provide coverage are equal or higher than that required to provide GSM services. This will increase the cost of operations significantly, thereby negatively impacting the financials of the companies. The other reason we expect growth to be restricted is the internet data cards services provided by CDMA operators on their network.

**Exhibit 5: Factors working for and against WiMAX in India**

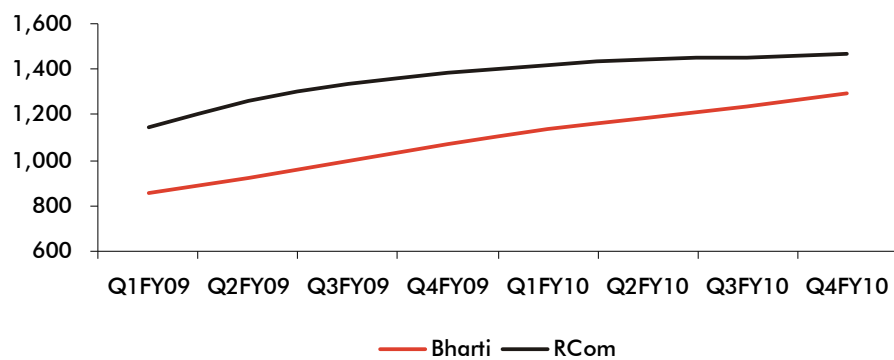
Source: Industry, Ambit Capital research

**WiMAX to provide another delivery mechanism**

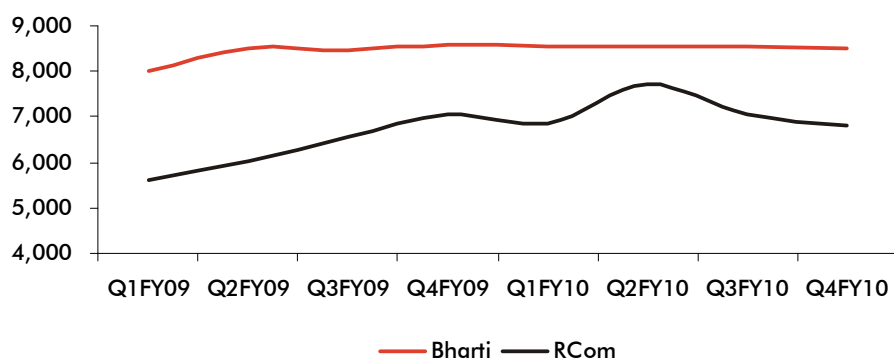
Though WiMAX provides certain advantages over wireline network such as speedy deployment, lower maintenance and upgrade cost and phased investment in accordance with demand, it does not offer any significantly different value proposition apart from providing service on a wireless platform. High speed wireless internet services are also being provided by CDMA operators in the country. Therefore, there is no incremental benefit coming from WiMAX services in our view. We expect WiMAX to be an additional option available to consumers apart from Digital Subscriber Line (DSL), cable model and Fibre-To-The-Home (FTTH) services.

**Exhibit 6: Revenue from internet services growing at a marginal pace**

Source: TRAI, Ambit Capital research

**Exhibit 7: Growth of BB Subscriber Base ('000)**

Source: Company, Ambit Capital research

**Exhibit 8: Revenue from BB services remained stagnant (Rsmn)**

Note: For Bharti revenue as reported under Telemedia segment and for RCom revenue as reported under Broadband segment

Source: Company, Ambit Capital research

## A brief overview of WiMAX

WiMAX is defined as worldwide interoperability for microwave access, which allows for broadband wireless access of information in the form of packet data. WiMAX, also known as IEEE 802.16 standard was introduced in October 2001.

The 802.16d-2004 standards, released in October 2004, was set as the fixed version of WiMAX. It allows for NLOS (non line of sight) connections and set OFDM (orthogonal frequency division multiplexing) as the transmission protocol. The end user can use a fixed WiMAX from a fixed location or can move as nomadic user, usually moving at a nomadic speed. The WiMAX can cover upto a cell radius of 3-10kms and provides download speed of 40mbps per channel, for fixed and portable access applications. Fixed WiMAX is a standardized technology and is used globally on a large scale.

Mobile WiMAX is based on IEEE 802.16e-2005 standards and is expected to operate in the 2.3GHz, 2.5GHz, 3.3GHz and 3.4-3.8GHz spectrum bands. The 802.16e-2004 standard supports fixed, nomadic, portable and mobile solutions. Mobile network deployments are expected to provide up to 15 mbps of capacity within a typical cell radius deployment of upto 3kms.

Mobile WiMAX equipments are currently included into laptops, desktops, mobile handsets and other wireless devices to provide data services.

### Exhibit 9: WiMAX deployment by region

Region	Deployments**	Countries
Africa	116	43
CALA	114	32
Asia-Pacific	112	23
Eastern Europe	85	21
Western Europe	79	17
North America (USA/Canada)	53	2
Middle East	29	10
<b>Total</b>	<b>588</b>	<b>148</b>

\*\* Deployment refers to networks that are either in service or planned/ in deployment

Source: WiMAX Forum, Industry, Ambit Capital research

### Exhibit 10: Deployment by Frequency

Deployments by Frequency	
2.3 GHz Deployments	53
2.5 GHz Deployments	112
3.3 GHz Deployments	9
3.5 GHz Deployments	311
5+ GHz Deployments	21

Source: WiMAX Forum, Industry, Ambit Capital research

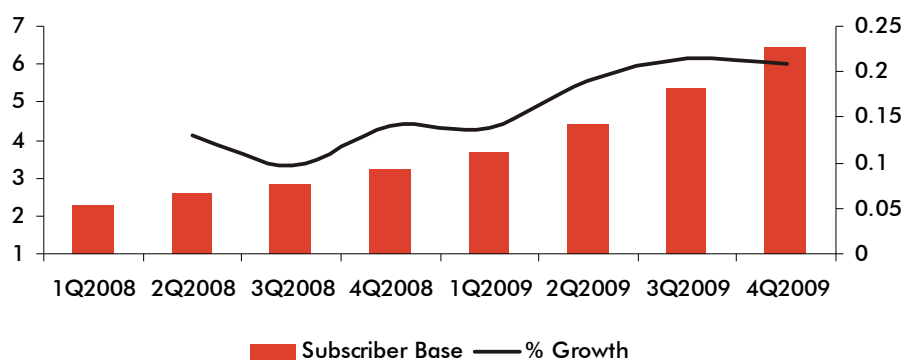
**Exhibit 11: Population Coverage by WiMAX**

Region	POPs Covered (mn)
Africa	81.3
Asia-Pacific	237.1
CALA	113.2
Eastern Europe	82.9
Middle East	27.4
North America	47.0
Western Europe	32.5
<b>TOTAL</b>	<b>621.6</b>

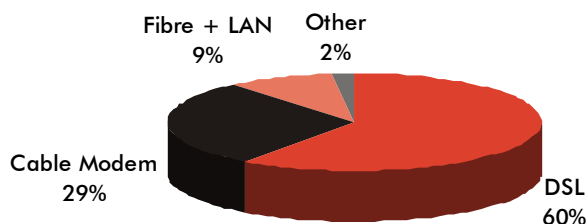
Source: WiMAX Forum, Industry, Ambit Capital research

## Large scale deployment; however subscriber growth remained elusive

Despite having more than 500 networks being deployed across 148 countries and covering 620mn population, the WiMAX service managed to get only 6.5mn subscribers by end Dec 2009. We believe that the lack of compelling applications and higher CPE cost are the key reasons for slower offtake of the service.

**Exhibit 12: WiMAX Subscriber Base (mn)**

Source: Industry, Ambit Capital research

**Exhibit 13: Technology-wise Global BB Subscriber Break Up (271mn)**

Source: OECD, Industry, Ambit Capital research



## Cost elements of WiMAX

A complete WiMAX end-to-end deployment includes many aspects. The key capex elements include WiMAX base station infrastructure, base station equipment, customer premise equipment (CPE) and base station backhaul network.

### Base station infrastructure

WiMAX base station site can be divided into three major parts namely site infrastructure, base station equipment and base station backhaul network. The site infrastructure includes site acquisition, antenna towers, backup power units, etc. The existing mobile infrastructure can be used for this purpose.

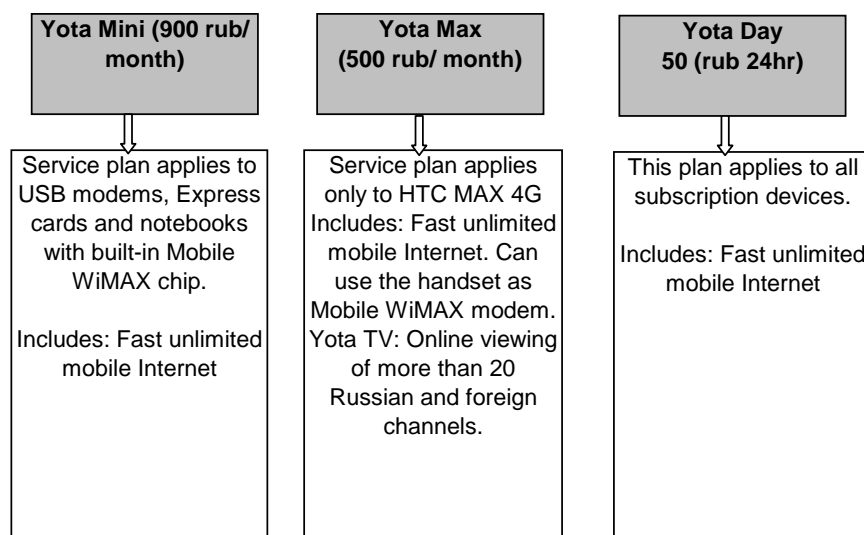
The base station equipment includes radio equipment, switches and antennas. Base station backhaul is the connection to the core network. It can be leased lines or point-to-point wireless link to an aggregation node or fiber node. In India, the backbone infrastructure for most of the incumbent telecom operators is already available; though incremental investment may be required to enhance capacity, if any.

### Customer premise equipment

CPE is placed at the user end. The signal transmitted by BTS is received by CPE, which is then connected to the access devices such as PC, laptop etc. The price of CPE is expected to play a vital role in the penetration of WiMAX services. At present, the cost of CPE is in the range of \$125-\$150. Many of CPEs in the market offer both WiMAX and WiFi. There are dual mode CPEs which support both IEEE802.16d and IEEE802.16e. In India at present, outdoor CPE are being deployed on a fixed WiMAX platform.

## Tariff plan

**Exhibit 14: WiMAX Tariff Plans for Yota (Russia)**



Source: Company, Ambit Capital research

**Exhibit 15: WiMAX Tariff Plans for Wateen Telecom (Pakistan)**

GB	256 kbps	512 kbps	1,024 kbps
5	Rs499	Rs599	Rs699
10	Rs899	Rs999	Rs1,099
Unlimited	Rs1,199	Rs1,299	Rs1,399

Source: Company, Ambit Capital research

## Frequency plays a key role

Frequency band is a critical element for WiMAX deployments and it is one of the major costs. The uniform allocation of spectrum worldwide provides standardization of equipments resulting in lower deployment cost, which in turn helps to accelerate the WiMAX development. However, the allocation of the spectrum varies across countries due to different government policies.

Generally, there are three main frequency bands available for WiMAX in the world. The most widely allocated band is licensed 3.5GHz band which covers frequencies from 3.3GHz to 3.8GHz. However, United States, South Korea, Australia, Mexico, and Brazil provide services in 2.3GHz to 2.7GHz band. Another band is License-Exempt 5GHz which is from 5.0GHz to 6.0GHz, which at present is being used by very few countries. In India, 2.3GHz band spectrum is available for auction and we expect operators to deploy mobile WiMAX.

## WiMAX and LTE competing for 4G supremacy

Globally, technology has started its progression towards Fourth Generation (4G) networks. At present, 4G technologies include Long Term Evolution (LTE), Ultra Mobile Broadband (UMB) and WiMAX. LTE is an upgrade on Universal Mobile Telecommunications System (UMTS). The technology development path is 2G-3G-HSPA-LTE. UMB is an improved technology based on CDMA2000 platform supported by Qualcomm. However, Qualcomm has favoured LTE over UMB. Most CDMA operators in the USA, Canada, China and Japan have announced plans to

adopt either WiMAX or LTE as 4G technology. Therefore, at present, the key competition is between LTE and WiMAX for 4G technology.

Both LTE and IEEE 802.16m aim at meeting the IMT Advanced requirements which is to achieve 100Mbps for mobile application and 1Gbps for fixed-nomadic application.

There are some key differences between LTE and WiMAX which has resulted in operators favouring LTE over WiMAX globally. For WiMAX, operator requires to build a new network whereas LTE only needs to make upgrade for the existing mobile infrastructure which is already used by over 80 percent of mobile subscribers globally. This is one of the reasons that many carriers intend to support LTE. Also, for WiMAX the spectrum available is still limited to 3.5GHz or 5GHz. The higher frequency spectrum increases the number of base stations WiMAX requires to cover the same area than LTE.

An advantage WiMAX has over LTE is that, the entire ecosystem for WiMAX is developed over the last four years. The large scale deployment coupled with standardization of equipment augurs in favour of WiMAX. LTE on the other hand, have very few deployments worldwide.

#### Exhibit 16: Comparison between LTE and WiMAX

	WIMAX 802.16e	IEEE 802.16m	LTE
Network Equipment available	2007	2010	2009
Handset Available	2008	2011	2010
Organisation	IEEE & WiMAX Forum	IEEE & WiMAX Forum	3GPP
Radio Technology	SOFDMA	SOFDMA	SOFDMA
Duplexing	TDD	TDD & FDD	FDD
Frequency Bands (MHz)	2300, 2500, 3500, 5000	Under 6GHz	700, 850, 900, 1800, 1900, 2100, 2500

Source: Industry, Ambit Capital research

**Exhibit 17: Price of BWA spectrum internationally**

Country	Entry Fee/ Hz (\$)	Annual Fee
S Korea	11.40	
<b>India*</b>	<b>5.15</b>	
Australia	0.37	
Taiwan	~0.00	
Malaysia	~0.00	
New Zealand	0.02	
Singapore	0.05	
Brazil	0.33	
Venezuela	0.13	
China	Free	
Greece	0.08	
Finland	0.18	
France	0.16	
UK	0.14	
Hungary	0.08	
Spain	~0.00	low annual fee
Austria	~0.00	low annual fee
Poland	~0.00	low annual fee
Ireland	~0.00	low annual fee
Denmark	~0.00	low annual fee
Sweden	~0.00	low annual fee

\* as per provisional winning price on June 7, 2010

Source: TRAI, Ambit Capital research

**Exhibit 18: Global WiMAX Frequency Deployment Map**

Source: WiMAX Forum, Industry, Ambit Capital research

**Exhibit 19: Global WiMAX Deployment Snapshot**

Source: WiMAX Forum, Industry, Ambit Capital research

## Explanation of Investment Rating

Investment Rating	Expected return (over 12-Month period from date of initial rating)
Buy	> 15%
Hold	5% to 15%
Sell	< 5%

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