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Spectrum above 6 GHz for Future Mobile Communications – In India

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Abstract: ***The exact nature of 5G is not yet defined, but to lay the foundations for its future introduction we need to understand how it might use spectrum. 5G is likely to provide much faster mobile broadband speeds than the current generation of mobile technology (4G), and the use of large blocks of spectrum is likely to be important to achieve the fastest speeds already identified possible bands below 6 GHz for future mobile services, including 5G, as part our Mobile Data Strategy, but large blocks of spectrum are difficult to find at lower frequencies. Therefore higher frequency bands, e.g. above 6 GHz, are also likely to be important. However, those bands are already used by a wide range of services that benefit citizens and consumers.***

Keywords: 5G, Mobile Generation, spectrum and Mobile Technology in India.

1. Introduction

The mobile sector continues to see dramatic growth around the world. Usage of cellphones, smartphones, and tablets is increasing at a rapid pace. With the growing popularity and ease of use of mobile devices such as iPhone, Android phones, tablets, and other portable devices, new mobile applications are coming online that increase access and capability, particularly in areas such as education, health care, transportation, and commerce.

But the tremendous increase in wireless utilization is coming up against the constraints of radio spectrum availability and telecommunications infrastructure. Radio spectrum refers to the parts of electromagnetic frequencies that are available for wireless transmissions. Different parts of the spectrum are used for different technologies and applications. A spectrum frequency band is a small section of the spectrum in which channels are used for a defined purpose. For example, the mobile broadband technologies utilized by smartphones and tablets, allows for high-speed access to the internet and other data services over mobile networks. Generally, frequencies from 30 kHz to 300 GHz are used as radio spectrum and governments allocate radio frequency bands for particular uses. It is important to note that spectrum is a scarce natural resource, since allocated spectrum cannot simultaneously be used for other purposes. Limitations in spectrum and mobile networks can create environments where consumers experience dropped calls, reduced wireless availability, or high prices. This, in turn, can cause slower mobile growth in many countries.

In this paper, we examine mobile technology in India. In particular, we study the crucial role of spectrum policy in facilitating wireless growth. The availability of devices, high telecommunications costs, and taxes on mobile usage make it difficult for consumers and businesses to take full advantage of the mobile revolution. India has enormous potential for growth in mobile applications as is reflected in its massive number of mobile customers. Many estimate that India will become the first mobile-first Internet market in the world. This is because nearly 80 percent of Internet users are doing so through mobile phones and for approximately 60 percent of Internet users, mobile is the only source of Internet access.

2. Mobile Technology in India

As is true in many places around the world, mobile technology has grown rapidly in India. The country has seen a rapid increase over the last decade. As Figure 3 shows, there were nearly 915 million subscribers in India in 2014,increasing from less than 50 million in 2004. The latest numbers from the Telecom Regulatory Authority of India(TRAI) show that mobile customers are more than 30 times the number of fixed line customers in India. There is also a rapid shift occurring in the type of devices that make up these numbers. From 19percent in 2013, smartphone market share had grown to 35 percent by the end of 2014. This trend is expected to continue, signalling a shift in the type and amount of usage of spectrum by mobile devices. Looking ahead, these numbers are projected to rise even further as future mobile growth takes place in the Asian Pacific. The latest report of the Cellular Operators Association of India (COAI) states that more than 80 percent of Internet users in India are using a mobile phone for access, and that for nearly 60 percent internet users, the mobile phone is the only medium of Internet access. Overall, according to an Ericsson report, the number of mobile subscribers is expected to rise to 1.145 billion by2020. And the smartphone penetration level is projected to increase to 45 percent or around 520 million devices. Ajay Gupta of Ericsson India said that “smartphones and MBB services are becoming more affordable. As a result, we are seeing the advent of a new Networked Society in India as in other parts of the world that will benefit consumers and businesses alike.”

3. The Challenges of India’s Spectrum Policy

India needs more spectrums to take advantage of new possibilities for social and economic Development. With demands for mobile technology expected to rise rapidly in future years, it is vital that the country deploy spectrum for

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commercial utilization in order to make possible the expansion of mobile broadband.

3.1 Lack of Available Spectrum

Availability is a problem because there are insufficient bands for the growing mobile demands in India. The dramatic growth of smartphones and tablets has outpaced the ability of some providers to offer reliable connectivity. As shown in Table 1, the availability of licensed spectrum in India is much lower than the U.S. and Europe, and also significantly lower than other developing countries like Brazil and China. While spectrum availability is a larger global problem, it is particularly acute in India. According to the COAI Annual Report, operators in India possess significantly smaller amount of spectrum, approximately 13 MHz on average, compared to international standards. This is low even in comparison to other Asian countries, such as Bangladesh (37.4 MHz) and Malaysia (75 MHz).

3.2 High Costs

Analysts have documented that "spectrum cost in India is one of the highest in the world." Its spectrum pricing runs around "25 times costlier than the countries such as U.S., France, Singapore, Germany, Spain and Sweden."Business leaders complain that spectrum is scarce, fragmented, overpriced, and inflexible. By having licenses that run just for 20 years, government policies force firms into expensive infrastructure investments without sufficient time to reap the financial rewards of those costs. India also suffers from high telecommunications costs. For example, a 2014 report from Merrill Lynch Global Research

Compares the Herfindahl-Hirschman Index (HHI) for various countries and India has the lowest market concentration at 0.22. The high levels of competition that result from low market concentration is reflected in the significantly lower tariffs and difficulties firms have in generating profits. The rate per minute (Call Charges per Minute, in USD) in India is 0.01 while Malaysia and Australia report 0.07 and 0.06 per minute respectively. This is probably the reason why Indian consumers report one of the highest average minutes of usage per subscriber per month, at 365 minutes, only second to China at 392 minutes.

While low tariffs and high usage reflect high consumer surplus, the cost structure in the Indian telecom business predicts that these benefits will be short lived. With increased congestion and limited spectrum capacity, there is likely to be a serious decline in quality. From the business perspective, we should expect consolidation. Allowing and facilitating mergers and acquisitions in the telecom sector will lead to a healthy evolution of this sector in the long run. Policy should be designed to make usage of the scare and valuable spectrum more efficient. Another market mechanism that should be a policy priority is trading and swapping of spectrum. This is required to free spectrum that might be trapped in inefficient firms, and policies must be put in place that allow and encourage such transactions. In a highly competitive environment such as India, it has been challenging to balance the need for operators to realize a profit while continuing to promote innovation and the public sector's interest in boosting government revenues through spectrum auctions. Government authorities have sought to raise large amounts of revenue through recent auctions. This has created revenue problems for leading telecommunications companies, and therefore limited their investment capital. The telecom sector in India also faces taxes and levies which amount to 30 percent of revenues in the sector, which is significantly higher than most other emerging countries. Despite this situation, the data show that the Indian telecom sector generates the second largest private sector investment in infrastructure at Rs.1,53,000crores during the 10th and 11th plan. The impact of these high costs however might partially explain the decline in service quality as measured by increased incidence of call drops and interruptions. Improvements in quality will require Telecoms to innovate and invest in new infrastructure such as mobile towers.

3.3 Fragmented and Inflexible Usage

The quality of spectrum is an issue because certain bands are reserved for specific applications. Some businesses note that too much spectrum is occupied by the Defence Ministry and therefore is underutilized, and that this limits private sector access to these resources. When government agencies sit on unused spectrum, it creates an artificial car city for companies that wish to innovate and squeezes the spectrum that is available for consumer and commercial applications.

3.4 Auction Outcomes

Past spectrum auctions have contributed to cost and availability problems. In 2008, for example, the 2G (second generation of mobile technology) spectrum awards generated considerable political controversy and legal action. After examining the government's decisions, the India Supreme Court condemned them as "arbitrary," "unconstitutional," and "illegal." Analysts complained that billions in potential revenue were lost because 2G licenses were sold at below market prices.

4. 5G implications

The 5th generation of wireless technology ("5G") has significant implications for consumers and the mobile broadband ecosystem because:

Consumers generate an increasing amount of mobile traffic, requiring ever-increasing capacity, continually improving user experiences, and reduced latency. 5G will offer an expected peak data rate higher than 10 Gbit/s compared and cell edge rates higher than 100 Mbps combined with virtually zero latency. 5G will support applications and industries of the future such as innovative health care services that provide real time monitoring capabilities, self-driving cars, and deliver the next generation of industry automation. This will mean5G will mean stepping away from a best effort approach and towards truly reliable, highly predictable communication. Flexible integration of existing access technologies such as LTE and Wi-Fi with new technologies creates a design that is future proof.

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5G supports the huge growth of Machine Type Communications (MTC), also called the Internet of Things, through flexibility, low costs and low consumption of energy. At the same time, 5Gwill be reliable and quick enough for even mission-critical wireless control and automation tasks such as self-driving cars.

5G will lower costs and consumption of energy. Energy efficiency is an integral part of the design paradigm of 5G, not an afterthought. Virtualized and scalable technologies will further facilitate global adoption and improved coverage.

4.1 Challenges to 5G:

A successful transition to 5G will require overcoming several challenges and establishing a policy environment that enables robust research and development. Among the key challenges facing5G are:

Need for harmonization: Various 5G initiatives are competing to lead the definition of 5G, including:

- The EU's 5GPPP (or 5G Public-Private-Partnership), the flagship initiative under Horizon 2020;
- China's IMT-2020 (5G) Promotion Group and the 2020 and Beyond Ad-Hoc Group;
- Korea's national research program supported by 5G Forum;
- Russia's, 5GRUS program; and
- The United States' 5G programs led by the National Science Foundation.

Establishing a common definition and foundational research base are key to making rapid progress toward 5G. Lack of coordination and cooperation will promote fragmentation and delay in vital standards work.

Spectrum needs: Additional radio spectrum for mobile networks needs to be allocated and put into use quickly to meet the increased capacity and coverage demands of 5G. This means looking at new spectrum bands such as millimetre wave and centimetre wave, and using available spectrum efficiently. Nokia's initial comments urged the Commission to take a broad view of spectrum opportunities, not just those above 24GHz.

Density: 5G networks will need to have considerably more base stations to meet the performance needs of future applications. These dense networks will be deployed as heterogeneous networks, combining macro sites with smaller base stations and using a range of radio access technologies including LTE-A,Wi-Fi and any future 5G technologies. These technologies will be used in macro, small and super small cells and will integrate various radio technologies flexibly and in various combinations.

Performance: In 5G, the best possible network performance will not be just about peak speed. There will be a wide range of performance measures to meet individual requirements imposed by each use case. Some real-time applications, such as driverless cars, will require virtually zero latency, while others, such as 3D video capture, will be more tolerant to latency but will require high capacity upload instead.

4.2 Policy Enablers

Because 5G must be compatible with previous technologies and evolvable to include use cases and challenges not currently identified, it will require a substantial amount of new research into advanced network capabilities. Policymakers can facilitate robust investment by adopting policies that increase value throughout the mobile broadband ecosystem, incentivize and reward innovation, promote standardization, and empower consumers. Several ongoing policy discussions could have significant implications for 5G, including:

Intellectual property/standardization: A key enabler of 3G and 4G has been the existence and success of multi-stakeholder standards organizations that encourage competitors to share technology and the time of key engineering staff to develop solutions to technical challenges.

Spectrum policy: Nokia believes in a varied, and aggressive approach to spectrum supply. Single-use spectrum is preferred by many mobile operators, and is an important ongoing input to facilitate innovation, coverage, and performance. However, Nokia strongly supports efforts to increase spectrum-sharing opportunities between commercial and government users in bands currently occupied by federal government agencies. Increasing testing opportunities, as the Commission contemplates through efforts like the Model City inquiry, are critical to innovation. Nokia supports these efforts and encourages the Commission to continue pursuing opportunities for collaboration, demonstration, and testing.

5. Evolution of Mobile Communications Over Time

4G mobile services (based on LTE technology) were launched in 2012 and take-up of these services is growing rapidly alongside continued use of 3G and 2G services. The precise timing for launch of future 5G services is currently uncertain, but the first release of the global standard for the new technology could be completed by the end of 2018 and commercial deployments could follow from around 2020.

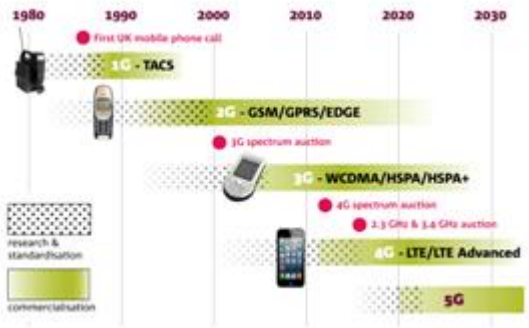

Figure 1: Evolution of mobile communications over time

6. Challenges in identifying spectrum above 6 GHz for 5G

As noted above spectrum at higher frequencies is already used for a range of important services. For example, 40% of

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the weighted spectrum between 6 and 100 GHz is authorised for use by Fixed Links, and 23% for Satellite services.

Many of these users responded to our consultation on WRC-15 to highlight the concerns they had relating to a future agenda item on bands above 6 GHz. Although there was strong support from the mobile sector for such an agenda item, the concerns raised included:

Satellite operators looked to bands above 30/31 GHz, thereby avoiding the Ku and Ka bands which are established and widely used by the satellite community.

6.1 Initiatives to 5G and/or bands above 6 GHz

- **Strategy.** Our Mobile Data Strategy9 sets out our priorities for looking at the potential future spectrum options below 6 GHz for mobile services.
- **Technology.** We have commissioned a study on the technical suitability of potential bands above 6 GHz for future 5G mobile services. We will also be holding a stakeholder event in March 2015 which will look at the spectrum implications of technology developments, particularly 5G technologies10.
- **Spectrum information.** We are continuing to increase the quality and quantity of information on spectrum use. Most recently we extended the Wireless Telegraphy Register11, to include more detailed technical information on spectrum use.
- **Spectrum demand.** We are continuing work on mobile data demand (as part of our mobile data strategy) and are initiating work to look at the longer term demand for spectrum for other key civil sectors, including those that have significant current use in bands above 6 GHz (satellite, space science and fixed links).
- **Sharing.** We published a statement on the future role of spectrum sharing for mobile and wireless data services in April 201412 and we are planning further work to explore new forms of sharing and how this might be extended to new bands.

Conclusion: **Indian telecom operators** are also gearing up for 4G LTE launch with Airtel having launched its 4G services in some parts of India. Reliance Jio is having a pan India license and will be launching the services by next year. Well, let us assume, both the telecom giants as well other operators launch 4G next year but what will be the adoption rate? Will it be a success in India?? Well, truly and factually speaking, it won't be as **Big** as compared to other Western countries.

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