



Key Regulatory Issues in an Era of Convergence

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SECTION I: INTRODUCING CONVERGENCE IN THE REGULATORY FRAMEWORK

India is now in a position to leverage the convergence of technologies to more rapidly and effectively meet its stated goals of universal voice and data connectivity. The rapid pace of technology, the globalization of commerce, and the issue of convergence, are all compelling reasons for Indian regulators and policymakers to develop a comprehensive, effective, and forward-looking framework to ensure India's long-term competitiveness in the global marketplace, as well as the well-being of its citizens.

1.1 What is Convergence?

Though there is no universal definition of convergence, it has been defined as “the ability of different networks to carry similar services,” and also as “the ability of one network to carry different services.” Good examples of convergence are the provision of Internet access and television to mobile handsets and the “triple play”¹ services offered by cable television networks and ISPs. Convergence is accelerating as existing networks are improved to offer new services (e.g., the upgrade of mobile networks to provide 3G/IMT-2000 and mobile television services, the enhancement of switched telephone networks to offer Digital Subscriber Line (DSL) data services, or the adaptation of cable networks to allow interactive services). Figure 1 illustrates several different combinations of technology, infrastructure and service.

Figure 1 - Examples of Technologies and Services that Enable Convergence

Multiple service provision under different network infrastructures			
Infrastructure	Voice	Data	Video
Copper line	PSTN	DSL, FTTP	VOD, IPTV
Cable (coaxial, fibre optic)	Some (analogue, VoIP)	Cable modem	Analogue, DTV
Mobile	Analogue, 2G, IMT-2000	2.5 G, IMT-2000	DVB-H, others
Fixed Wireless	Some (VoIP)	Proprietary, IMT-2000, WiMax, LMDS, MMDS	DVB
Power lines	VoIP	BPL	VOD, DVB, IPTV
DSL=Digital Subscriber Line, FTTP=Fibre to the premise, VOD=Video on Demand, IPTV=Internet Protocol TV, DVB=Digital Video Broadcasting, 2G=Second generation mobile service, IMT-2000=International Mobile Telecommunications-2000 mobile service, BPL=Broadband over Power Line, LMDS=Local Multipoint Distribution System, MMDS=Multichannel Multipoint Distribution System.			

Source: Telecommunications Management Group, Inc. 2006

¹ Triple play is the bundled offer of voice, data and video or television services. Cable operators, traditionally restricted to offering broadcasting services, are expanding their offerings to include bundles with voice and data services. Similarly, ISPs are no longer restricted to providing Internet access, and their offerings now include bundling their traditional data services with IPTV and VoIP.

Convergence, including advanced services, provides many advantages to those economies in which it is fully implemented: (i) it promotes the expansion of competition, allowing the introduction of inter-modal competition, in which networks and technologies compete with each other with no technological or regulatory restrictions; (ii) it fosters the development of more and more efficient technologies and services; (iii) it reduces the costs of telecommunications services; and (iv) it increases the appearance of a tailored offering to satisfy the specific needs of end users.

In a world of increased global competition, where competition is no longer limited to the domestic market, countries cannot risk losing the advantages posed by convergence because of artificial barriers set by their regulatory frameworks. However, adapting regulatory frameworks to convergence is not always an easy task. Traditional frameworks were designed for an era when clear functional differences existed between services and infrastructure. These frameworks were not designed for the new environment of converged networks and services where functional differences no longer exist. In addition, the boundaries that separated the broadcasting, ICT and telecommunications sectors are disappearing because of convergence, as all forms of content (voice, data, video, etc.) become undifferentiated bits of data. Therefore, the traditional regulation of these sectors through an independent framework for each sector also needs to be adapted to a new reality where broadcasting, ICT and telecommunications are steadily interwoven.

Policymakers and regulators around the world are already responding to the challenges posed by convergence, though with varying degrees of success, depending on the scope and depth of their changes. In fact, India has begun to address this challenge by modifying aspects of its regulatory framework to foster new technologies, by simplifying licensing, and by establishing flexible frameworks for specific wireless environments. However, these modifications have not been enough to realize the full advantages of convergence and the deployment of advanced services and technologies. India still has the chance to fully adapt its regulatory framework to a converged environment and allow its growing economy to fully benefit from the advantages of these new and more efficient technologies.

1.2 Adapting Regulatory Frameworks to Convergence

The responses of regulators and policymakers to the challenges of convergence have not been uniform, but have consistently focused on two key elements: the introduction of the principles of technology and service neutrality, and the establishment of greater flexibility in key aspects of their existing regulatory frameworks.

First, regulators and policymakers have modified their licensing regimes from the traditional one-service/technology licence to a broad set of categories, and some have adopted the more simplified approach of unified licensing. In addition, the administrative procedures for obtaining licences are being reduced as much as possible, and in some cases, even eliminated.

Second, countries are combining this simplification with the introduction of flexible and technology and service neutral approaches to the rights and obligations granted by the licences. Interconnection, numbering, universal service obligations and consumer protection rules are being adapted to the new environment of convergence in order to

allow the introduction of advanced services and technologies, while guaranteeing public goals such as interoperability of services and consumer protection.

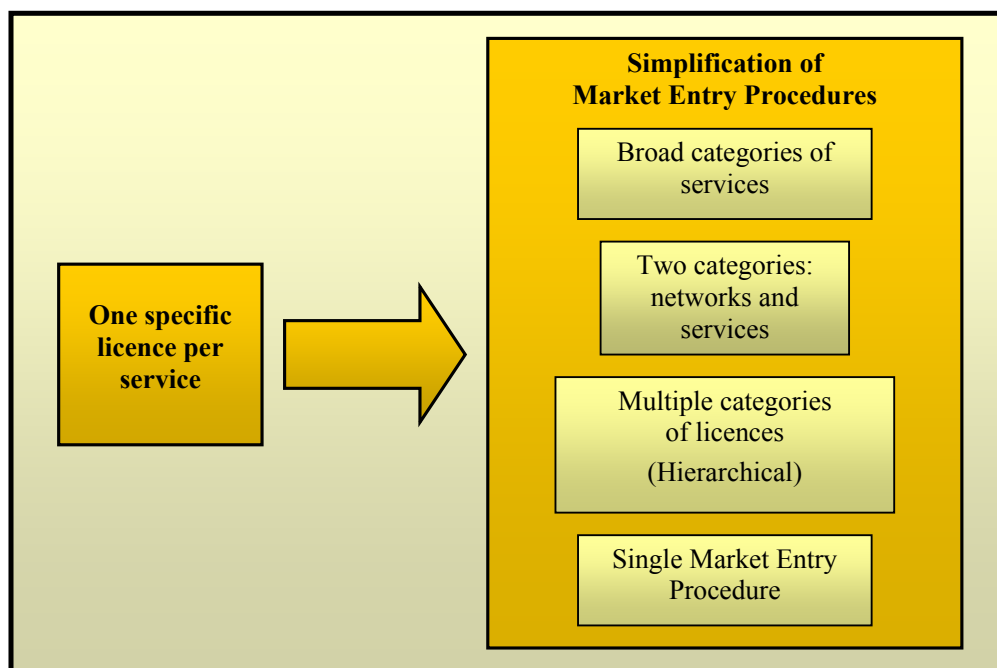
Third, the regulatory frameworks for broadcasting and ICT are also being adapted to convergence, and in the most effective examples, are coordinated with the regulatory changes to telecommunications regimes. This has fostered the expansion of converged broadcasting and telecommunications services, while the regulation of broadcasting content maintains its independence as it adapts to a technology neutral environment.

1.3 Modification of Licensing Regimes and Market Entry Intervention

Modifications of licensing regimes typically involve changing from a technology or service specific structure to a technology neutral, simplified set of licensing categories, and in some cases, a unified (single) licence or market entry procedure for all technologies and services. In addition, the simplification of the administrative requirements of these procedures is a necessary element. Usually, both components are introduced together in order to achieve greater simplification and flexibility. It is important to note that any modification must be managed to minimize inconsistencies between new and existing rules. Also, licensing reforms will only be completely effective in addressing the challenge of convergence if the guiding principles of technology neutrality and flexibility are applied to the rights and obligations of the telecommunications operators as well as to the other essential elements of the regulatory framework.

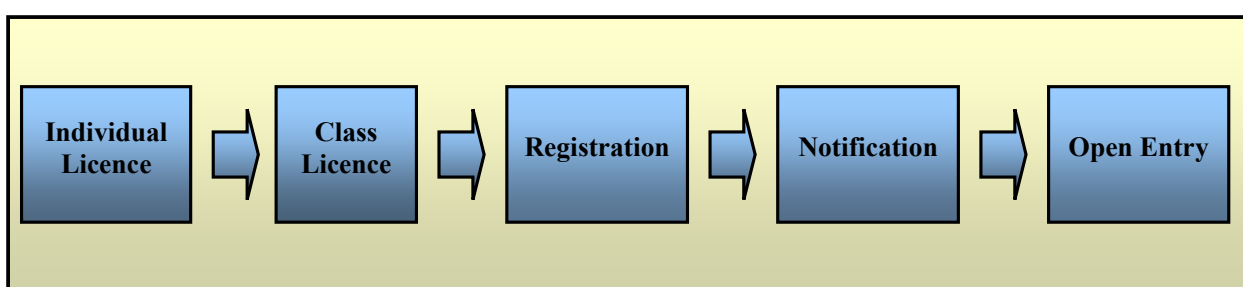
Figure 2 illustrates the range of licence categories, from more complex (one licence per service) to the single market entry procedure (one licence or market entry procedure for the provision of any service).

Figure 2 - Simplification of Market Entry Intervention



In addition to simplifying market entry procedures, it is also necessary to simplify the administrative requirements for telecommunications operators. Figure 3 shows the variety of administrative methods used by regulators: individual licences (more complex, since each licence request is considered individually), class licences (an approval process for a broad category of service), and open entry (no licence is required for the service). In between class licences and open entry, regulators offer two procedures that depending on their specific requirements may fall in one of two classifications: registration (requiring the operator to formally register with the regulator before operation of the service begins), and notification (requiring the operator only to notify the regulator of the service; no regulatory approval is necessary). It is important to note that regardless of which method is chosen, the regulator must ensure full transparency of the process, in order to ensure an efficient market.

Figure 3 - Simplification of Administrative Requirements



Countries have adopted different combinations of these two simplified methods. An example of simplifying licensing categories into broad categories of services is Malaysia, where the adoption of a new licensing framework simplified the existing 31 service-based licences into four broad technology-neutral licensing categories: Network Facilities Provider (NFP); Network Services Provider (NSP); Application Services Provider (ASP); and Content Application Service Provider (CSP; a special subset of application services that includes television and radio broadcast services and Internet content services). The service providers that fall under any of these categories may request an individual licence or a class authorization depending on the degree of control for each service that is deemed necessary.²

Singapore's method is another example of licence simplification. There are only two categories of licences for the provision of telecommunications services: (1) Facilities-Based Operator (FBO) licences and (2) Services-Based Operator (SBO) permits. The FBO licence is always an individual licence, whereas the SBO may be an individual licence or, for some services, a class licence.³

Some countries are adopting models of simplification based on multiple categories of licensing, where a so-called "unified licence" covers most or all services, and other licences follow a hierarchy system, whereby each licence allows for the provision of

² Malaysia Communications and Multimedia Act 1998, Act 588.

http://www.mcmc.gov.my/mcmc/the_law/ViewAct.asp?cc=4446055&lg=e&arid=900722.

³ Infocomm Development Authority of Singapore (IDA).

<http://www.ida.gov.sg/idaweb/pnr/infopage.jsp?infopagecategory=licensing;pnr&versionid=14&infopageid=13616>. These two licenses are hierarchical in that FBO license allows for the provision of all services included in the SBO license, provided they have been notified to the regulator.

progressively narrower categories of services. This is the case in the well-known 2004 proposal of TRAI in India,⁴ as well as the recently adopted “unified licence” in Peru.⁵ These countries combine the administrative procedure of a licence for the “unified licence” category with less burdensome requirements, such as class licences (in the case of India) or registrations, for the other categories. The system is simpler in Peru than in India: there is a “unified licence,” which allows for the provision of any telecommunications service, and a registration for the provision of value-added services.

Finally, some countries have streamlined their licensing regimes even further by establishing a single market entry requirement for all telecommunications services. These countries have established different administrative procedures, from requiring a licence, such as in Argentina,⁶ to a notification regime, such as in the European Union.⁷ In general, the licensing regime with the fewest administrative requirements will be the most effective in addressing convergence and successfully fostering new advanced services.

In addition to the aforementioned simplification processes, some countries allow specific services to have an open entry into the market in order to promote and foster advanced services, especially those related to the Internet. A notable example is the United States, where Internet access, VoIP and other IP services, fall under the category of “information services,” and do not require any licence to operate in the market.⁸

1.4 Adaptation of Regulatory Conditions

Although the simplification of the licensing regime is essential in eliminating barriers to entry for advanced services, and convergence among networks and services, it is only a part of the modifications that telecommunications regulatory frameworks require to be fully adapted to the challenges posed by convergence. A successful modification of a regulatory regime should include the essential elements of the regulatory framework. Any changes to regulatory frameworks should include the key principles of flexibility for new technologies, service and technology neutrality, and a level playing field among services and technologies within the same licence category.

These modifications on essential elements of regulatory frameworks focus on rights and obligations such as interconnection, numbering, universal service, and consumer protection.

⁴ Telecom Regulatory Authority of India. Recommendations on Unified Licensing. <http://www.trai.gov.in/trai/upload/recommendations/13/recom13jan05.pdf>

⁵ Congreso de la República del Perú. Ley que establece la concesión única para la prestación de los servicios públicos de telecomunicaciones.

⁶ Decree PEN 764/2000, B.O. 29476 (05/09/2000) dated 3 September 2000.

⁷ Directive 2002/20/EC of the European Parliament and of the Council of 7 March 2002 on the authorization of electronic communications networks and services (Authorization Directive). However individual rights of use may be required for scarce resources.

⁸ 47 U.S.C. § 230 (b).

1.4.1 Interconnection

Traditional interconnection regulation was established for switched voice services, where rates were generally based on time (i.e., per minute). New advanced services, most notably those based on the IP protocol, require interconnection rights and new interconnection schemes with different types of access and charges. These changes are necessary to permit, in a converged environment, the fundamental principle that any network operator be able to interconnect to any other operator regardless of the network type. The changes generally follow three broad trends.

The first trend has been for regulators and policymakers to introduce symmetrical interconnection regimes, where any operator, regardless of network type, is obliged to interconnect with any other operator. This is the case in Argentina and in the countries of the European Union. In other countries, interconnection rights have been expanded to specific operators, such as ISPs or SMS service providers.

The introduction of a symmetrical interconnection regime is essential to establish a level playing field for inter-modal competition. In a converged environment, where any network or technology is able to provide any kind of services, the restriction of interconnection rights unfairly discriminates against operators and reduces the benefits of inter-modal competition.

A second trend has been the introduction of new kinds of interconnection, such as access to parts of the infrastructure (e.g., the local loop or directory services databases), or to allow the provision of wholesale services (e.g., wholesale Internet access service or mobile roaming). This has been the case in the European Union, which has introduced the concept of “access” for these new types of interconnection as a right and obligation for all electronic communications service operators.⁹

Finally, some countries have introduced a technology neutral interconnection charging system based on capacity, instead of the traditional metrics of time and distance. An example of capacity-based interconnection is one where operators may request a specific capacity for interconnection and pay a flat-rate charge that reflects the fixed-cost nature of the interconnection capacity.

1.4.2 Numbering

Numbering policies and regulations were originally developed to address switched voice telephony. As a result, numbering plans generally established different ranges for voice services (e.g., fixed and mobile telephony), and divided numbering into geographic areas. This differentiation had a twofold function of informing end users of the charges of the calls, and maintaining the interconnection cost structure based on services and distance.

However, convergence has forced regulators to update the traditional numbering rules to accommodate new advanced services, and among them, those based on IP technologies. Regulators are expanding rights to obtain numbering resources for new services. For instance, Japan, South Korea and many EU members, such as the United Kingdom, Germany, France and Spain, have granted numbering rights to VoIP providers. Some of these countries allow operators to use traditional geographic numbers; others have

⁹ Directive 2002/19/EC of the European Parliament and of the Council of 7 March 2002 on access to, and interconnection of, electronic communications networks and associated facilities (Access Directive).

created a specific numbering range; and yet others allow the use of both, geographic and specific numbering ranges. The conditions of geographic numbers usually restrict VoIP nomadic use while the specific numbering range allows it.

Countries that have adopted number portability have focused on inter-modal portability (e.g., transferring a telephone number from a mobile phone to a fixed line phone), which affects both mobile and fixed numbering resources. Regulators must consider possible limitations such as geographical restrictions on phone numbers (e.g., area codes), and the potential technical and economic effects to existing interconnection configurations.

Finally, a few forward-looking regulators, including Austria, China, Finland, France, Japan, the Netherlands, Poland, the UK, the US, and others, are involved in trials of ENUM,¹⁰ a suite of protocols under development by the ITU to unify the telephone system with the Internet. ENUM allows any telephone number of the public telephone network to be converted into an IP address, and thus carried over the Internet. The ENUM initiative raises the possibility of introducing a fully neutral approach to numbering, simplifying numbering regulations and addressing complexities resulting from convergence.

Although ENUM is not yet active, regulators should consider planning for modifications to their current regulatory framework in order to take advantage of this service if and when it becomes active. Because ENUM modifies the rules of a numbering plan to allow for nomadic and cross-border use, regulators will need to review their numbering plans, interconnection policy, and other rules in accordance with the principles of flexibility and service/technology neutrality, to ensure that future use of ENUM is not precluded. A technology-neutral numbering plan, such as the one established by Denmark,¹¹ will ensure that the regulatory framework is able to include future numbering systems.

1.4.3 Universal Service

The emergence of new advanced technologies and converged services is also challenging the traditional concept of universal service. Universal service is a mechanism intended to provide telecommunications services to underserved areas and populations. Traditionally, its scope included only voice service telephony. However, since new advanced technologies and converged services require Internet access or even broadband access, countries are increasingly expanding the scope of universal service to include these kinds of access.

In addition, regulators and policymakers are considering whether the promotion of advanced services and technologies requires a temporary exemption of contributions to the universal service fund by the providers of these services.

Finally, countries are encouraging the provision of these advanced services and technologies in underserved areas in order to reduce the cost of universal service.

The reforms to address convergence in the universal service regime are addressed in more detail in Section II.

¹⁰ <http://www.itu.int/ITU-T/inr/enum/trials.html>

¹¹ ITST, Guide to the Danish Numbering Plan, July 2003, at <http://www.itst.dk/image.asp?page=image&obino=143612075>

1.4.4 Consumer Protection and Information

Although regulators and policymakers are introducing a flexible approach to deal with the emergence of new advanced technologies and converged services, this does not mean the elimination of consumer protection rules. Generally, these rules have been adapted to provide the flexibility needed to promote new advanced services while ensuring their ultimate goal -- consumer protection and informed decision-making.

Regulators and policymakers have introduced requirements that providers of new converged services inform consumers of the differences between these services and traditional telecommunications services. For instance, VoIP providers are entitled to operate under more flexible rules than switched voice telephone service providers in many jurisdictions, such as Hong Kong, the United States, and the United Kingdom. However, they are obliged to disclose to end users the difference between their service and traditional switched voice service, especially with regard to emergency calls, in order to ensure that consumers make informed decisions.

1.5 Modification of Spectrum Management Rules

As with licensing regimes, new advanced technologies and converged services that use spectrum are demanding more flexibility and service/technology neutral frameworks. Without the introduction of these essential principles, fully converged services and new advanced applications, such as mobile television or IMT-2000 data services, cannot fully realize their advantages, such as a more efficient use of spectrum, reduction of prices and a variety of new applications for business and consumers. The reforms to spectrum management rules necessary to address convergence are addressed in greater detail in Section III.

1.6 Adaptation of Broadcasting Regulation to Convergence

Convergence and new technologies have blurred the boundaries between the broadcasting and telecommunications sectors. Broadcasting is no longer independent from telecommunications. IP networks are carrying broadcasting services that compete for the same end users served by over-the-air and cable television. And 3G video services and mobile television provide a new capability to satisfy end-users – mobility.

For these reasons, if countries seek to take full advantage of these new developments in the broadcasting world, they must adapt their broadcasting regulatory frameworks.

The main trend in this area has been to split the regulation of the transmission network and technology from the regulation of the content. Thus, the regulatory framework of telecommunications services regulates any transmission network or technology, regardless of content, whereas the regulatory framework of broadcasting services only regulates the content of the broadcasting services. This has been the model followed by the European Union in its reform of the Television without Borders Directive.¹²

¹² *Proposal for a Directive of the European Parliament and of the Council Amending Council Directive 89/552/EEC, on the Coordination of Certain Provisions Laid Down By Law, Regulation or Administrative*

This reform of the regulatory framework of broadcasting services is a consequence of the implementation of the technology neutrality principle and eliminates artificial restrictions posed by a broadcasting regulation designed for a pre-convergence environment.

1.7 The Way Forward

As India continues its economic and technical progress, its regulators and policymakers should leverage the powerful effects of convergence on innovation, competition, connectivity, and economic growth. These benefits, however, will be successful only to the extent that regulators and policymakers observe the key principles of service and technology neutrality, and establish and enforce the appropriate licensing rights and obligations. In addition, policymakers will realize the maximum benefit to the extent that they craft policy to meet universal service goals, ensure proper frequency management, and coordinate their efforts with complementary spectrum policy.

No framework is effective without the establishment of a transparent regulatory regime, and Indian policymakers and regulators should ensure that any modifications include these key steps. Transparency leads to numerous benefits to government, industry and the general population: the consultation component allows regulators to stay current with developments in the industry, and full transparency encourages a robust telecommunications sector, allowing for more efficient modification of the regime over time, as technologies, needs and priorities inevitably change. Because technology will always change faster than policy or regulations, India's challenge is to design a system flexible enough to meet national goals, and accommodate technological change.

SECTION II: UNIVERSAL SERVICE IN A CONVERGING WORLD

2.1 Introduction

The key goal of a country's universal service/access policy is to develop the infrastructure and regulatory tools necessary to provide each member of its population with access to a point of communication. Many countries have been successful in establishing and implementing universal service/access policies that have resulted in the expansion of their telecommunications networks to make communication available and accessible to a larger part of the population, including underserved and rural areas. At present, however, technological change is challenging existing policies and forcing regulatory authorities to rethink the universal service obligations they impose on their carriers and establish a framework that will enable the government to carry out their universal service/access policies in a converging telecommunications sector.

2.2 Universal Service Obligations

Although there is no fixed or standard definition for universal service obligations, currently established universal service/access policies typically seek to meet the following objectives: availability, affordability and accessibility.¹³ The range of the scope universal service obligations is very broad because developed and developing countries face different market conditions and must meet different objectives in order to provide unserved and underserved rural populations with universal service/access.

In general, universal service obligations are established under the premise that a minimum set of telecommunications services should be made available to all end users in the country, regardless of their geographical location, and at an affordable price. *Figure 1* below shows the universal service obligations for designated universal service providers in the European Union, Uganda and India and illustrates how universal service/access objectives vary from one country to another.

Figure 1

European Union	<p>EU Member States must ensure the following:</p> <ol style="list-style-type: none"> 1) Access at a fixed location upon request, to enable users to make and receive local, national and long distance calls, fax communications, and to enable them to have functional access; 2) At least one comprehensive directory and one comprehensive enquiry service comprising the numbers of all fixed and mobile subscribers who so wish; 3) Availability of public pay phones over the whole territory; 4) Measures that ensure that the disabled have access to the same services at an affordable price. 5) <i>(since 2005)</i> Required to supply connection that provides "functional" Internet access (FIA), which is limited to a single narrowband connection and does not extend to ISDN or broadband. 6) Must respond to all reasonable requests to install a telephone line, offering the same prices irrespective of location.
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¹³ Rethinking Universal Service for a Next Generation Network Environment, Working Party on Telecommunication and Information Services Policies, OECD, April 2006, p. 10.

Uganda	<p>(1) Ensure universal availability of connections by every person or individual households to public communication networks through inter alia pay phones, community tele-centres, tele-boutiques, kiosks, cafes or community communications internet access terminals</p> <p>(2) Provide the following services: (i) connection to a fixed communication network able to support voice telephony, fax and data transmission,(ii) reasonable geographic access to public call boxes across Uganda, (iii) ability of consumers to access emergency and free services, operator assistance and directory inquiry services, (iv) ability to meet needs of people with disability,(v) delivery of affordable basic communication services to all customers on reasonable request, (vi) providing customers with disabilities with the same or equivalent services as all other customers so as to have access to the same level of universal service.</p>
India	<p><u>Stream I:</u> Provision of Public Telecommunications and Information Services (a) Operate and maintain village public phones (VPT); (b) after target of one VPT per village achieved, provide additional public phone in villages of 2000+ without public call office; (c) replace multi access radio relay technology public phones; (d) upgrade public telephones to public tele-information centres; (e) install high speed public telecommunications information centres.</p> <p><u>Stream II:</u> Provide household telephones in rural and remote areas as determined by central government</p>

Sources: What Rules for Universal Service in an IP-enabled NGN Environment? Background Paper, International Telecommunication Union, April 2006, pp. 5-8.; The Communications (Universal Service) Regulations of Uganda, 2003, Section 6; and Universal Service Obligation Fund, Department of Telecommunications, Ministry of Communications & Information Technology of India at <http://www.dot.gov.in/uso/usoindex.htm>.

These examples demonstrate that, despite the fact that countries have begun to adapt universal service obligation objectives to take advantage of the opportunities brought about by technological development (i.e., the Internet) and provide both voice and data communication services, most universal service obligation objectives still rely on the improvement and expansion of wireline networks to provide service and access to populations in unserved and underserved areas. Efforts to provide universal service/access through wireline networks have produced incremental results, but countries should consider the benefits that new technologies - such as wireless technologies - can bring to telecommunications networks and to the fulfilment of universal service/access goals.

2.3 New Technologies

Recently, new technologies have begun to provide unserved and underserved areas with faster service and more affordable access to communication. As of 2004, cellular phone users exceeded the number of main telephone lines in operation in 152 countries.¹⁴ Mobile technologies are even being used increasingly to provide rural and difficult to

¹⁴ Telecommunications Management Group, Inc.

reach communities with fixed-wireless and mobile public payphones.¹⁵ In many developing countries, mobile networks have become a substitute for fixed networks because (i) they can provide wider coverage, (ii) they can usually be easily and quickly deployed, (iii) their management and maintenance is simpler, and (iv) pricing schemes applied by mobile operators have made access to telephony service affordable for the urban poor.¹⁶

As third generation (IMT-2000 or 3G) wireless technologies are deployed around the world, they offer both voice and data services at affordable costs and thus can provide even greater access to communications services. Third generation technologies, such as CDMA 2000 and WCDMA can support both voice and broadband wireless access, transmit large amounts of traffic in a small amount of spectrum, as well as provide wider coverage. CDMA operators in India (as a result of Unified Licences being introduced) have been able to build networks quickly and are offering low price plans in underserved areas.¹⁷ In addition, operators in Brazil, China and the United States are using CDMA 2000 technology to expand and deploy Internet access across the country, including remote areas. In Peru, a clinic in the Andes is using 3G wireless voice and data equipment to communicate with medical professionals around the world to provide medical assistance to patients in this remote area of the country. The clinic, which had no connectivity of any kind until February 2006 and no fixed line communications, has been able to treat over 3,000 residents in the area. In the same manner, EV-DO high-speed wireless technology is being used in the Democratic Republic of the Congo to access vital patient information quickly and to notify doctors in case of emergency.¹⁸

Other technologies such as Voice over Internet Protocol (VoIP), very small aperture terminals (VSAT), and broadband over power-line (or power-line communications) which are not as widely used at present, are also options that can provide connectivity inexpensively and effectively to rural areas, and can help countries achieve universal service/access.¹⁹

Given the importance of new technologies in reaching unserved and underserved rural populations, regulatory authorities should modify their universal service/access policies by incorporating new technologies and relying on them to reach rural populations. Forward-looking telecommunications policies can foster the use of new and innovative technologies and can be instrumental in helping countries to achieve their universal service/access goals.

2.4 Technology Neutrality

A critical factor in establishing progressive policies for achieving universal service/access is technology neutrality. In other words, when establishing universal service/access

¹⁵ Mobile Operators: Their Contribution to Universal Service and Public Access, January 2003, pp. 7.

¹⁶ UMTS Forum Report "Benefits of Mobile Communications for Society", June 2004, Report No. 36.

¹⁷ Opportunity for All: Using Wireless to Provide Universal Access to Telecom Services, pp. 2-6.

¹⁸ 3G Creating Digital Multimedia Access Opportunities Around the World, 3G CDMA Wireless Technologies Benefiting Society.

¹⁹ A New Model for Rural Connectivity, Development Through Enterprise, Al Hammond and John Paul, May 2006.

policies, countries should maximise the opportunities for achieving their universal service/access goals by not limiting technological choice.²⁰ By avoiding traditional paradigms that rely only on wireline operators to achieve universality, countries can encourage the use and application of innovative technologies and foster a more competitive and dynamic market that can further support universal service obligation goals by introducing technology-neutral policies. In turn, such policies will be conducive to a universal/access policy that will better answer the needs and demands of a country's rural population.

2.5 Licensing

In establishing the framework necessary to provide universal service/access to rural populations, a country also should consider a licensing regime that will allow it the flexibility to take advantage of technological development and convergence.

As telecommunications markets have liberalised, countries have moved away from restrictive individual licensing regimes, which can limit the scope of technologies and services that an operator can offer, to a variety of more progressive licensing options such as service or technology neutral licensing regimes. Unified (converged) licences, which can be described as a license that allows an operator to offer a panoply of services under one authorisation,²¹ seem to be well-suited for countries trying to expand their telecommunications networks to reach as much of the population as possible. This type of regime opens the scope of technologies and services that can be offered by one operator and thus increases participation of new market entrants, encourages the introduction and use of new technologies, and also facilitates the process of obtaining a license. Countries such as India, Australia, individual member states of the European Union, Japan, Kenya, Malaysia, Mali, Mauritius, Singapore, Tanzania, and Uganda²² have all introduced some form of converged licensing regime based on the characteristics and needs of their markets.

2.6 Universal Service Fund

The Universal Service Fund should not only support a country's present universal service objectives, but also be able to adapt to the demands and trends of a converging telecommunications sector by fostering the use of new and innovative technologies to achieve future universal service obligation goals. The advantages and benefits of wireless technologies require that countries reconsider their universal service obligation objectives and establish universal service fund disbursement mechanisms that will support the implementation of new technologies to serve rural populations.

²⁰ What Rules for Universal Service in a an IP-enabled NGN Environment? Background Paper, International Telecommunication Union, April 2006, p. 20.

²¹ The Challenge of Creating Policy and Regulation in a Converged ICT Era, Ernest C. A. Ndukwe, Telecom World Africa Conference 2005, Capetown, South Africa, p. 7.

²² Licensing Approaches in an Era of Convergence, Global Symposium for Regulators, Geneva, Switzerland, 8-10 December, 2004.

In order to encourage the use of new technologies in achieving universal service/access, countries first have to revise present universal service fund objectives. Given the importance mobile technologies are playing today in providing affordable access to previously unserved or underserved areas and the increasing usage of other new technologies in similar efforts, universal service funds should consider integrating and supporting the application and deployment of new technologies to meet universal service obligation requirements. In Colombia, South Africa and Uganda, mobile payphones and public access businesses have already been used to fulfil regulatory obligations or to meet universal service fund competition requirements.²³ Because wireless technologies can usually be deployed faster and more affordably, incorporating them into universal service fund programs can provide countries with the means necessary to meet universal service obligation priorities more efficiently and effectively.

To ensure the smooth incorporation of new technologies into universal service fund programs, and guarantee the equal participation of all telecommunications sector participants, countries also need to make certain that the purpose of the universal service fund and the role of the universal service provider is well-defined. When Peru's FITELE fund was established, it was determined that the fund would provide populations in rural areas and localities considered of "preferred" social interest with greater access to telecommunications services. In addition, the fund's administration and management regulations stipulated that FITELE would not finance past or future network expansion obligations imposed on telecommunications operators by the government. Thus, the incumbent operator was excluded from accessing FITELE funds to finance its rollout obligations.²⁴ In Uganda, RCDF funds are only used to improve and service rural areas. In addition, "serve or lose" clauses have been included in main operator licences with regards to rural areas motivating main operators to effectively comply with universal service obligation, but also providing new market entrants with an opportunity to provide those services if the main operator fails to do so.²⁵ In India, the universal service fund is currently facing problems because, aside from being eligible for universal service funds, the incumbent operator receives Access Deficit Charge (ADC) revenues (that have been reduced from 30 to 10 percent, but that come from the country's universal service fund) to cover its deficit for providing fixed lines in rural and urban areas. This gives the incumbent operator a "favoured" position in comparison to other telecommunications service providers that have access to the fund.

Mechanisms also need to be put in place to make universal service funds accessible to a wider range of telecommunications service providers. Limiting access of funds only to a specific category of licensee or to licensed operators, for example, can create barriers that continue to support existing conditions (i.e., the expansion of wireline networks to provide universal service/access) and discourage the implementation of new technologies to provide service in unserved or underserved areas. In Peru, telecommunications

²³ Universal Access and Universal Service Funds: Insights and Experience of International Best Practice, Intelcon, July 2005.

²⁴ OSIPTEL Resolution No. 48-2000-CD/OSIPTEL approving Regulations for the Administration and Management of the Fondo de Inversion de Telecomunicaciones (FITELE), October 2000; and Aprueban Normas Complementarias al Reglamento de Administracion y Funcionamiento de FITELE y su Exposicion de Motivos, OSIPTEL Resolucion de Consejo Directivo No. 025-2005-CD/OSIPTEL, May 2005

²⁵ The Challenge of Universal Access – African Solutions for Africa, Country Case: Universal Access in Uganda, Patrick F. Masambu, March 1-4, 2005.

services providers with concession contracts for final public services (fixed line, including pay phones, and mobile) and value added services (data services including broadband Internet access) can access FITEL funds. If the entity/company requesting the funds does not have a concession contract for the area for which it is requesting the funds, the entity/company needs to request the appropriate expansion of the concession contract from the Ministry of Transportation and Communications.²⁶ Letting a variety of entities have access to universal service funds allows countries to benefit from a greater number of possible resources to help it achieve its universal service goals. In addition, these resources can sometimes provide innovative solutions for small-scale projects that would not normally be considered profitable.

In addition, the development and presentation of project proposals for universal service funds consideration should not be restricted only to the fund authority or to telecommunications providers, but instead should be open to all entities with an interest in contributing to the fulfilment of universal service/access. In Chile, project proposals can be presented by telecommunications service providers, regional/provincial/municipal authorities, universities, non-governmental organisations (NGOs), neighbourhood communities and others. SUBTEL, the entity responsible for administering and managing the country's universal service fund, uses these project proposals to design and develop the fund's annual project agenda.²⁷ A system where multiple parties can submit project proposals allows all interested parties to contribute in achieving universal service obligation objectives. Having multiple sources for project proposals can provide a more realistic vision of the needs and conditions of the market, such as what type of service is required by localities and which technology is best suited, and are more likely to result in creative and resourceful project solutions.

Establishing technology-neutral telecommunications policies that include an adaptable licensing regime can facilitate the entry and use of new and innovative technologies and provide a wider range of participants to achieve universal service/access goals. Revising universal service obligation objectives and implementing suitable mechanisms for the disbursement of universal service fund resources can also help in taking full advantage of multiple resources and technological development to better serve and benefit underserved and unserved populations.

2.7 The Way Forward

As India modifies its regulatory framework, policymakers and regulators should consider the following suggestions in order to create a more efficient and effective universal service/access program:

- Reconsider universal service fund objectives to take into account the advantages and benefits wireless technologies can bring to achieving universal service/access in the country;

²⁶ OSIPTEL Borrado de Directores Resolution # 025-2005-CD/OSIPTEL, May 2005.

²⁷ SUBTEL decree approving the Guidelines for the Telecommunications Development Fund (Fondo de Desarrollo de las Telecomunicaciones), December 28, 2001.

- More clearly define the purpose of the universal service fund and the role of the universal service provider to guarantee the equal participation of all telecommunications service providers, as well as encourage the incorporation of new technologies in universal service fund programs;
- Put mechanisms in place to make universal service fund accessible to a wider range of telecommunications service providers; and
- Permit the development and presentation of project proposals for universal service funds that are open to all entities with an interest in contributing to the fulfilment of universal service/access goals.

SECTION III: APPROACHES TO FREQUENCY MANAGEMENT

3.1 Abstract

Understanding the necessity of managing the radio spectrum, as well as how it is managed, enables regulators to ensure that the spectrum resource is used both effectively and efficiently. This paper provides an overview of key issues in spectrum management in an era where technology advances are fostering convergence of services delivered through use of the spectrum. We address how the spectrum management paradigm is changing as a result of pressures to respond to the opportunities and challenges that convergence provides, what factors are driving current spectrum allocation and licensing decisions and what is being done to find spectrum to support additional current and new services. We conclude by describing the impact that selected technologies are having, or are likely to have, on the spectrum management paradigm.

3.2 Introduction

Among the more obvious characteristics of the current rapidly changing telecommunications sector is a spectrum management environment that is continuously being driven by new technologies. This presents both opportunities and challenges for the spectrum regulator and the spectrum user. These technologies could provide enhanced communications services, including converged telecommunications and broadcasting services, with faster data throughput, enabling more complex and multi-featured applications that benefit the commercial, civil, and government sectors.

Managing the valuable spectrum resource is now more daunting and crucial than ever before. Unencumbered frequency bands used for communications services were once widely available; now they are a relatively scarce commodity in an increasingly spectrum-dependent world. Spectrum is the underpinning of the mobile phone industry that has recently overtaken the number of fixed lines around the world, the enabler for providing satellite-delivered education and medical information to rural areas of the world, and the basis for required safety communications between aircraft and air traffic controllers. The broadcast industry uses spectrum to collect feeds from all over the world, and also to transmit information to the public. Local governments have law enforcement and fire departments as well as other city service workers that need access to spectrum for their communications during both emergencies and routine operations. Utilities need spectrum for communications between sites, central offices and field workers. The needs prevail whether the systems employed are terrestrial or space-based.

As new spectrum technologies unfold and proliferate, spectrum managers and regulators will have to adapt and evolve to continue to manage the increasing crowded spectrum resource in a responsible, fair, and technology-neutral manner. Current regulatory regimes that are based on national and international frequency allocations that provide for exclusive use of frequencies will need to be continuously reviewed. The traditional regulatory schemes were tailored to a time when radio systems were fixed, were not frequency agile, used simple modulation schemes, had simple transmitters and receivers, and were, predominantly, pre-designed systems.

3.3 Spectrum Management in an Era of Convergence

Radiocommunications spectrum is a scarce resource that supports a variety of applications and has traditionally been allocated and licensed on the basis of specific service types such as cellular mobile operations, broadcasting – both terrestrially bound and satellite dependent, space communications, and long-distance terrestrial communications. As new spectrum technologies unfold and proliferate, spectrum managers and regulators will need to must adapt and evolve to continue to manage the increasing crowded spectrum resource in a responsible, fair, and technology-neutral manner.

At its root, spectrum management is about addressing the problems of potential interference between different spectrum users, and has both national and international aspects to it. Spectrum management encompasses all activities associated with regulating the use of the radio spectrum, including the structure and processes for allocating, allotting, assigning and licensing spectrum in the most economically efficient way possible. It involves establishing and enforcing the associated rules and regulations to enable all users equitable access to the resource. Spectrum management also involves coordination with the neighbouring countries and the world as a whole. Regulators need to consider cross-border coordination with neighbouring states and administrations, regional coordination with regional organisations, and international coordination and cooperation with international organisations and events such as the International Telecommunication Union (ITU) and the World Trade Organisation (WTO).

Within their own borders, there are purely national issues that administrations and their respective regulators must manage, and include issues relating to interference, scarcity, and highest and best use. Certain uses are better suited to particular portions of the spectrum, which has given rise to the concept of frequency “bands” that are designated for a particular use. This concept underpins the concept of frequency allocations as defined in the ITU Radio Regulations, which designate particular frequency bands for use by one or more services. In determining the best use for a particular radio frequency, it is also important to remember that some uses can be as efficiently, or more efficiently, served by wired technologies rather than by wireless technologies. Thus, spectrum management also involves consideration of when the best implementation of a service is not wireless at all.

3.4 A Shift in the Spectrum Management Paradigm

Spectrum management is currently undergoing a transition, or more accurately a paradigm shift. Perhaps as recently as 15 years ago, it was considered best for spectrum to be managed in a rigid, top-down style. It is now generally accepted that a more flexible approach to regulating and managing the spectrum offers the best opportunities for all users. The trend now is for regulators to modify the traditional allocation and licensing process to permit more flexible allocations by minimising constraints on services that licensees may offer and technologies they employ. Licensees are permitted to partition the spectrum they have access to and transfer a portion of their license along geopolitical or other boundaries to other entities. Licensees can also disaggregate the spectrum they are licensed to operate within by transferring discrete portions or “blocks” of their spectrum to other entities. And, in some instances, they are allowed to buy the licences

from earlier licensees without having to involve the regulator until the point in time when the buyout has been completed.

The focus of the more flexible approach to allocating and assigning spectrum is on efficiency, equity, in-band migration, and technical neutrality. Efficiency and equity concerns relate to which uses or services are most important to the nation as a whole, how many people would benefit from the service, and whether licensing the particular service or application would stimulate competition and improve economic viability. Others efficiency factors include selection of the optimum frequency bands (from a technology perspective) to provide the service, whether there are incumbents in those bands, and if so, the cost of relocating the incumbents. In-band migration – when regulators allow earlier-generation licensees to migrate to advanced services by using existing spectrum – is an effective tool to allow the operators to decide when the market and its consumers are ready for new and advanced wireless services. Technical neutrality allows operators the flexibility to maximise the spectrum and overlay or deploy advanced technologies, including advanced wireless services, in response to consumer demand.

Countries such as New Zealand, United Kingdom, United States, Singapore, and Australia are examples of administrations that are experimenting and applying a more flexible approach to spectrum management on a large scale.

3.5 New Technologies Impacting Spectrum Management

In today's environment, having sole use of spectrum is a luxury: it may be expensive to maintain, and is generally no longer possible for newcomers to obtain. The current trend is to develop new spectrum-efficient technologies that allow new users of spectrum to be accommodated while at the same time reducing the cost per user per hertz by increasing the number of users that can access a given portion of spectrum.

The move from the analogue to the digital world has sparked the demand for ubiquitous services, increasing data rates and improved quality of service. While the move to digital has stimulated the demand for more and better services and has provided solutions to meet many of these increasing demands, it has also led to challenges. Spectrum users now find that while they once were able to have their own spectrum for communications, they must now increasingly share spectrum with other users. This has led to mounting pressure for improved efficiencies in air interface structures, such as new modulation techniques, smart antennas, adaptive coding and power control. At the network level, this has led to capabilities to support dynamic channel allocation and handover strategies, and ad hoc networking. At the operational level, issues such as dynamic spectrum allocations and the large-scale implementation of cognitive radios are no longer remote possibilities. The question is not if, but rather when.

In an environment where technology changes outdistance the ability of regulators to modify current rules and adopt new ones to take advantage of the technology advances, decisions taken to manage and license spectrum based solely on a specific technology or technologies are inefficient, distort the marketplace, and inhibit competition. Operators of radio systems should be encouraged to deploy new technologies that offer higher data rates, better quality of service, and more diverse applications, particularly when adoption of the new technologies result in less spectrum being needed to provide the service.

Technologies that are driving the mobile service market are well known and are the topic of discussion and publication in both the trade and scientific press. Perhaps the most

familiar of these is the IMT-2000 or 3G technologies adopted by the ITU in 2000. These technologies provide the basis for a set of standards that support voice and data services in a globally harmonised manner. Recognising that data compression, semiconductor and signal processing technologies were advancing, the ITU adopted procedures to allow for the continual update of the standards adopted in 2000. As an indication of the success of the IMT-2000 standardisation process and its market take-up, the ITU and its members are currently preparing for a World Radiocommunication Conference (WRC-07) in which the issue of identifying spectrum for systems beyond 3G will be addressed.

Another example of an evolutionary technology that is constantly undergoing standardisation is “WiFi.” WiFi refers to a family of wireless networking standards developed by the Institute of Electrical and Electronics Engineers (IEEE).²⁸ The primary standards currently in use for WiFi are IEEE 802.11a, IEEE 802.11b and IEEE 802.11g. Each of these standards has different characteristics, but in general terms, they can all provide local area network connectivity for suitably equipped devices, including personal computers, and can allow the networked devices to connect to the Internet if a connection is available. WiFi generally is operated in unlicensed spectrum bands in most countries.

A new standard involving the transmission of high-speed data relying on spectrum as its means of transport is the IEEE 802.16 standard. Often referred to as WiMAX,²⁹ it is designed for broadband wireless access. Vendors claim that WiMAX base stations will be capable of transmitting data at 75 Mbps over a distance of 30 miles between base stations and of providing individual subscribers with data speeds of up to 15 Mbps over a 1-mile radius. It is important to differentiate between broadband wireless access (BWA) services and WiMAX. The former is a broad category of services that include various 3G voice and data services such as Cdma2000 and WCDMA, while WiMAX is a specific set of technologies that can be employed to deliver broadband wireless access services. WiMAX proponents, working primarily through the WiMAX Forum, have, over the last few years, developed certification and marketing processes for 802.16 technologies under the WiMAX name and is still being tested. Although the fixed wireless standard was ratified by IEEE in 2004, certification of WiMAX products did not begin in earnest until 2005, with the first certifications announced in January 2006.³⁰ Those initial products were certified under the WiMAX Forum’s certification profile for 3.5 GHz systems, based on the IEEE 802.16-2004 and ETSI HiperMAN standards. It is important to appreciate that it is not the only technology capable of delivering such services.

3.6 Spectrum Management – The Road Ahead

In view of the steady development and deployment of new and emerging technologies and the increase in demand for spectrum-dependent wireless services, a few key spectrum management challenges become immediately evident. There is general agreement that the regulatory framework in many countries will have to change to accommodate the flexibility that modern technology allows in the provision of telecommunications goods

²⁸ More information, including the full text of the IEEE standards, is available from the IEEE Standards Association at <http://standards.ieee.org>.

²⁹ <http://www.wimaxforum.org>.

³⁰ WiMAX Forum, “WiMAX Forum Announces First WiMAX Forum Certified Products,” January 19, 2006, http://www.wimaxforum.org/news/press_releases/Certification_Announcement.pdf.

and services. The challenges lay in the identification of the changes that should be made, how they should be phased in, and how they should be implemented.

Many view spectrum as a basis for providing a common public good. As such, it is a legitimate Government role and responsibility to ensure equitable access to this resource. Much of what is required to ensure equitable access, however, tends to conflict with the flexible-use, soft regulatory policies espoused by some. There are changes, however, that can be made to permit spectrum licensees more say in what services they choose to implement and how these services are provided to the consumer – be it Government or private sector. Basic rules will still need to be in place to give those who choose to provide telecommunication services the certainty needed to induce them to invest time and capital. An example of such rules are those associated with power limits placed on transmissions in a given frequency band. As long as a licensee operates in manner consistent with the power rules, they have the flexibility to provide any service they choose.

There are advocates that promote the free and unregulated use of the “publicly-owned” airwaves, allowing the market forces to create RF emissions protocols and etiquettes for operating wireless devices on a non-interference basis. However, a completely unlicensed method of spectrum use that leaves all users vulnerable to interference is not attractive in the long-term to spectrum-dependent service providers. These providers, along with venture capitalists, assume heavy initial infrastructure investments and seek business plans with a greater chance of long-term return on investment.

Certain technologies such as ultra wideband and cognitive radios that operate using frequencies on a shared basis or that select different operating frequencies cannot be managed by the current traditional regime. But making changes to the regulatory frameworks that have served the spectrum community well for many decades will be slow and difficult.

The future of spectrum management policies and regulations can be approached from a few disparate angles. One approach would be to retain the current regulatory schemes that are structured around separate and compartmented frequency allocations, allotments, and assignments for specific services and uses and implement changes on a reactive or as needed basis. With the unyielding demand for wireless goods and services, as evidenced by economic trends and forecasts, the competition for the limited spectrum resource will increase, exacerbating the pressure on spectrum regulators to create newer and more innovative methodologies for making more spectrum available or confronting contentious policy issues with regard to reallocating and reprioritising access to spectrum.

An alternate approach is to proactively modernise spectrum management policies to create a more dynamic regulatory scheme that is committed to protecting incumbent frequency licensees, but is flexible enough to accommodate and foster the development and deployment of new technologies. Given that the key advantages of these new technologies, flexibility and modifiability of technical parameters, change the nature of spectrum access and utilisation, a more flexible regulatory paradigm may be more beneficial to future spectrum users. Such a regulatory approach permits broader and more flexible use of frequencies by their authorised users within the technical parameters of allocations. It would rely less on the current command-and-control method to a more balanced approach that incorporates both “spectrum commons” and exclusive use spectrum models, making limited exceptions for critical missions, such as public safety and national security.

It is important to keep in mind that new and emerging technologies are not a panacea and do not necessarily supplant other traditional technologies. Rather, new technologies have their roles and specific uses. Often new technologies do not replace their older counterpart technologies, but rather, supplement or complement them. Examples are numerous: OFDM was at one time expected to replace CDMA, but has not; WiMAX was supposed to replace 3G, but instead, both technologies appear to be finding their separate roles and niches; and CDMA, was expected to replace GSM, but currently both technologies co-exist globally. It is clear that while new technologies may hold promise, they may only thrive in niche markets.

New and emerging technologies and the increase in demand for spectrum-dependent wireless services will lead to spectrum management challenges for the regulator and user alike. There is general agreement that the regulatory framework in many countries will have to change to accommodate the flexibility that modern technology allows in the provision of telecommunications goods and services. The challenges lay in the identification of the changes that should be made, how they should be phased in, and how they should be implemented.

3.7 The Way Forward

New and emerging technologies will spur an increase in demand for spectrum-dependent wireless services, challenging India's regulators and users alike. The following are offered as next steps for India's telecommunications regulators to apply in the management of its spectrum resources:

- Define a clear roadmap for access to spectrum needed to support current and next generation services on a technology neutral basis;
- Embrace and define new capabilities and technological change into the management of the radio spectrum;
- Adapt and modify the telecommunications regulatory framework to accommodate the flexibility that modern technology allows in the provision of telecommunications goods and services;
- Enable the introduction of new and different services over existing infrastructure by ensuring a level playing field to all current and future operators; and
- Enable and encourage deployment of broadband wireless access on a sustainable basis.

SECTION IV: COORDINATION OF COMMERCIAL AND GOVERNMENT SPECTRUM USE

4.1 Abstract

The quest for additional spectrum to support commercial advanced wireless services will continue to challenge spectrum regulators. The use of wireless services by subscribers will continue to increase. Pressures for new spectrum will grow as wireless carriers introduce additional services over their networks, particularly Internet and other wireless data services. Pressures on traditional spectrum policies will result in new policies being adopted. Arguments that significant economic benefits are expected with the proliferation of mobile commerce will continue to be made. The result is likely to be that Government users will continue to be seen as a possible solution for the enhanced spectrum requirements of the commercial sector. It is against this backdrop that regulatory authorities must balance the needs of commercial and government spectrum users. This paper will address how the coordination of commercial and government spectrum use is being undertaken in various countries throughout the world. In cases where government and commercial interests seek the same bands, regulators and stakeholders have to determine the appropriate course to follow in order to provide access to spectrum for new users as well as developing procedures for relocating and compensating displaced users.

4.2 Introduction

As witnessed in India over the past several years, mobile telecommunications services are experiencing significant subscriber growth. As this growth continues around the world, operators are deploying advanced technologies such as CDMA2000 1xEV-DO and HSDPA that enable higher data rates and greater system capacity providing the foundation upon which to offer more advanced services. These new services will drive even more rapid subscriber growth, causing operators to closely monitor their spectrum usage and seek opportunities to acquire more access rights to the spectrum.

Meanwhile, most governments have considerable spectrum holdings, which are used for a variety of local, national and international purposes. Furthermore, governments are also fostering the introduction of new technologies to meet current and future requirements leading to increased spectrum needs for government services. As the spectrum needs of both commercial and government users continue to evolve, policymakers will increasingly be forced to consider policies and mechanisms that ensure closer coordination between spectrum users in order to balance the spectrum needs of a rapidly changing commercial telecommunications sector with the spectrum needs of the government.

In India, commercial spectrum users will face internal pressure to both gain access to additional spectrum and to find ways to use spectrum more efficiently as they participate in Government plans to significantly improve access to telecommunications services across India. As Indian spectrum policy is being re-evaluated, it is worthwhile for the Government to consider a closer coordination of commercial and government spectrum use.

4.3 Commercial and Government Spectrum Uses

As a finite and scarce resource that is critical to their operations, a wide variety of both government and commercial organisations place a high value on radiocommunications spectrum. Government spectrum usage is spread across several areas, including national defence, public safety and emergency services, safety of life services such as air traffic control and space operations. In each of these cases, spectrum is not only employed purely for two-way communications, but is also used to enable effective and efficient deployment and coordination of resources.

Governments also often occupy large blocks of spectrum. For example, in 2000 the United Kingdom's Radiocommunications Authority (which has since been merged into the Office of Communications, or Ofcom) noted that the U.K. armed forces alone occupy 30 percent of the spectrum between 9 kHz and 30 GHz.³¹ Large swaths of spectrum set aside for government use have led some current and potential commercial users to see reassignment of government spectrum holdings as a means by which to expand private sector spectrum availability. However, as is to be expected, most government spectrum users are protective of their spectrum, and defence ministries and armed forces are often particularly zealous guardians of their spectrum resources, given their need for reliable and secure communications to support key national systems.

Commercial use of spectrum has grown considerably over the last several years, particularly with the advent of mobile telecommunications. Such growth is expected to continue as mobile technology continues to improve with the introduction of more advanced services. IMT-2000, or 3G, mobile networks are already able to provide not only voice services, but also broadband data services such as text messaging, ring-tones, location-based and e-commerce services. As mobile technologies have evolved, they have become more spectrum-efficient, allowing operators the flexibility to weigh the cost of acquiring more spectrum against the cost of deploying more spectrally efficient technologies.

Mobile operators are by no means the only commercial spectrum users, however. Spectrum is also a critical resource to satellite communications providers, private point-to-point communications providers, broadcasters and paging service operators, among others. Broadcasters around the world are beginning to grapple with spectrum issues as they consider migration from analogue to digital television. Migration plans are starting to evolve allocating new spectrum to broadcasters for deployment of digital broadcasting, to be followed by the refarming of spectrum previously used for analogue broadcasting. In fact, this reclaimed spectrum, sometimes called the "digital dividend," is a valuable resource for policymakers struggling with spectrum scarcity, but it is giving rise to significant challenges for policymakers struggling to decide the exact timing for the start and completion of the transition.

With both government and commercial interests heavily using finite spectrum resources in ever-increasing numbers, it has become progressively more important for each side to employ means by which they can make better use of their existing spectrum as well as for policymakers to consider means by which the two groups can coordinate their spectrum usage.

³¹ Radiocommunications Authority (United Kingdom), "Spectrum Pricing: Third Stage Update and Consultation," paragraph 4.29, December 2000, <http://www.ofcom.org.uk/static/archive/ra/topics/spectrum-price/spec-pric/dec2000/3rdwave.pdf>.

4.4 Finding Spectrum for New Services

As both public- and private-sector spectrum users seek methods by which to find spectrum for the deployment of new services, there are five main avenues that can be pursued: increased sharing, increased technical efficiency, extension of the upper limit of the useful spectrum range, band clearing and relocation, and spectrum pricing.

4.4.1 *Increased Sharing*

While spectrum may be assigned to particular users on an exclusive basis, many users do not use all of their spectrum at all times. Users may only be employing a portion of their spectrum at any given time, and they may only be transmitting or receiving during a fraction of any given time period and remain inactive during the rest of the period. They may also only operate in one geographic sector or region of their assigned service area at a given time. These operational characteristics can be exploited to permit sharing between other users or services by relying on pre-agreed or coordinated schedules. Operators of spectrum-dependent services can coordinate their spectrum use over a geographic area or through the management of transmission strength to geographically limit the distance that a potentially interfering signal can be received. In the future, it is expected that sophisticated radios, such as cognitive radios, will be able to actively assess the surrounding electromagnetic environment and allow multiple services and technologies to use the same spectrum in the same area and avoid interference.

However, spectrum sharing requires increased complexity in time spent to coordinate and/or in the equipment deployed, often resulting in higher operational costs. Spectrum sharing technologies are constantly being developed and improved, but as more creative sharing mechanisms are developed, the necessary equipment becomes more complex and at least initially more costly.

4.4.2 *Increased Efficiency*

Users can also gain more spectrum for new or expanded services by more efficiently using their existing spectrum. There are multiple means by which to increase efficiency, generally divided into three categories. The first option is to increase the amount of information that can be transmitted in a given amount of spectrum, such as through improved modulation techniques. Another option is to reduce the amount of information that needs to be transmitted, such as through compression technologies that recognise patterns in transmitted data and reduce the transmission of repeated elements. A third option is to exploit frequency reuse, such as by using smaller cells in a cellular system to limit the distance a signal needs to travel or by taking advantage of antenna directivity.

Technologies that engage any or all of these methods to increase efficiency reduce the pressure on spectrum users to gain access to additional spectrum for service expansion or even maintenance of existing quality of service. However, as with advanced sharing technologies, deployment of more efficient infrastructure has associated costs.

4.4.3 *Extending Useful Frequency Range*

As microwave component technology has improved, the upper limit of the useful frequency range has expanded. Technologies are being developed to take advantage of ever-higher frequencies, which results in more spectrum being available to potential users. However, not all frequencies have equal characteristics. One key factor is that as

the frequency used becomes higher, the useful distance to which the signal propagates becomes smaller, all else being equal. In addition, as the frequency becomes higher, rain, snow, fog and even atmospheric composition become major factors in limiting the usefulness of radio signals as a mechanism to transfer information. Thus, while current microwave technology allows the usage of frequencies up to 77 GHz, the higher frequencies have smaller useful propagation distances and require more infrastructure to cover the same geographic area as infrastructure in a lower frequency. Thus, while the state of the art in microwave component technology continues to make higher frequencies usable, the costs of network deployment in a higher frequency are not always the same as in lower frequencies.

4.4.4 Band Clearing/Relocation

Drawing less on technology and more heavily on negotiation and policymaking to make spectrum available is the concept of band clearing or reallocation, in which spectrum may be reallocated for other purposes. By definition, relocation requires existing spectrum users to relocate to other bands or to other modes of communication, allowing the spectrum to be allocated for other uses. Relocation and reallocation are not simple matters, as they require not only negotiation or implementation of new policies, but also new infrastructure for the relocated users and the costs involved in the relocation process.

Furthermore, relocation involves complex – and often contentious – negotiations that include spectrum valuations, technical planning, relocation costs, and scheduling. A variety of techniques have been engaged to facilitate band clearing, including voluntary negotiations, implementation of government decisions, and multi-stakeholder planning exercises. Growing demand for spectrum and congestion has made negotiations increasingly contentious, making relocation and reallocation efforts more difficult.

4.4.5 Market-Based Spectrum Pricing

Economic principles can also be employed to ensure efficient spectrum usage. While early spectrum allocations and assignments were based on “first come, first served” principles, as demand for spectrum has grown, it has become increasingly necessary to employ market forces to determine spectrum values. By introducing market pricing to spectrum fees, spectrum resources will more likely be distributed to those users who will derive the greatest benefit from them due to their willingness to pay higher fees. The higher spectrum fees, in turn, encourage licensees to use their spectrum efficiently.

Market-based spectrum pricing is achieved primarily through one of two methods: auctions and administrative pricing. Though there are several variations, the general concept of all auctions is that potential users indicate the value they place on a particular spectrum resource through the fee they are willing to pay. Administrative pricing involves a designated entity, such as a regulator, setting a spectrum fee based on what it considers fair market value.

4.5 Reallocation Cases

4.5.1 United States 1.7 GHz/2.1 GHz

In 1999, the United States Federal Communication Commission released a Spectrum Policy statement that was the impetus for the allocation of additional spectrum for 3G

services, though early efforts to this end were unsuccessful.³² In July 2001, the National Telecommunications and Information Administration (NTIA), that part of the United States Department of Commerce, which oversees U.S. Government spectrum usage, and the Federal Communications Commission (FCC), which oversees private spectrum usage, agreed to the creation of the Intra-Government 3G Planning Group, which was comprised of six key government agencies with interests in spectrum management.³³ The purpose of the group was to determine the need for spectrum to support advanced wireless fixed and mobile services in the United States, and if it was determined that such a need existed, to identify potential spectrum bands to meet that need.

After considerable discussion and study, a plan was agreed on to undertake a detailed evaluation of the 1710-1770 MHz and 2110-2170 MHz bands, as they appeared to have the greatest potential for possible use for 3G services and had the least impact on Federal government spectrum use. The 1710-1770 MHz band was in use by the Federal government while the 2110-2170 MHz band was used by the private sector to support numerous microwave systems. The task of assessing the 1710-1770 MHz band was assigned to NTIA while the FCC was tasked with assessing the 2110-2170 MHz band. The 1710-1755 MHz band had been identified earlier for transition to private sector operation with the condition that significant Government operations would be permitted to continue in the band indefinitely.³⁴

NTIA and the Department of Defense (DOD) assessed the 1710-1770 MHz band, as the DOD was the primary user of the band. They determined that the 1710-1755 MHz portion of the 1710-1770 MHz band held the greatest potential for reallocation to commercial use. The concept of spectrum sharing was explored as part of the assessment, though industry expressed its belief that the entire 1710-1755 MHz band would need to be cleared of all DOD usage eventually. Meanwhile, the FCC assessed the potential for relocation of, or sharing with, the fixed wireless systems activities in the 2110-2170 MHz band. The FCC's assessment indicated that the fixed wireless microwave systems could be relocated to alternate frequencies.

The conclusion of the study was that the Federal Government decided it could vacate 45 MHz between 1710-1755 MHz and move their operations in that band to higher frequencies. The FCC decided to make 45 MHz between 2110-2155 MHz available for advanced wireless services and paired it with the 1710-1755 MHz freed up by NTIA. This spectrum is scheduled to be auctioned by the FCC in the latter half of 2006 for advanced wireless services use.

4.5.2 United States 700 MHz/Digital Television

In the late 1990s, the FCC began implementation of a plan to transition U.S. broadcasters from analogue to digital television. With respect to spectrum usage, the transition will, when complete, free approximately 108 MHz in the 700 MHz band due to the ability to

³² National Telecommunications and Information Administration (United States), "An Assessment of the Viability of Accommodating Advanced Mobile Wireless (3G) Systems in the 1710-1770 MHz and 2110-2170 MHz Bands," July 22, 2002.

³³ The National Telecommunications and Information Administration, the Federal Communications Commission, the Department of Defense, the Office of Management and Budget, the Office of Science and Technology Policy, and the Department of State.

³⁴ Omnibus Budget Reconciliation Act of 1993 (OBRA-93), Pub. L. No. 103-66, 107 Stat. 312 (1993).

organise digital television channels closer together by virtue of their reduced interference characteristics. As such, the FCC also moved to determine the best means by which to clear this reclaimed spectrum, also known as the “digital dividend,” adopting different methods for different portions of the band.

In the case of the 746-806 MHz band, the United States Congress had determined that it was to be allocated for future use by public safety and commercial wireless licensees. In January 2001, the FCC adopted rules and policies that allowed the private sector to determine the band clearing mechanisms that would best suit the needs of broadcasters and potential new licensees in the 746-806 MHz band.³⁵ Thus, while the FCC did implement rules and processes by which to facilitate band clearing, it left the majority of the mechanism development process to the current and future spectrum users.

By comparison, due to the higher number of incumbent broadcasters in the 698-746 MHz band, the FCC took a larger role in band-clearing arrangements. The FCC determined that it would review voluntary band-clearing measures on a case-by-case basis to determine whether they would serve the public interest, thus still allowing private negotiations, but with FCC oversight.

4.6 Market-based Spectrum Pricing Cases

4.6.1 United Kingdom Administrative Incentive Pricing

The United Kingdom has a policy of charging public sector organisations for spectrum on a comparable basis to the private sector.³⁶ The rationale behind the policy is that government users, like private sector users, should have incentives to use spectrum efficiently. Furthermore, this parity between commercial and government spectrum pricing secured wider stakeholder approval of market-based spectrum pricing for the private sector at its introduction in 1998.

The United Kingdom approach is known as administrative incentive pricing, which is a variant of administrative pricing. In administrative pricing, a spectrum manager sets spectrum fees in place of direct market forces. The administrative incentive pricing variant attempts to set prices that promote efficient spectrum use.³⁷ Administrative pricing was first introduced in the 1998 Licence Charge Regulations in the United Kingdom, which grew out of the Wireless Telegraphy Act 1998, which empowered the Secretary of State to for Trade and Industry charge higher fees for spectrum management purposes, rather than simply to recover spectrum management costs. Administrative pricing was then phased in for various services annually over the next several years.

By 2005, the United Kingdom regulator, Ofcom, was in the process of developing appropriate spectrum pricing for government users. In a February 2005 statement, Ofcom indicated that emergency services were to have spectrum fees comparable to those

³⁵ Federal Communications Commission (U.S.), Third Report and Order in WT Docket No. 99-168.

³⁶ Radiocommunications Authority (United Kingdom), “Spectrum Pricing: Third Stage Update and Consultation,” paragraph 4.29, December 2000, <http://www.ofcom.org.uk/static/archive/ra/topics/spectrum-price/spec-pric/dec2000/3rdwave.pdf>.

³⁷ Radiocommunications Authority (United Kingdom), “Spectrum Pricing: Third Stage Update and Consultation,” paragraph 4.13, December 2000, <http://www.ofcom.org.uk/static/archive/ra/topics/spectrum-price/spec-pric/dec2000/3rdwave.pdf>.

for business radio rates, such as PAMR services, and that the Ministry of Defence was to more than double its spectrum payments to reflect higher comparative fees and the overall higher opportunity cost of the defence spectrum.³⁸

By requiring both government and commercial users to pay market-based fees for spectrum, the United Kingdom is providing an incentive for efficient use of all spectrum, rather than cases in which government users pay minimal or zero spectrum fees and have no incentive to ensure their spectrum is put to its most efficient and effective use.

4.7 The Way Forward

As demand for spectrum from both commercial and government users increases, policymakers are faced with greater challenges in ensuring scarce spectrum is used efficiently and effectively. In order to meet this goal, they are considering a variety of approaches, including those outlined herein. In particular, they are increasingly considering means by which to ensure closer coordination between public- and private-sector spectrum users to serve the needs of the public interest as well as to provide one of the key inputs to a vibrant telecommunications sector.

In India, the recent announcement of the transfer of 45 MHz of defence spectrum to the private sector is an indication that there is already some level of coordination between commercial and government spectrum use. However, as the Government seeks to rapidly increase teledensity and access to telecommunications services, there will be increasing pressure from commercial spectrum users to both gain access to more spectrum and to find ways to improve the efficiency of their current spectrum usage. As such, it is important to consider whether there is the potential for closer, more active coordination of commercial and government spectrum use.

As India considers ways of fostering such active coordination, broad stakeholder coalitions are one potential means by which spectrum coordination issues could be addressed. By tasking key government and commercial stakeholders tasked with a specific mission, such as identifying additional spectrum for 3G services or encouraging more efficient use of particular spectrum, diverse viewpoints can be taken into consideration and, ideally, mutually acceptable solutions developed. While the U.S. example of the 1.7 GHz and 2.1 GHz bands was an example of a government task force, the inclusion of private sector stakeholders can provide valuable insight into the priorities and vision of the private sector.

In addition, market-based spectrum pricing for government spectrum users as well as private-sector users could ensure an increased level of parity in the Indian spectrum market between public and private spectrum users. Market-based pricing encourages effective spectrum usage by ensuring that all users have incentives to make efficient use of their spectrum. The concept can even be linked with stakeholder coalitions, with the stakeholders considering market-based pricing as a means of encouraging efficient spectrum usage.

³⁸ Ofcom (United Kingdom), "Spectrum pricing: A statement on proposals for setting Wireless Telegraphy Act license fees," February 23, 2005, http://www.ofcom.org.uk/consult/condocs/spec_pricing/statement/statement.pdf.

While multiple approaches can be successful in addressing India's increasing spectrum demands, coordination through stakeholder coalitions and market-based pricing can provide sustainable methods of coordinating commercial and government spectrum usage.