Wireless broadband masterplan
FOR THE FEDERAL DEMOCRATIC
REPUBLIC OF NEPAL

OCTOBER 2012
Telecommunication Development Sector

ITU

Wireless broadband masterplan for the Federal Democratic Republic of Nepal

October 2012

Executive summary

This report provides an analysis of the current state of Nepal's broadband capability and recommendations for the implementation of an effective wireless broadband technology. It also considers key regulatory aspects for the provision of wireless broadband services throughout the country.

The Government of Nepal is committed to ensuring that all citizens have access to effective wireless broadband services, and to encouraging a content-rich environment that will facilitate a growing online community. Nepal presents its own unique set of challenges in developing wireless broadband. Nepal is landlocked with an underdeveloped telecommunications infrastructure, a population of some 28 million people of whom 82 per cent reside in rural areas and difficult mountainous topography.

The recommendations in this report are focused on achieving the maximum gains in terms of coverage, and on ensuring that the provision of fast and effective broadband services can be achieved in a short period of time.

Key considerations in the Nepal wireless broadband masterplan include:

- the economic and social importance of broadband and its role in improving productivity and providing information and services;

- the structure of the telecommunications market and the current regulatory framework;

- broadband access targets and future spectrum requirements;

- examining the case for regulatory change including amendments to the Radio Act 1957 as well as the current applicable licencing regime; and

- key technologies, including GSM, W-CDMA, WiMAX, satellite and LTE.

With these considerations in mind this masterplan reaches the following conclusions:

- There is a need to immediately commit to legal/regulatory reform in the telecommunications sector. It is suggested that a unified licensing structure be introduced, thereby enhancing transparency and market efficiency, and that the Radio Act should be amended to provide for frequency / spectrum management and licences.

- The offering of a new third national telecommunication operator licence is required to facilitate competition and wireless broadband services.

- It is recommended that the government should aim to provide at least total of 442 MHz for mobile services by 2015 in the 700, 900, 1800, 2100 and 2300 MHz bands. In particular, the 900 MHz band should be refarmed on efficiency grounds so that spectrum is utilised on a national basis and that 36 per cent of the 900 MHz spectrum band that is currently only in use by rural providers is made available for reuse.

- Nepal's landlocked status means that improving international connectivity needs to be a focal point of the Nepal Telecommunications Authority (NTA) efforts. This will necessitate legal reforms that establish an effective interconnection/open access regime. The Rural Telecommunications Development Fund (RTDF) could be used to improve optical fibre backhaul networks.

- The Government of Nepal could greatly encourage the development of new and existing content by using a range of tools, including education programmes, subsidies and government leadership.

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1. Introduction

1.1 Project background

Based on an objective assessment of needs and priority, the Federal Democratic Republic of Nepal was one of four countries selected by the International Telecommunication Union (ITU) (the others being, Myanmar, Samoa, and Viet Nam) to develop a national pilot wireless broadband masterplan. The ITU Guidelines for the preparation of national wireless broadband masterplans for the Asia Pacific region[1] provides the reference framework for the development of a national wireless broadband development. It was used extensively in the development of this report.

A landlocked nation with 28 million inhabitants, Nepal presents itself as an ideal candidate for the wireless broadband masterplan given its topology and relatively underdeveloped fixed-line infrastructure. Its growing economy and position next to the Asian economic powerhouses of China and India mean that in order for it to reap the true benefits of economic integration and trade, it needs to harness the full benefits and offerings of the new paradigm of converged ICT services. It can only do this through a wireless broadband infrastructure developed via an achievable and transparent framework.

This masterplan forms an important input into the broader policies and strategies of the government that address the 'digital divide' in Nepal and develop the implementation plans to propel the nation into an advanced ICT economy. These policies are being developed by the Nepal Telecommunications Authority (NTA) and the Ministry of Information and Communications (MoIC).[2]

1.2 Structure of the masterplan

This masterplan comprises six main topics of analysis and recommendation:

(i) broadband: global and regional context (section 2);

(ii) Nepal and the wireless broadband market (section 3);

(iii) medium to long term goals to optimise wireless broadband for Nepal (section 4);

(iv) key considerations of the masterplan (section 5);

(v) facilitating applications and content (section 6); and

(vi) conclusions and recommendations including a roadmap (section 7).

2. Broadband: Global and regional context

There is now almost a global consensus on the importance of broadband to a country's economic growth and the social interaction of citizens. The ability to access and provide data rich applications and content has become a pre-requisite for global trade and is fast becoming a necessary component of interaction between members of the public as well as government. While broadband connectivity is simply a means of accessing and providing data in as fast a manner as possible, its role has been identified as of high enough importance for it to warrant the characterisation of a 'human right'.[3]

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[1] www.itu.int/ITU-D/tech/index.html

[2] It should also be noted that this report should be read with other recent ITU reports focusing on Nepal namely the (i) Universal Access to Broadband in Nepal: A Report for the Nepal Telecommunication Authority, July 2011 and (ii) the Roadmap for the Transition from Analogue to Digital Terrestrial Television Broadcasting in Nepal, February 2012.

[3] www.broadbandcommission.org/Documents/Broadband_Challenge.pdf

Aside from the practical benefits of broadband, such as greatly enhanced ease of accessing and providing data-rich content, numerous studies have documented the positive relationship between broadband access and national prosperity. A World Bank study emphasised the importance of broadband penetration for developing economies having concluded that every 10 per cent increase in broadband penetration provides a 1.38 per cent increase in GDP. [4]

Likewise other studies project a boost to Malaysian GDP by 2020 as part of the modelling of the impact of Malaysia's High Speed Broadband (HSBB) project[5] and that 10 per cent higher broadband penetration in a specific year is correlated with 1.5 per cent greater labour productivity growth over the following five years.[6]

Broadband networks are able to deliver a host of applications and services that other mediums are simply not capable of providing. These services include:

- e-commerce;
- e-banking;
- e-government;
- e-education;
- paper-less work;
- improved education/training; and
- telemedicine/e-health.

Given these factors, broadband and improving broadband is now an international focus of development work including by the United Nations (UN),[7] ITU and UNESCO.[8] This has resulted in broadband targets being incorporated within the UN Millennium Development Goals and prompting the creation of the Broadband Commission as a joint undertaking of ITU and UNESCO.

2.1   UN Millennium Development Goals

The UN Millennium Development Goals (MDGs) comprises of eight specific targets for developing nations to achieve by 2015.[9] Telecommunications and broadband falls with the eighth goal of developing a global partnership for development with sub-target 8(F) stating that 'In cooperation with the private sector, make available the benefits of new technologies, especially information and communications'.

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[4]   Christine Zhen-Wei Qiang and Carlo M. Rossotto with Kaoru Kimura, Chapter 3 Economic Impacts of Broadband, in World Bank, Information and Communication for Development 2009: Extending Reach and Increasing Impact (IC4D2009).

[5]   Windsor Place Consulting, A high level cost benefit analysis of Malaysia's broadband deployment, Melbourne, 17 December 2007.

[6]   Booz & Company "*Digital Highways: The Role of Governments in 21st Century Infrastructure* (2009).

[7]   See www.un.org

[8]   See www.unesco.org

[9]   These are namely: (1) Eradicate extreme poverty and hunger; (2) Achieve universal primary education; (3) Promote gender equality and empower women; (4) Reduce child mortality; (5) Improve maternal health; (6) Combat HIV / AIDS, malaria and other diseases; (7) Ensure environmental sustainability; and (8) Develop a global partnership for development.

Measured against the agreed indicators by the number of fixed telephones, mobile cellular subscriptions and the number of Internet users per 100 population, significant progress has been made globally (Figure 1).

Figure 1: Fixed telephone lines and mobile cellular subscriptions - Internet users - broadband subscriptions (per 100 inhabitants)
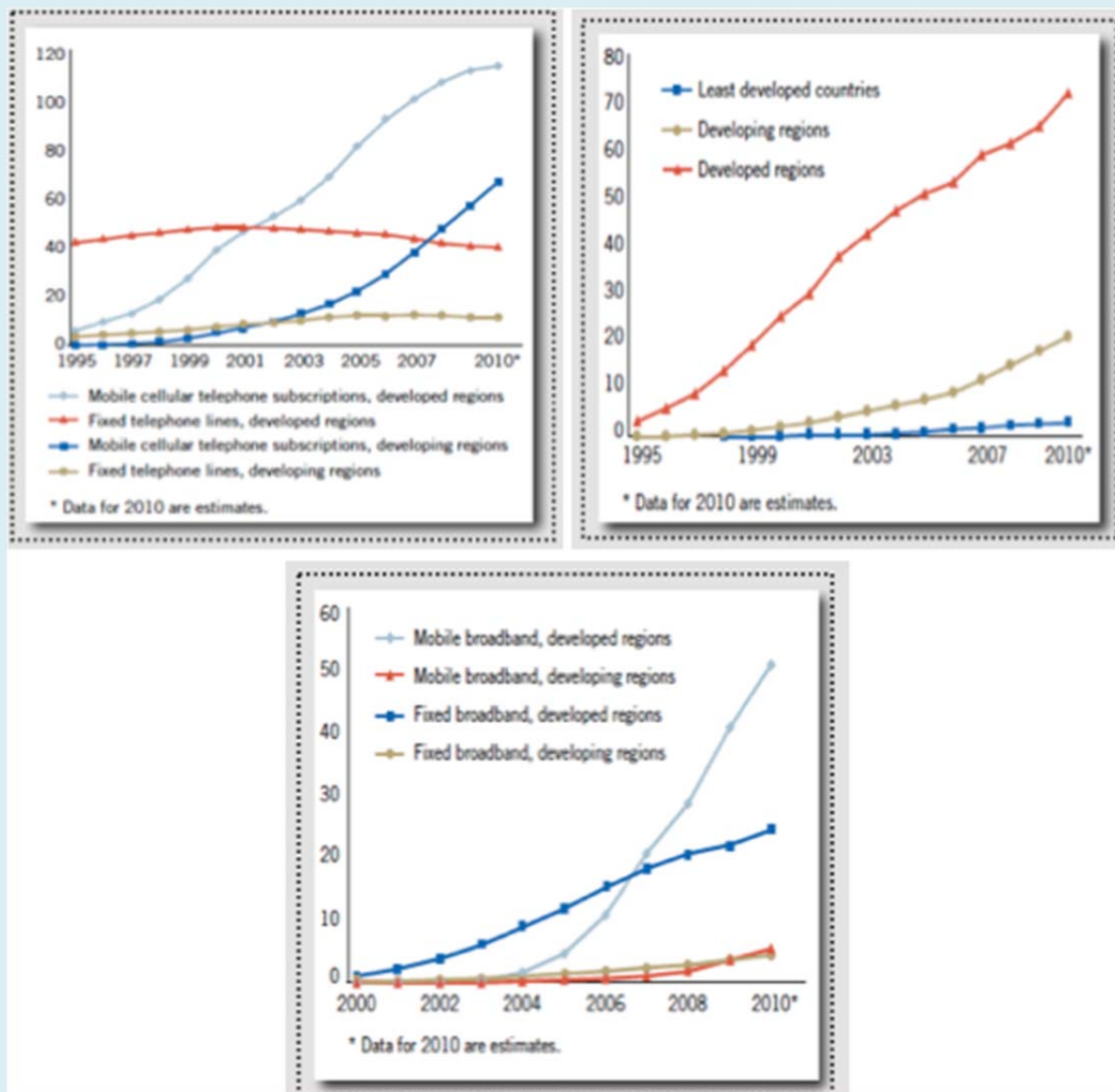
Source: UN Millennium Development Goals Report, telecommunications indicators 2011[10]

This masterplan is consistent with target 8.F[11] of the MDGs and following the successful achievement of the masterplan goals, will be a significant factor in reducing the digital divide between Nepal and its more developed Asian counterparts.

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10   http://mdgs.un.org/unsd/mdg/News.aspx?ArticleId=59

11   www.itu.int/ITU-D/ict/mdg/goals.html#g8

2.2   Broadband Commission

Until recently, broadband policy was largely the domain of national governments and the focus of regional initiatives. However, creation of the Broadband Commission for Digital Development in May 2010, a joint effort by ITU and UNESCO, is clear evidence of a shifting paradigm. The Commission was set up with the aim of engaging in 'advocacy and high-level thought leadership to demonstrate that broadband networks:

- are basic infrastructure in a modern society – just like roads, electricity or water;

- are uniquely powerful tools for accelerating progress towards the MDGs;

- are remarkably cost-effective and offer impressive returns-on-investment (ROI) in both developed and developing economies alike;

- underpin all industrial sectors and are increasingly the foundation of public services and social progress;

- need to be promoted by governments in joint partnership with industry, in order to reap the full benefits of broadband networks and services.'[12]

Within the context of this masterplan, these conclusions and regulatory considerations are important as they provide both guidance and clarity. With respect to these considerations, the masterplan will be consistent with the focus of the Commission and its recommendations/policies.

The Commission debated the possible way of defining broadband and conceded that delineations such as upstream/downstream speeds are arguably inadequate due to rapid technological advances. Instead, they believed that focus on core concepts, such as *always-on* service (the user isn't required to make a new connection to the server each time) and *high capacity* (capable of carrying lots of data per second) would be preferred alternatives as they would neither be as constraining nor subject to frequent revision.[13]

In the report, *Broadband: A Platform for Progress*[14], the Commission discussed a range of issues for governments to consider when deploying broadband networks. Conclusions that emerged from the report included, *inter alia*:

- infrastructure policy should be goal oriented and not focused on particular technologies;

- pricing or other access barriers should be removed;

- associations between infrastructure and a type of service should be avoided;

- infrastructure sharing is beneficial and should be encouraged; and

- fibre-optic networks are likely the preferred backhaul network solution, but depending on national geography / topology, may need to be complimented by wireless infrastructure.[15]

The report identifies a number of considerations to be taken into account by governments and regulators in developing economies that are grappling with the challenges associated with increased broadband access. There are a number of areas in this regard that are of particular relevance to this masterplan. These are summarised in Table 1.

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[12]   www.broadbandcommission.org

[13]   www.broadbandcommission.org/Reports/Report_2_Executive_Summary.pdf

[14]   www.broadbandcommission.org/Reports/Report_2.pdf

[15]   www.broadbandcommission.org/Reports/Report_2_Executive_Summary.pdf

The Commission endorsed the 'Broadband Challenge' in October 2011 whereby broadband connectivity was recognised as a human right and a crucial driving force behind economic growth. Importantly, governments were urged to adopt policy platforms that would facilitate broadband network deployment and service uptake. Member States were advised against retaining policies that would limit market entry and tax ICT services unnecessarily. Governments were encouraged to promote coordinated standards of interoperability and achieve maximum utility for scarce radio spectrum. It was seen as necessary to review existing regulatory and legislative frameworks, many of which reflect outmoded 20th century models and ensure that information flows are free and unhindered.[16]

Table 1: Broadband challenges

No.	Issue	Details
1.	Attracting investment in broadband	This may include: • reduce investment / regulatory barriers; • encourage infrastructure sharing; • introduce innovative spectrum management mechanisms; and • amend regulatory frameworks to eliminate discriminatory rules that favour one company / industry over another.
2.	Addressing persistent gaps in the market	It is recognised that in cases where infrastructure deployment is highly expensive or impractical, the government may need to be proactive in addressing bottlenecks. Authorities also need to maintain cognisance over possible adverse implications of hyper-competition, which may dampen sector investment. The universal service fund (USF) may pose challenges as changing definition of services may require the government to address issues of which entities are required to contribute.
3.	Funding broadband	The Commission stated that true access gap (a shortfall between market-based measures and universal access) may need to be addressed in circumstances where there is evidence that regulatory incentives and lower-cost network alternatives are not enough to encourage supply in certain instances. Governments may address these issues vis-à-vis remedies relating to issuing special licences in defined locations, funding local community initiatives, providing direct financial support to operators or mandating the deployment of broadband access networks. [17]

The Commission adopted a set of four broadband targets to be achieved by 2015:

i. all countries should have a national broadband plan / strategy or include broadband in their universal access / service definitions ;

ii. entry level broadband services should be made affordable in developing countries through adequate regulation and market forces (for example, amounting to less than 5 per cent of average monthly income);

iii. forty per cent of households in developing countries should have Internet access;

iv. Internet user penetration should reach 60 per cent worldwide, 50 per cent in developing countries and 15 per cent in least developed countries.

It should be noted that ITU is optimistic that all of these targets will be either met or exceeded by 2015. In order to reap the benefits of wireless broadband, Nepal must strive to meet and exceed these country household broadband targets.

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[16] www.broadbandcommission.org/Documents/Broadband_Challenge.pdf

[17] *Ibid.*

2.3   ITU ICT Development Index and link to growth

According to ITU analysis, there is a strong correlation between the development and maturity of a country's ICT infrastructure and economic growth. This relationship is even more prominent in emerging economies.

The ICT Development Index (IDI) is intended to provide insight into the level and evolution over time of national ICT development, progress in ICT development, the digital divide and development potential of ICT. It represents an amalgamation of data measuring ICT access, usage and skills.

The 2011 edition of the ITU report *Measuring the Information Society*[18], shows that Nepal increased its IDI value by 22 per cent from 1.28 in 2008 to 1.56 in 2010, thereby ranking 81 out of 152 nations considered. This increase is largely explained by the improvement in mobile cellular penetration from 14.5 per 100 inhabitants in 2008 to 30.7 per 100 inhabitants in 2010. Mobile broadband penetration however is virtually non-existent, while fixed broadband penetration is a very low 0.4 per cent.

The 15 per cent improvement in mobile cellular penetration has positive implications for the future of wireless broadband in Nepal and the achieving of key masterplan targets/priorities. The significant improvement in IDI over a mere two years is largely the result of substantial growth in the supply and demand of mobile services. As a consequence, ITU is optimistic that there is much forward momentum in place so as to expedite the aspects of the masterplan and set even loftier benchmarks.

It should also be noted that the fulfilment of masterplan priorities would undoubtedly improve the Nepal IDI ranking which would have beneficial implications for national growth and its regional positioning.

2.4   SAARC ICT Initiative

Nepal, alongside other SAARC[19] Members (Afghanistan, Bangladesh, Bhutan, India, Maldives, Pakistan and Sri Lanka), is committed to a regional ICT policy aimed at increasing penetration, quality and harmonisation of ICT services.

A 'Plan of Action' for telecommunications services has evolved over three SAARC conferences in 1998, 2004 and 2008. The following aspirational goals and objectives were formulated:

- '*To promote cooperation in the enhancement of telecommunication links and utilization of information technologies within the SAARC region;*
- *To minimize disparities within and among Member States in the telecommunications field;*
- *To harness telecommunication technology for the social and economic upliftment of the region through infrastructure development by optimal sharing of available resources and enhanced cooperation in technology transfer, standardization and human resource development; and*
- *To evolve a coordinated approach on issues of common concern in international telecommunications fora.'*

At subsequent SAARC conferences, Member States committed to implementing fellowships and training programmes for telecommunications HR staff as well as R&D and adopting uniformly applicable low tariffs for intra-SAARC phone calls. In addition, Member States were directed to 'give priority to universal access' and 'cooperate in the development of plans and for the utilization of ICT in e-commerce, health care education and other areas by the exchange of information and expertise'.

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[18]   www.itu.int/net/pressoffice/backgrounders/general/pdf/5.pdf

[19]   www.saarc-sec.org/

In 2009, a meeting of the Working Group on Telecommunications and Information and Communications Technology agreed in principle to a proposal regarding upgrading of national and regional telecommunications infrastructure.

An 18-point SAARC Plan of Action on Information and Media (PAIM) was formulated to achieve the ICT and media objectives that member states agreed to in the 1998 Dhaka conference. These objectives (revised in 2004) included, *inter alia*:

- reducing rates for media transmission and information materials;

- ensuring the free flow of information; and

- enhancing the exchange of data through the Internet.

It is worth noting that the achievement of higher broadband penetration will facilitate the meeting of PAIM targets.

2.5   Other global developmental trends in broadband policy and regulation

In recent years, several key trends have emerged with respect to broadband policy and regulation. Governments around the globe have become increasingly cognisant about the importance of high-speed networks and their link to economic growth. As a consequence, there has been a substantial increase in government participation and intervention within the ICT sector. Broadly speaking, this intervention consists of:

- the encouragement of private sector participation via improved access arrangements, simplified licensing and deregulation;

- the development of national broadband plans / policies;

- financial support in the form of subsidies, tax breaks, grants and loan assistance;

- expanding the scope of universal service obligations (USO) to encompass broadband services;

- updating regulatory regimes to take into account the convergence of media and communications; and

- redirecting universal service funds (USFs) to enable broadband in rural / isolated / low-income areas.

Regulators are coming to terms with the need to prepare for a dramatic increase in the demand for scarce spectrum. Global spectrum management arrangements are evolving to meet changing patterns of use and demand for spectrum. Following a trend that began in Australia, Japan, the US and New Zealand, steps are being taken to reduce the involvement of government and let market mechanisms govern the allocation and destination of use of spectrum including:

- allocating spectrum through price-based selection processes – especially auctions – or alternative proxy methods to impose apparatus charges which reflect the value of the spectrum;

- the owners of spectrum rights are increasingly free to decide which technology to use and which services to provide with it;

- in line with spectrum liberalization, the introduction of spectrum trading in some markets is allowing spectrum rights to be allocated via market mechanisms to the users that value it the most; and

- the increasing prevalence of spectrum leasing arrangements which allows a spectrum owner to sub-lease, part or all of their allocated frequencies.

3.   Nepal and the wireless broadband market

3.1   Country overview[20]

With over 28 million inhabitants, Nepal is one of the few landlocked nations in Asia (see Figure 2). Located on the southern side of the Himalayas the nation has a diverse, mountainous topology and extremely varied climate. The population is largely rural, with only 18 per cent living in urban areas.

Figure 2: Map of Nepal

In recent times, economic growth has picked up pace, after having been suppressed by years of political instability and civil war. In 2010 Nepal's GDP increased 4.6 per cent (down from 4.9 per cent in the preceding year). GDP per capita in 2010 was estimated at USD 1 200. An estimated 24.7 per cent of the population lived below the poverty line in 2008.

Agriculture is Nepal's primary economic activity, employing over 80 per cent of the population and providing 38 per cent of GDP. Unemployment, at 46 per cent is extremely high by global and regional standards.

Until the partial deregulation of the telecommunications sector in the early 2000s, government-owned Nepal Telecom (see www.ntc.net.np) was the nation's sole service provider. However, following the entry of private operators, it faces competition in the mobile services sector but remains the sole provider of PSTN and ISDN services. Nepal's telecommunications market remains under-developed. On 6 February 2012, Nepal Telecom announced a rise in net profit of 12.5 per cent to NPR 12.12 billion (approximately USD 157.5 million).

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[20] ITU: *Universal Access to Broadband in Nepal*, 2011. *Asian Development Bank and Nepal Fact Sheet*, December 2010

3.2   Current market structure and competition[21]

Table 2 shows Nepal telecommunication penetration and growth rates in early 2012.

Table 2: Penetration and growth rates

Service	Subscribers			
	2010 (million)	2012 (mid-January) (million)	% of population	% growth since 2010
Fixed	0.842	0.847	3.2	0.56
Mobile	9.2	13.6	51.1	47.8
Other	0.605	0.875	3.3	44.6
Data / Internet	1.9	4.05	15.2	113.2

Source: NTA. GSM subscribers 12.75 million, CDMA 0.85 million

Mobile networks continue to grow rapidly. Ncell, operator of the nation's largest GSM network now provides 3G services using the 2100 MHz band to all main urban areas in Nepal. Ncell currently has 7 million GSM subscribers, up from 6.85 million in December 2011, followed by Nepal Telecom with a customer base of 5.74 million in January 2012, up from 5.65 million a month earlier. The customer base of Ncell is therefore 1.26 million higher than its competitor Nepal Telecom. In addition to the main two operators, three operators currently provide telephony in rural areas:

- *Gramintel (STM)*: licensed to provide Rural Telecom Services (RTS) in rural areas of the Eastern Development Region. It provides fixed and pay phones;

- *United Telecom Limited* (UTL): the first private operator to be granted a nation-wide licence.

- *Nepal Satellite Telecom Pty Ltd (NSTPL)*: licensed to provide Basic Telecom Services (BTS) throughout the country;

- *Smart Telecom (STPL)*: licensed to provide RTS in rural areas of all development regions excluding the Eastern Development Region using VSAT technology.

While the fixed line market is flat with little to no growth, Nepal Telecom announced plans to upgrade its network to ADSL2+ services. It is likely that 90 per cent of the population will be covered by either Ncell or Nepal Telecom networks.

Nepal's wholesale (i.e. backhaul) market for telecommunications services remains underdeveloped. As a consequence, operators have deployed their own east-west backhaul networks. There are now two complete east-west networks owned by Nepal Telecom and Ncell. A third east-west backbone is owned and operated by the Nepal Electricity Authority. Smaller providers operate their own, smaller backhaul networks.

In the past year, Nepal Telecom has made a number of announcements and/or plans to address the country's teledensity and digital divide. These include:

- In February 2012, Nepal Telecom announced its signing of contracts to deploy 4G (WiMAX) equipment from Airspan Networks connecting 58 municipalities and 3 915 villages spread across Nepal. The network will utilise 30 MHz of spectrum in the 2.3 GHz band.

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[21]   For a more detailed analysis, see ITU: *Universal Access to Broadband in Nepal*, 2011.

- In August 2011, called for tenders for an ambitious 10 million GSM/W-CDMA lines in two packages (one addressing the Central, Eastern, Far Western and Mid-Western development regions and the other Kathmandu Valley and Western Development Region). The Commission for the Investigation of Abuse in Authority (CIAA) gave Nepal Telecom clearance on this project on 23 January 2012.
- By the end of 2011, Nepal Telecom planned to have deployed 500 Wi-Fi hotspots throughout the country.

Given the landlocked status of Nepal, international connectivity is another pressing issue for the NTA. Four carriers operate international gateways and the NTA policy approach has a preference for an open access regime and competitive supply of services.

3.3   Competitive state of industry

Table 3 outlines the telecommunications carriers of Nepal. Since the 1992 telecommunications reforms, the market has steadily liberalised with a phased process of privatisation for Nepal Telecom. In addition, since 2010, a number of new participants have emerged in the mobile services market, thus serving to increase competition. Nonetheless, Nepal Telecom remains the dominant operator and any move to increase wireless broadband penetration in Nepal would be likely to necessitate their involvement.

Table 3: State of competition in telecommunications market, 2011

Company		Service	Market Share*	Description
Nepal Telecom		Mobile and fixed-line	58%	Incumbent. Provides GSM and CDMA and soon WiMAX mobile services.
United Telecom Ltd		Wireless local loop	5%	Limited mobility service using CDMA
Ncell		Mobile	36%	Owned by TeliaSonera. Provides GSM services.
Smart Telecom		Fixed-line Mobile and Satellite	n.a	Services central development regions and remote western regions (fixed) VSAT. Mobile coverage in 250 VDCs.
Gramintel		Fixed-line Mobile	n.a	Services eastern regions (fixed) Mobile service (GPRS and EDGE)
Nepal Satellite Telecom)		Fixed-line	n.a	Services western regions.

Source: NTA, 2011, www.ktm2day.com and company websites

3.4   Current policy objectives/initiatives

There are a number of policies/initiatives that are currently being pursued by the government and the NTA. Specifically, an overarching National Broadband Policy is currently being formulated by the NTA. It is envisaged that the wireless broadband masterplan will be consistent with and compliment Nepal's broader ICT policy development plans. The policy established a broadband framework which, *inter alia,* established the following:

- a commitment to defining the term 'broadband' as possessing minimum uplink / downlink speeds;

- a commitment to technology neutrality; and

- a policy framework favouring equity and access over growth and innovation e-services catering to low-income households and mandated speeds for specified e-services.[22]

The government's 2010 ICT masterplan provides for a new spectrum management strategy. It is recommended that the appropriate spectrum allocation policy is one that is focused on the optimisation of frequency use. It was stated that allocations should be a function of coverage, thereby providing allowance for additional spectrum as coverage increases and built-in instruments to discourage spectrum hoarding. It should also be noted that the NTA has mandated a 15 per cent investment in rural area network by licensees as a means of stimulating investment in telecommunications infrastructure in rural areas.[23]

3.5   Asia Development Bank Wireless Broadband Initiative

The Asia Development Bank (ADB) Wireless Broadband Initiative commenced in 2008 with the objective of bringing wireless broadband to remote areas of Nepal. A sum of USD 25 million was granted to facilitate the rollout via public private partnerships (PPPs). As of 2011, the initiative evolved into a proposal to deploy wireless broadband services in at least 1 900 VDCs in 38 districts with a minimum up/downlink speed of 256 kbit/s in each direction. The ADB agreed to provide some USD 6 million to the enterprise that tendered the successful bid. However, regional connectivity issues and the responsibility of backhaul and other costs have meant significant delays and uncertainties. (For more details see Appendix A).

3.6   Regulatory framework

Table 4 details the legislation and subsidiary legislation that are applicable to the Nepal telecommunications sector.

Table 4: The telecommunication legal regime in Nepal

Ambit of operation	Laws / Regulations / Instruments
Licensing	• *Telecommunications Act 1997, as amended by the Amendment Act 2007 and the Telecommunications Amendment Act 2008* • *Telecommunications Regulations 1998* • *Rules on Licensing Telecommunication Services* • *Quality of Service Parameters for Basic Service (26 June 2007):* • *Quality of Service Parameters for Internet (26 June 2007*

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[22]   See www.nta.gov.np/articleimages/file/Broadband_Policy_Consultation_16_April_2009.pdf

[23]   See ITU, Universal Access to Broadband, Nepal, 2011.

Ambit of operation	Laws / Regulations / Instruments
Spectrum management and allocation	• *Radio Act 1957* • *Radio Communications (License) Regulation 1992* • *Telecommunication Service Radio Frequency (Distribution and Pricing Related) By-law 2066*
Access and interconnection	• *Telecommunication Act 1997*
Retail and tariff regulation	• *Telecommunication Act 1997*
Competition	• *Telecommunication Act 1997**
Universal service obligation	• *Telecommunication Act 1997*

* While there is no specific competitive framework – but NTA implicitly has power to regulate for competition via licensing and other mechanisms.

3.7   Spectrum utilisation

Radio frequency laws and regulations are governed by the *Radio Act 1957*. This Act simply empowers the government to make rules with respect to radio machines (Section 10) and stipulates that subject to express exceptions, a licence is required to hold, use and manufacture radio machines (Section 3).

Chapter 11 of the *Telecommunication Act* provides for the creation of the Radio Frequency Policy Determination Committee. Its purpose is to determine policy relating to radio frequencies and spectrum allocation.

While the following Table 5 outlines the current spectrum allocations to mobile service providers please refer to Appendix B for the Nepal cellular mobile service frequency allocation table.

Table 5: NTA – current cellular spectrum paired allocation (MHz)

Licensee	CDMA 800	GSM 900	GSM 1800	CDMA 1900	IMT 2000 (3G)	Total MHz
Nepal Telecom	2 x 8MHz	2 x 7.2 MHz, 2 x 2.4 MHz	2 x 9 MHz, 2 x 6 MHz	-	2 x10 MHz	52.6
STSPL	-	2 x 2.4 MHz, 2 x 0.6 MHz	-	-	-	3
UTL	2 x 3 MHz, 2 x 1.25 MHz	-	-	2 x 1.25 MHz	-	5.5
NSTPL	-	2 x 4.4 MHz	2 x 9 MHz	-	-	13.4
STM	-	2 x 2.4 MHz		-	-	2.4
Ncell	-	2 x 6 MHz, 2 x 2 MHz	2 x 9 MHz, 2 x 2 MHz	-	2 x 10 MHz	29

Source: NTA – Existing Cellular Spectrum Allocation

3.8 Key challenges[24]

In order to materially increase wireless broadband penetration, the NTA along with government needs to devise solutions to successfully address three key challenges: power disruptions, affordability, and policy and regulatory barriers.

3.8.1 Power disruptions

Nepal's power grid is insufficient and needs substantial investment. Unlike domestic fixed line networks (which are self-powered), the national grid will power wireless networks and therefore subject to potentially crippling disruptions which may have the effect of suppressing broadband uptake. The government may need to mitigate this significant obstacle via the use of alternative power sources, such as solar, grid upgrades and backup battery equipment.

3.8.2 Affordability

At present, notebook computers and 3G Internet access priced at approximately 70 and 20 per cent per capita income, respectively, are unaffordable to many Nepalese. Lack of affordability of both Internet access devices and services constitutes the most significant barrier to wireless broadband adoption in Nepal. The government will need to endeavour to bridge this affordability gap by considering the merit of a number of options such as: free Wi-Fi hotspots, subsidies and community Internet centres etc. These policies are especially important for the approximately 70 per cent of the population who live in isolated/rural areas.

3.8.3 Policy and regulatory barriers

A number of policy and regulatory barriers exist which impact wireless broadband penetration. These include, *inter alia*:

- a complex licensing scheme that acts to discourage enterprises from entering the domestic market and hence providing additional competition;

- non-transparent spectrum allocation regime and inefficient allocation of key spectrum bands (e.g. on a regional basis without reuse);

- the lack of an effective interconnection regime; and

- inefficient taxes that add to the expense of purchasing new technology / equipment.

These barriers will need to be addressed by the government in order to facilitate the most efficient and effective rollout of wireless broadband services.

4. Medium to long term goals to optimise wireless broadband for Nepal

4.1 Global mobile data traffic growth

Based on global statistics the number of wireless broadband subscribers has exceeded the number of fixed broadband subscribers and will continue on an explosive growth path as per current growth estimates. According to the Cisco *Visual Networking Index Global Mobile Data Traffic Forecast* overall mobile data traffic is expected to grow to 10.8 Exabytes (1 Exabyte=10^{18} bytes) per month by 2016 as shown in Figure 3.

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[24]   ITU, *Universal Access to Broadband* in Nepal 2011.

Figure 3: Overall mobile data traffic growth 2011 – 2016

IP Traffic
[TB thousand per month]

Global

Asia Pacific

Selected Segments	2011	2012	2013	2014	2015	2016	CAGR
Data	0.17	0.33	0.55	0.86	1.35	2.17	65%
Video	0.31	0.74	1.56	2.92	4.88	7.62	90%
File sharing	0.08	0.11	0.15	0.20	0.26	0.36	36%

Source: Cisco, VNI Report, 2012
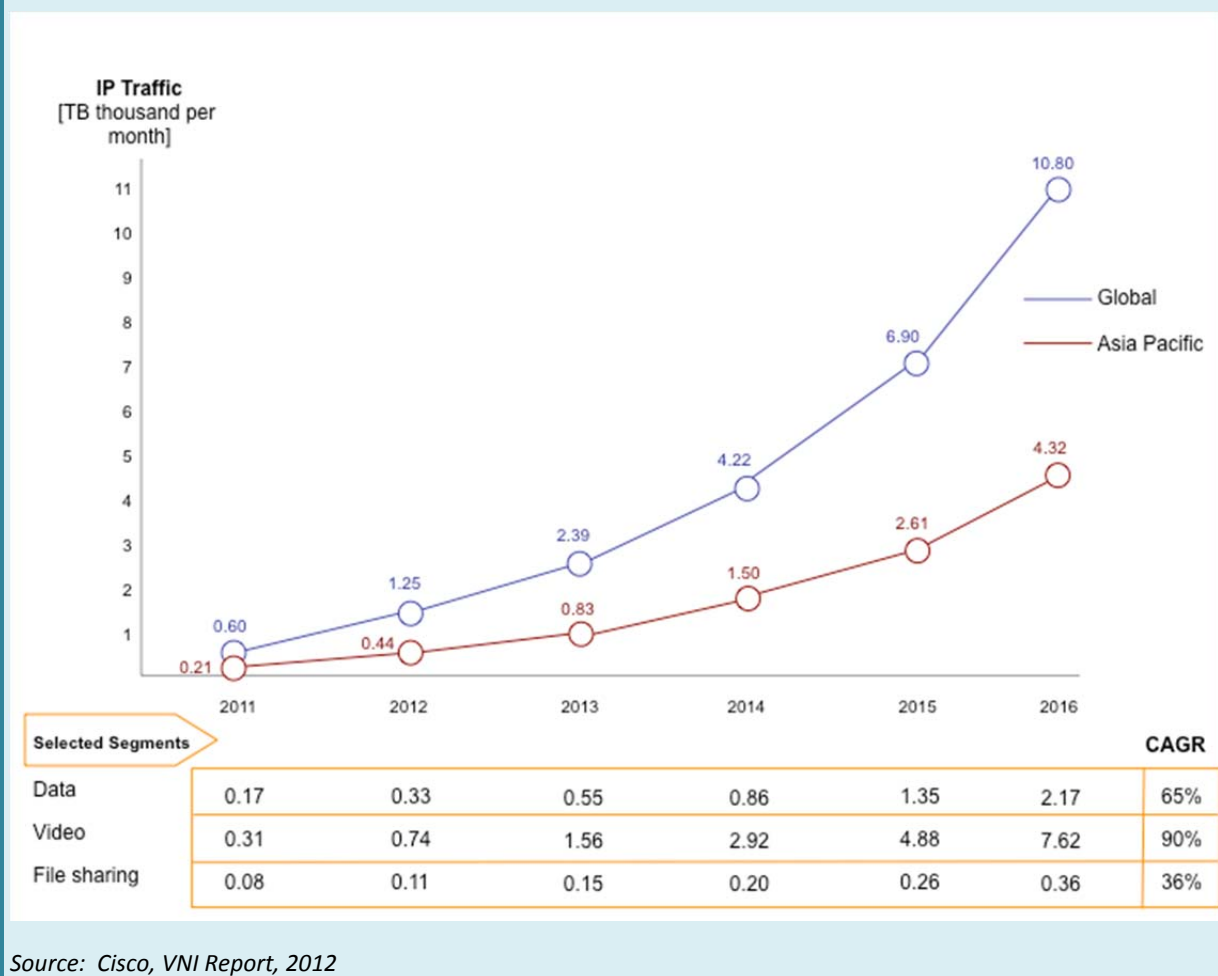
As the industry embraces mobile broadband, data demand on the network is increasing rapidly, and operators need to find a cost efficient way to continue providing the service. A ten-fold increase in mobile data traffic could translate to less than 10 per cent increase in revenue for operators. LTE serves as the common migration path for all existing mobile standards to address the cost challenge (Figure 4).

Figure 4: Benefits of LTE: decoupling revenue and traffic

Source: UBS, 2009[25]
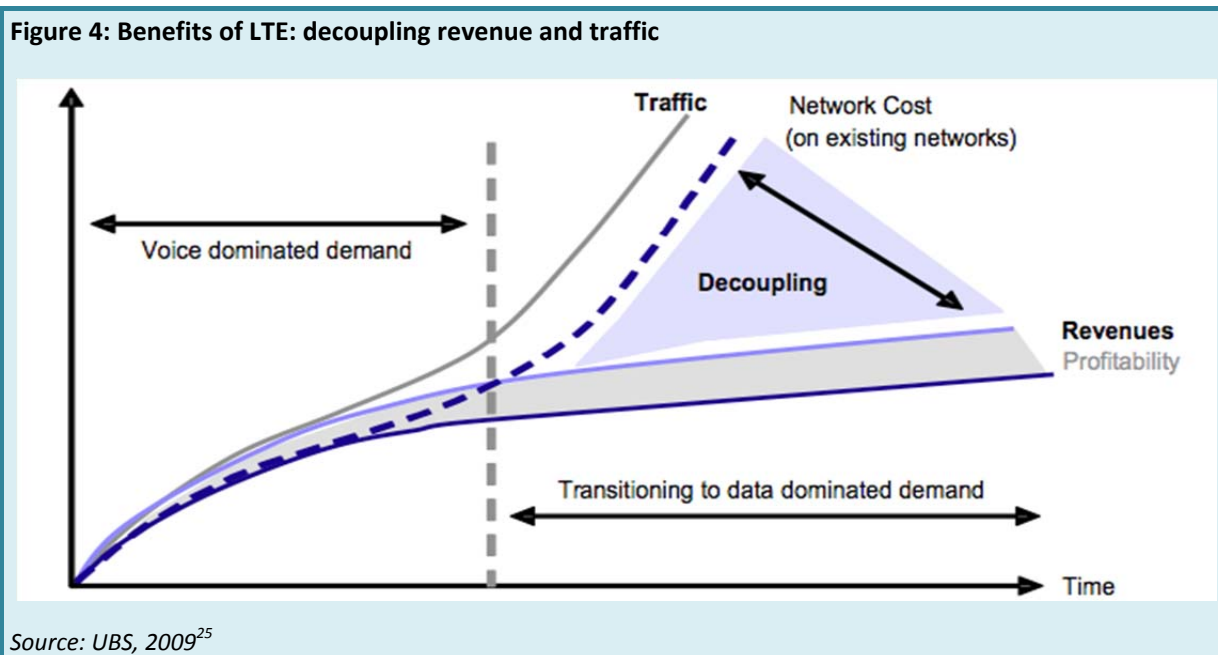
4.2 Estimating wireless broadband growth

In Nepal, while there statistics exist on the current number of Internet users by technology (Table 6), no operator nor the NTA has developed bottom estimates on future broadband subscriber growth or more importantly the growth of Internet/broadband data use by subscribers.

Table 6: Current status of broadband in Nepal as at the end of 2011

Services	Subscribers				Total
	NDCL	UTL	NCELL	ISPs	
Dial-up (PSTN/ISDN)	5 464	-		14 207	19 671
Wireless Modem, Optical Fibre	-			30 495	30 495
Cable Modem, Cable etc.	-	-	-	16 919	16 919
ADSL	77 737			-	77 737
GPRS	1 321 517		2 234 545	-	3 555 862
CDMA 1X	109 076	64 233		-	173 300
Total	1 513 594	64 283	2 234 545	61 621	3 873 993
Internet Penetration Rate					14.55%

Source: NTA Presentation, Kathmandu, 2 February 2012

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[25]   UBS Investment Research, Asia Telecom Sector: LTE Implications for Asian Mobile operators, 25 June 2009.

Even the detailed ITU report on Universal Access to Broadband in Nepal focused on a macro broadband penetration of 10 per cent and a number of initial deployment goals as detailed in Box 1. Instead the current focus of the government and NTA is to secure a broadband Internet penetration of at least 10 per cent by 2015. It is likely that from a wireless broadband coverage perspective, this goal will be easily achieved as the Kathmandu Valley with approximately 5 million inhabitants comprises over 16 per cent of the country's population. As such when the final National Broadband Policy is set it should also set a number of 'reach" targets for the sector.

Instead of broadband availability being the key limiting factor, the key limitation on the take up of broadband services in Nepal is likely to be affordability both in terms of device cost and in monthly subscription charges. While recent moves in neighbouring India, to provide low cost access devices (e.g. the Aakash tablet[26]), offer some promise, more will need to be done in relation to affordability with lower cost tablets, PCs and smartphones etc. to have a broader market adoption of broadband services in Nepal.

Box 1: Revised draft broadband policy for Nepal: Proposed broadband access goals for 2015

The following ten goals can be considered both ambitious and achievable by 2015:

1) Broadband penetration will pass 10 per cent.

2) Urban broadband users will have a choice of at least three broadband suppliers.

3) Companies in central business districts will have a choice of at least three broadband suppliers.

4) All government agencies will have a broadband connection, an informative web site, responsive email access and opportunities for basic transactions such as application forms to be completed online.

5) All 75 district capitals will be connected by optical fibre backbone links.

6) [50] per cent of Village Development Committees will have a broadband connection.*

7) [70] per cent of secondary schools will have a broadband connection and use it both for professional education and as part of the standard curriculum.*

8) All hospitals and [50] per cent of clinics will have a broadband connection.*

9) Community resource centres with a broadband connection will be established using international best practice models in [100] villages.

10) Villages beyond the reach of commercial wireless broadband services will be identified as the basis for a 'smart subsidy' program to support service extensions.

* target dates for 100 per cent coverage will be established as part of the planning for wireless broadband access.

Source: ITU, Universal access to broadband in Nepal, 2011, page 52

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[26] – see www.akashtablet.com

5. Key considerations for the wireless broadband masterplan

5.1 Introduction: Enabling the wireless broadband end-to-end ecosystem

The key elements of this masterplan are to enable the end-to-end ecosystem which provides connectivity and content to consumers. This is shown in Figure 5. While the focus is necessarily on the customer access networks, this masterplan examines five key factors which are critical in facilitating the broadband penetration in Nepal:

(i) policy and regulatory aspects (see section 5.2);

(ii) technology aspects (see section 5.3);

(iii) spectrum management aspects (see section 5.4);

(iv) international connectivity (see section 5.5);

(v) facilitating content and application (See section 6).

Figure 5: End-to-end broadband connectivity

Source: Author
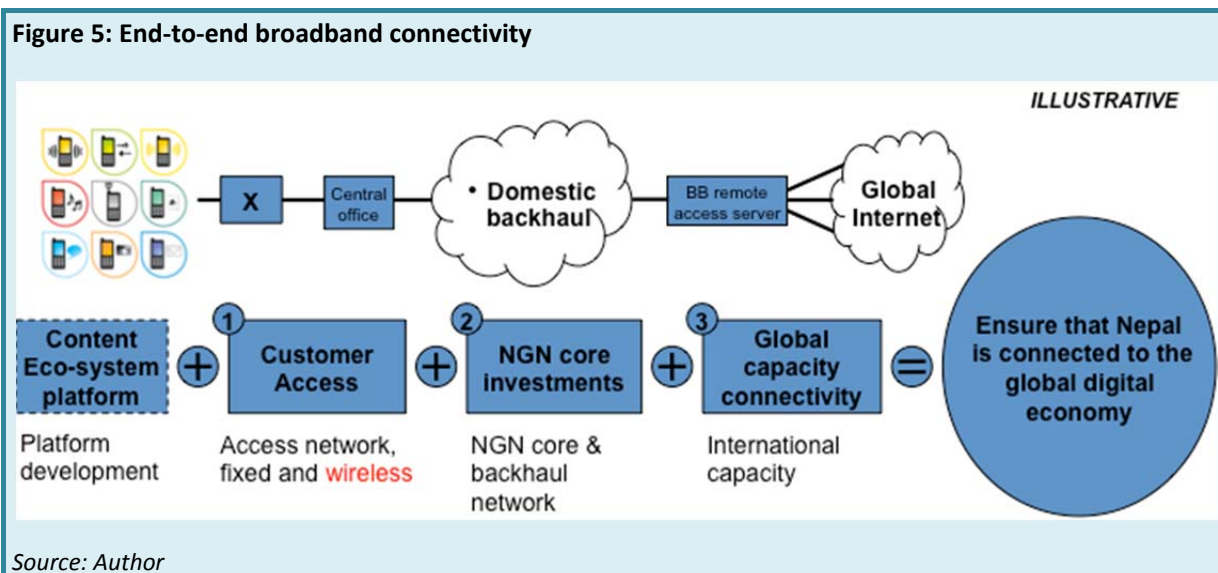
5.2 Policy and regulatory aspects

From the review which has been undertaken of the Nepal policy and regulatory frameworks applicable to wireless broadband services, there are a number of elements which could be improved in order to create a globally comparable regulatory environment. While a number of elements are assessed in Table 6 (section 5.2.5), three issues relating to licensing and spectrum management and regulation require explanation.

5.2.1 Unified licensing structure

Licensing is one of the core elements of a regulatory framework and is one of the most important instruments which governments and regulators can employ in the context of the communications sector and its reform. Licensing is integrally tied to the structure of the telecommunications markets, the degree of competition between them, the revenues earned by governments in opening markets and ultimately, the efficiency of the supply of telecommunications services to the public. It is therefore important to ensure that a workable licensing framework is in place in Nepal. This is because a robust, forward-looking and transparent licensing regime is critical for the long term success of the Nepal communications sector.

A telecommunication licence may be defined as an official authorisation to provide services and/or operate networks. It also can be a regulatory "code" or otherwise a scheme that defines the terms and conditions under which the licensee may operate. Licences usually also describe the rights and obligations of the provider. In short, the licensing process controls both entry into a communication market and, often, the behaviour of the licensee once it enters and operates within that market.

The current operating licences for telecommunication services issued pursuant to the *Telecommunications Act 1997* could be better structured and drafted. While the current licences were issued in the past, it is timely for a review to be undertaken of all the telecommunications licences in order to minimise inconsistencies and ensure that the licences are properly aligned going forward. The introduction of a standard licensing framework is a key step in an overall restructuring of operator licences in order to reflect the technical and market realities of convergence.

A unified licensing regime would simplify the licensing procedure, allow service providers to use any technology, ensure flexibility and efficient use of resources. In addition, unified licensing framework removes arbitrary and artificial distinctions which are not technically supported, promotes sector competition and sector convergence. The *Telecommunications Act 1997* is broadly drafted and facilitates the implementation of a unified licensing regime. Appendix C sets out a draft unified licensing template for telecommunications services in Nepal.

5.2.2   Facilitation of competitive entry of a new entrant

The current duopoly in national licensing is not likely to produce the optimal outcomes for consumers going forward.

As such, consideration should be given to facilitating the competitive entry of a new entrant to accelerate wireless broadband services in Nepal. If the new entrants are willing to risk their capital to invest in infrastructure, this should be encouraged. A possible new entrant would also increase competition tension if new cellular spectrum (e.g. 700 or 2600 MHz) was to be auctioned going forward. A suggested competition and spectrum allocation strategy for Nepal to adopt to underpin voice and wireless broadband deployment (and to maximise government revenues) is detailed in Appendix E. Introducing additional competition into the Nepal mobile service market is a two-stage process as Appendix E demonstrates.

5.2.3   Spectrum management and regulation

There are two main acts that regulate radio frequency spectrum in Nepal. These are the *Telecommunications Act 1997* and the *Radio Act 1957*. The *Radio Communication (License) Regulation 1992* also addresses various aspects of radio regulation in Nepal:

- The Radio Act provides for control and regulation of activities of holding, making and using "radio machines" in Nepal. "Radio machines" is defined to capture equipment used for receiving or sending words, pictures or signals continuously through radio waves <u>without</u> wire connection. A list of "machines" are set out in the definition. Article 3 is key given that it provides that" a person licensed to operate telecommunications service under the *Telecommunications Act* or a customer using the telecommunication service through such a person shall not be required to obtain a licence under this Act to hold, make or use the radio machine relating to the telecommunications service". Note that this act regulates radio machines, and not radio frequency allocation *per se*.

- The *Radio Communication (License) Regulation 1992* requires a person to obtain licence to hold, use, manufacture, sell or distribute all kinds of radio machines. Similar to the Radio Act, there is no provision on radio frequency allocation or licensing of frequency spectrum.

- The *Telecommunications Act* provides for regulation of telecommunications. Section 22 provides for a person desiring to operate "Telecommunications Service" to apply for a licence[27]. Importantly, there is no provision for the licensing of radio frequency spectrum. Section 49 on "Provision of Determination of Radio Frequency Policy" merely provides for radio frequency policy determination committee to *inter alia* determine radio frequency policy, allocate radio frequency, determine pricing of radio frequency and determine policy for coordination of radio frequency.

Based on the above, it appears that there are queries concerning radio frequency spectrum allocation and licensing and how they are addressed in law. Going forward, these queries could be addressed by legislative amendments. It is recommended that the *Radio Act* be amended to address radio frequency allocations and licensing (via auction or otherwise) and spectrum fee issues. The proposed amendments to the *Radio Act* are set out in Appendix D.

5.2.4 Refarming and reuse of 'rural' 900 MHz allocations in urban areas

Existing allocations of 900 MHz spectrum which are wasteful and inefficient in allocating certain 900 MHz frequencies exclusively for rural services and then allowing these key spectrum bands to lie 'fallow' and not allowing such spectrum to be used in urban areas should also be immediately reviewed. This is a regulatory issue and not a technical one.

Such allocations to rural only providers comprise a total of 5.4 MHz of paired 900 MHz spectrum. This represents almost 20 per cent of the 900 MHz spectrum which is currently allocated for use in Nepal. The lack of reuse is highly unusual in global terms and if this spectrum was available for use it would have an immediate impact on both affordability (costs would reduce especially in urban areas) and the quality of service. The latter assumes that part of the congestion in the air interface which degrades service quality in Nepal.

5.2.5 Other key policy and regulatory issues

Table 6 details a number of key policy and regulatory issues which have arisen during the course of the development of this masterplan which ought to be implemented in order to accelerate wireless broadband services in Nepal.

Table 6: Other key policy and regulatory issues

No.	Issues	Comments
1.	*Utilisation of key spectrum below 1 GHz*	Given the dominant position of mobile services in Nepal (which will grow even more so) and wireless broadband in the future, the need for Nepal to utilise key spectrum below 1 GHz spectrum resource (especially the 700 MHz band)[28] is profound. In this respect, Nepal should lock in to regional Asia Pacific proposal of 2 x 45 MHz digital dividend spectrum. In this respect and as discussed further in Appendix E, an early indication should be made that an auction of certain 700 MHz spectrum will take place later in 2012 or early 2013.

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[27] Note that the Act only expressly provides for licensing of "Telecommunications Service" and is silent on licensing of "Telecommunications System" and "Telecommunication Line". "Telecommunications Service" is defined as "service relating to the acts of the conveyance or the reception of any sounds, signs, signals, writings or images by the wire, radio, optical or other electromagnetic systems whether or not such signs, signals, writings, images, sounds or intelligence have been subjected to rearrangement, computation or other change in any manner for their emission, transmission or reception".

[28] The availability of this band in Nepal is confirmed by the Roadmap for the Transition from Analogue to Digital Terrestrial Television Broadcasting in Nepal, February 2012.

No.	Issues	Comments
2.	*Flexible rights of use for key wireless spectrum allocations*	Flexible rights of use should be instituted for key wireless spectrum allocations with technology use given that artificial technology limitations may deny operators being able to use efficient and spectrally efficient technology. For example, 3G W-CDMA at 900 MHz is more cost effective than rollout of 3G W-CDMA at 2100 MHz. In addition, while the current focus in Nepal is on 2.3 GHz and 2.6 GHz bands which is mainly used for Kathmandu, the lower frequencies are better (for example, LTE at 1800 MHz) and cheaper than 2.6 GHz Capex.
3.	*Flexibility to use 2.3 GHz band going forward*	Given current NTC support for WiMAX in the 2.3 GHz radio frequency band as they are almost finished with a lengthy procurement process, the NTA should provide them flexibility going forward and avoid orphaned technology in Nepal. In this respect, the band plan and their allocation should permit deployment of TD-LTE in the 2.3 GHz radio frequency band. This should also provide an early upgrade path for Nepal to take account of more affordable devices including smartphones and tablets in the market.
4.	*Determining spectrum price for 3G spectrum*	It is not possible to have a real auction to determine the price which ought to be paid for the 3G spectrum in Nepal. The current pricing proposals for the 3G spectrum is high and not consistent with global and regional benchmarks. Nepal needs to use a benchmarking study to determine the price for 3G spectrum. This is further discussed in Appendix G.
5.	*Accelerate infrastructure sharing framework*	An infrastructure sharing policy, preferably mandated, will be a significant positive for the country. Likewise there is a need for clarity on interconnection and access. Improved regulatory clarity will also make a third telecommunications licence more appealing. It should be noted that while mobile number portability (MNP) may be desirable it is not necessary and for Nepal would add considerably to costs and network complexity when quality of service is already an issue.
6.	*Using satellites in rural, remote and uneconomic areas*	Using satellites in rural, remote and uneconomic areas of Nepal as part of a national broadband solution is both good public policy and makes commercial sense given this can provide cost effective solutions which are robust. In addition, they could be utilised to provide cellular network connectivity in areas without fibre or microwave facilities or direct connectivity when mini BTS are not economic.
7.	*Role of NTA as facilitator*	The role of the NTA as a facilitator is crucial in order to create an enabling environment, regulatory certainty and a gradual reliance on market mechanisms to promote wireless broadband services. This includes: • developing predictable and transparent regulatory framework; • promoting competition; • encouraging investment in infrastructure; • engaging in consultation with industry; and • quarterly collection of statistics from operators to ensure latest ICT figures.

5.3 Technology aspects

5.3.1 Introduction

While ITU advocates a technology-neutral approach, this does not mean that a particular mobile technology is preferred over another. What a technology-neutral approach does is to ensure that operators are not hamstrung into continuing supplying a particular service when cheaper and more efficient substitutes are available. When selecting a mobile technology and deploying it in a designated frequency band, it is important to consider whether the said technology is harmonised. Harmonised technology ensures interoperability and cheaper telecommunications equipment. This section will address the issues relating to technology harmonisation and canvas the major mobile technologies available for Nepal.

The proposed Nepal Government Universal Access Broadband Policy focuses on the expansion of broadband services without specifying whether it has any preferred spectrum bands. The great benefit of lower spectrum ranges is increased propagation, which means broadband services are capable of reaching a larger geographic area and a higher number of people. This is particularly important for Nepal given its mountainous terrain, which will rely on the greater range achieved by lower frequencies to ensure maximum coverage (see comparison in Figure 6).

The aim of the government should be to exploit the technological benefits of the lowest frequency bands as much as possible (e.g. including the 700 MHz and 1800 MHz bands) for the deployment of LTE technology. This will ensure that the country has the capacity to take advantage of 4G broadband services and the growth that is expected to take place in this area. In the following sections we examine GSM, W-CDMA, LTE, WiMAX, wireless offload and satellite technologies.

Figure 6: A comparison of different access technologies

Source: Author
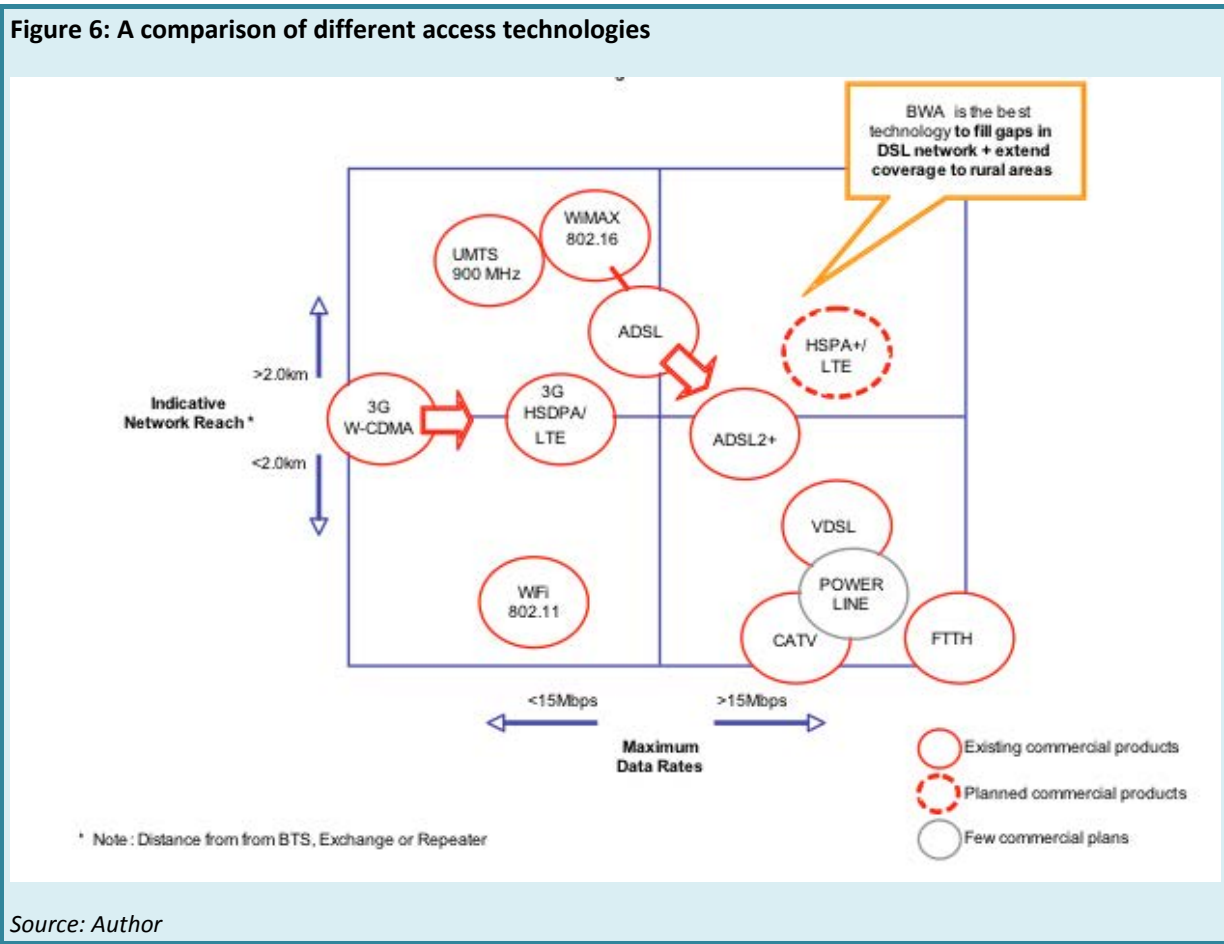
5.3.2   GSM and W-CDMA

5.3.2.1   GSM

Nepal key wireless services operate on a range of bands reflecting either vendor support or other factors. Spectrum allocations are consistent with the majority of countries worldwide.

In the transition from 2G to 3G a number of standards have been developed, which are categorized as 2.5G. These are add-ons to the 2G standards and mainly focus on deployment of efficient IP connectivity within the mobile networks. Data access is provided by General Packet Radio Service (GPRS) and offers throughput rates of up to 40 kbit/s. As of Q2 2010, there were over 4.42 billion GSM subscriptions.[29]

5.3.2.2   W-CDMA/HSPA

W-CDMA is the access scheme defined by ITU to be the main technical platform for UMTS or Third Generation Mobile services. W-CDMA services are to operate within the following frequency bands: 1920 MHz – 1980 MHz and 2110 MHz – 2170 MHz. ITU had selected W-CDMA as one of the global telecom systems for the new IMT-2000 3G mobile communications standard. In W-CDMA interface different users can simultaneously transmit at different data rates and data rates can even vary in time. W-CDMA is capable of delivering up to 384 kbit/s in outdoor environments and up to 2 Mbit/s in fixed indoor environment. W-CDMA is currently at release 9.

High Speed Packet Access (HSPA) is a set of technologies that allow W-CDMA operators to run their networks at broadband speeds. Peak downlink and uplink throughput is at 14.4 and 5.7 Mbit/s, respectively. HSPA+, which harnesses MIMO (multiple in, multiple out) enables peak data rates of up to 42 Mbit/s.

The roadmap for wireless technology evolution from GSM to W-CDMA to LTE services is shown in Figure 7.

Figure 7: Wireless technology roadmap

Source: Ericsson and Qualcomm, 2009.
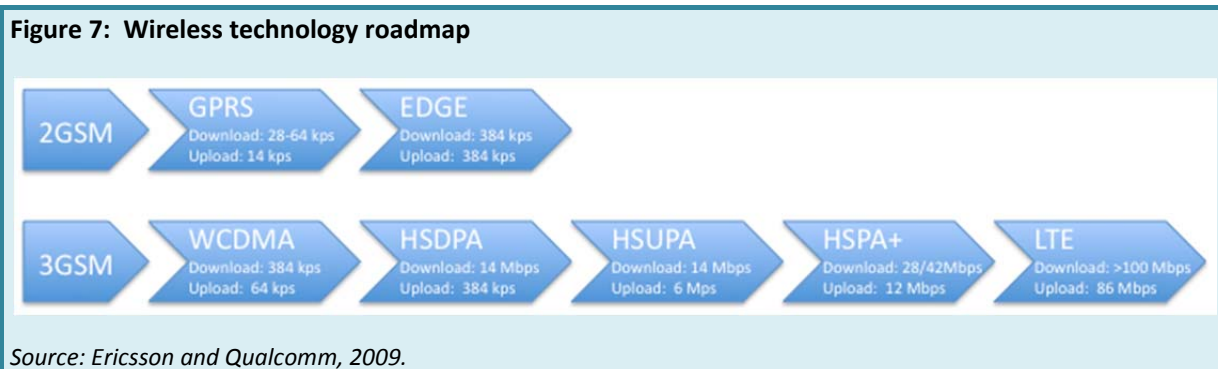
As of January 2012, there are reportedly 241 HSPA+ network commitments with 187 HSPA+ networks having been launched. Total subscribers amount to 822.4 million (including 469 million HSPA subscribers).[30]

As case studies show (Box 2) that the cost of 3G coverage with UMTS900 can save operators between 50 to 70 per cent of mobile network costs (including Capex and Opex) versus UMTS2100. UMTS900 can more cost effectively provide 3G and mobile broadband services in rural and regional areas. There is also an added benefit of improved indoor coverage.

Using the nation's existing GSM infrastructure makes sense to achieve a rapid transition to widespread wireless broadband in Nepal. The Nepal Government and the NTA should permit the early use of GSM band by NTC and NCell, in particular to provision W-CDMA at 900 MHz.

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[29] www.gsacom.com//downloads/charts/GSM_market_share_global.php4

[30] www.gsacom.com/news/gsa_fastfacts.php4

Box 2: Case Study: Optus UMTS900 Network

In 2008, Australian carrier Optus launched the world's largest UMTS900 network. With almost 1 000 base stations, the network covers over 96 per cent of the population.

Given Australia's population distribution, fixed broadband penetration is relatively low and demand for wireless broadband high. Optus recognised this as an opportunity to compete with Telstra's national coverage and decided to expand its 3G network to enable high-speed data services. Optus had launched a UMTS2100 network in 2005, but UMTS900 was recognised as more cost effective for rural areas.

Deployment

Recognising the potential of UMTS900 to economically extend coverage to low-density areas, the regulator (ACMA) quickly approved the deployment.

From a strategic perspective, Optus chose to focus on areas where GSM usage was lower. It used its existing network infrastructure, overlaying coverage on existing 2G base stations and in urban areas, co-locating with UMTS2100.

Results

The use of UMTS900 technology enabled Optus to deliver a better quality network at a lower cost, with each base station covering a greater geographical area than UMTS2100 due to reduced path-loss. Using UMTS2100 to achieve the same coverage outcomes would have cost at least AUD 800 million. With UMTS900, capital expenditure was reduced to less than AUD 500 million.

In addition, the deployment delivered unexpected benefits to the 2G service. When re-farming the 900MHz spectrum, Optus' focus on site optimisation led to increased 2G performance in some cases.

The only barrier to further success noted by Optus was handset availability: at December 2008, just 7 of 34 of Optus handsets were compatible with UMTS900 but the operator has plans to increase this number.

5.3.3 LTE

LTE is the latest standard in the mobile network technology evolution that follows from the GSM/EDGE and UMTS/HSPA network technologies. It is a project of the 3rd Generation Partnership Project (3GPP).[31] The current LTE specification Release 9 provides downlink peak rates of at least 100 Mbit/s, an uplink of at least 50 Mbit/s. LTE supports scalable carrier bandwidths, from 1.4 MHz to 20 MHz and supports both frequency division duplexing (FDD) and time division duplexing (TDD). The next step for LTE evolution is LTE Advanced and is currently being standardized in 3GPP Release 10.

In October 2010, ITU accepted and officially designated LTE-Advanced as an IMT-Advanced (4G) technology, while the 3GPP published Release 10 of the LTE standard in March 2011 and has frozen the set of features for LTE Advanced.[32] One of the major reasons for aligning LTE with the call for IMT-Advanced is that IMT conforming systems were candidates for the spectrum bands identified at WRC07. Such moves made LTE a truly global standard compared with the fragmentation of earlier wireless standards. Commercialisation of LTE-Advanced systems are expected in the 2014-15 timeframe.

In January 2012, ITU confirmed the status of LTE-Advanced and Wireless MAN-Advanced technologies were both granted IMT-Advanced Technology status by ITU (Box 3).

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[31] The 3rd Generation Partnership Project (3GPP) is collaboration between groups of telecommunications associations, to make a globally applicable third generation 3G mobile phone system specifications within the scope of the IMT-2000 project of the ITU. 3GPP specifications are based on evolved GSM specifications. 3GPP standardization encompasses Radio, Core Network and Service architecture. See www.3gpp.org and for LTE specifically see www.3gpp.org/article/lte

[32] 3GPP is setting the Release 11 requirements in 2011 with its completion scheduled for late 2012.

Box 3: ITU announcement on 4G technology

In January 2012, LTE-Advanced and Wireless MAN-Advanced technologies were both granted IMT-Advanced Technology status by ITU. After undergoing evaluation by ITU and meeting the specification requirements, the technologies are now officially accorded 4G status.[33]

ITU is responsible for setting mobile technology standards worldwide. The approval signifies the next stage in the evolution of LTE, which is set to deliver vast improvements in speed and efficiency.

The new technology will be significantly faster than 3G, with speeds above 100 Mbit/s. It will also make more efficient use of radio-frequency spectrum, meaning higher data transfers will be possible with a lower bandwidth requirement. The new technology will facilitate the growing demand for data transfer over mobile networks.

According to the GSA, as of January 2012 there are 226 LTE network commitments in 76 countries and 59 pre-commitment trials. There were approximately 3.6 million subscriptions at this time. By 2015, an expected 744.2 million will subscribe to LTE. [34]

5.3.4   WiMAX

WiMAX is the popular name of IEEE802.16 standard. It serves as both a fixed and wireless access technology. Coverage of 50 km and capacity of around 70 Mbit/s is a reality with this technology. It is, however, important to note that the capacity offered over long distances is only a fraction of the maximum capacity, and WiMAX as access technology is offered in distances of 5 to 10 km. WiMAX is thought of by some as a good complementary / competitive infrastructure to traditional broadband. Another important aspect is that 70 Mbit/s will only be achieved if frequency bandwidth of 20 MHz is allocated and assigned by the local authorities. Many regulators will probably assign smaller frequency bands to the potential WiMAX operators. A competing technology to the mobile version of WiMAX (IEEE.802.16e) is LTE.

By mid-2011, global subscribers (including fixed WiMAX) were said to number approximately 20 million. The number of mobile mobile WiMAX subscribers is expected to rise to 59 million by 2015.[35]

5.3.5   Why LTE is the recommended technology following 3G/W-CDMA

LTE is acknowledged as the next step for a superior mobile broadband experience, targeting capacity and data rate enhancements to support new services and features requiring higher levels of capability and performance. LTE will enhance more demanding applications such as interactive TV, mobile video blogging, advanced games and professional services with significantly higher uplink and downlink data rates, supported by the necessary network architecture and technology enhancements.

Most importantly as shown in Figure 8, LTE is more spectral efficient than other air interface technologies. As such, LTE reduces the cost per GB delivered which is essential for addressing the mass market, and supports a full IP based network and harmonisation with other radio access technologies.

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[33] ITU, '*IMT-Advanced standards announced for next-generation mobile technology*', media release, 18 January 2012

[34] www.gsacom.com/news/gsa_fastfacts.php4   and   www.electronics-eetimes.com/en/lte-subscribers-to-account-for-10-percent-share-by-2015.html?cmp_id=7&news_id=222910064

[35] www.fiercewireless.com/story/wimax-forum-trumpets-20m-global-subscribers/2011-08-17 and www.eweek.com/c/a/Enterprise-Networking/Mobile-WiMax-Subscribers-to-Reach-59-Million-by-2015-Report-442841/

In a survey of major operators, the great majority (some 88 per cent) indicated that they were already considering LTE upgrades for their next generation networks, with likely deployments in 2011 and beyond. This is consistent with the fact that LTE has had rapid global acceptance with 49 commercial LTE networks having been launched in 29 countries, some 226 operators in 76 countries are investing in LTE and there are 59 pre-commitment trials in 17 more countries. It is also expected that at least 119 LTE networks will be in commercial service in 53 countries by the end of 2012.[36]

A possible complication in relation to voice over LTE seems to have been resolved with the first VoLTE call on a commercial network (Verizon) in the world in February 2011. It is expected that VoLTE should be widely available in 2012.

Figure 8: Summary of downlink spectral efficiencies for various air interfaces and antenna schemes
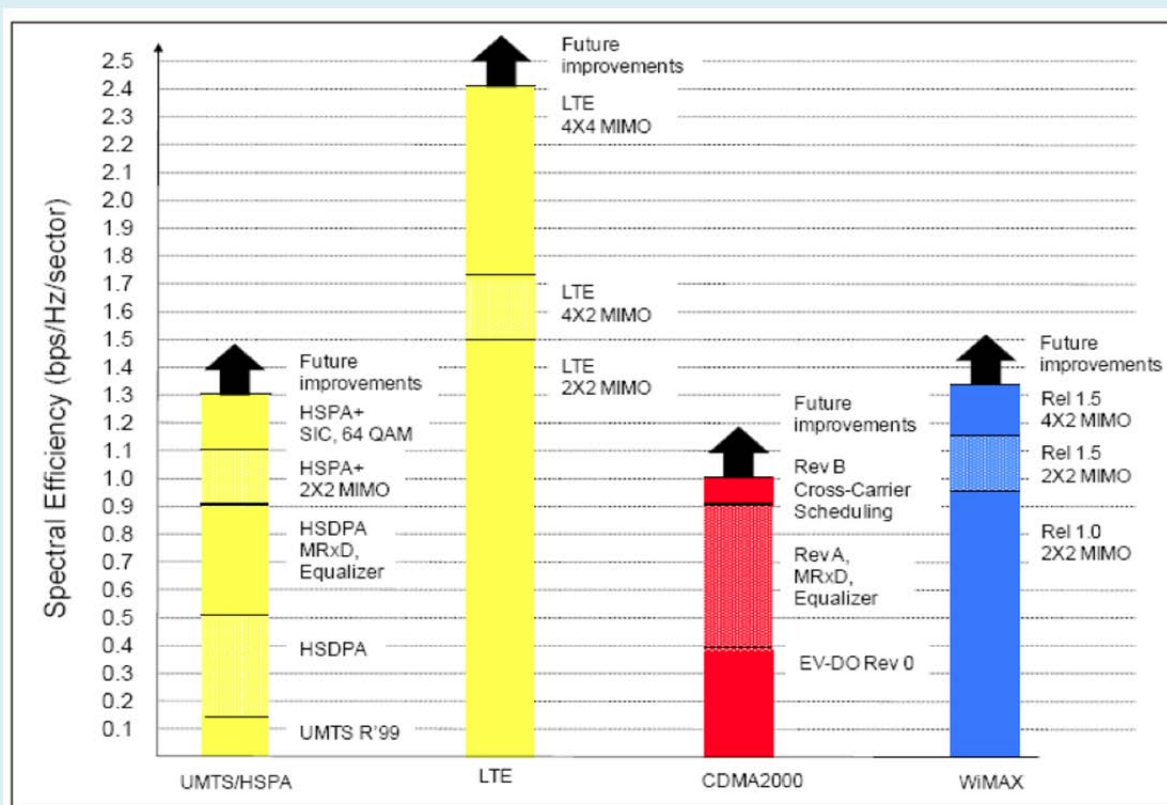
Source: 3G Americas, MIMO and Smart Antennas for 3G and 4G Wireless systems, Practical Aspects and Deployment Considerations, May 2010, page 58

More broadly, there are a number of steps to provide optimal voice services on LTE networks and devices. Firstly, the current approach is to use dual radiophones that utilise the 2G networks in the mobile phone for all voice calls. Secondly, voice calls will be provided over LTE with circuit switch fall back (CSFB) to the 2G networks where necessary (e.g. no coverage). Lastly the ultimate approach will be to adopt Single Radio Voice Call Continuity (SR VCC) for VoLTE, which uses an IP Multimedia Subsystem (IMS) for call anchoring and handover and is based on a third party call control mechanism. This allows a mobile phone with an on-going voice call to transition to the circuit-switch domain in the event of loss of LTE coverage. An IMS-based SRVCC provides QoS control, flexible charging, and better user experience. The options for addressing on LTE networks are detailed in Figure 9.

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[36] GSA, *GSM/3G Market/Technology Update*, 5 January 2012.

Figure 9: Options for addressing voice on LTE
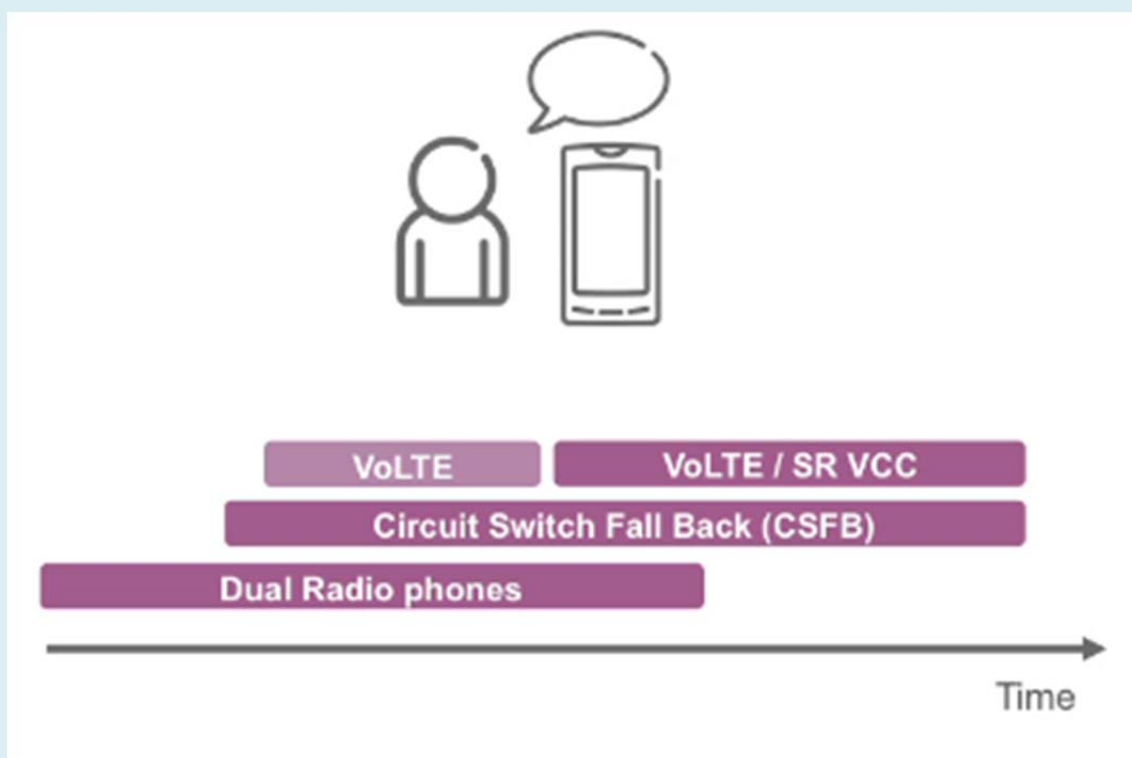
Source: Informa Telecoms & Media and Ericsson, LTE Early Launch Strategies: Who and Why? Webinar, 21 June 2011

5.3.6   Wireless offloading

As wireless data and broadband services grow in Nepal the NTA should safeguard the quality of wireless services by encouraging operators that adopt network offloading techniques. These include Wi-Fi offloading, Femtocell deployment, smart repeaters and distributed antenna systems. Network offloading should be facilitated by PTD policy as it alleviates capacity constraints, and is a sensible allocation of spectrum resources. Specifically, the ability to utilise open access spectrum (such as 2.4 and 5 GHz) to support those small number of cell sites/locations which face congestion has considerable merit. An analysis of the potential use of off-loading techniques should form part of the needs and valuation models for additional spectrum.

5.3.7   The role for satellite

Satellites are valuable part of the broadband infrastructure strategy. They are able to provide ubiquitous connectivity and are very well suited for areas which are either underserved or unserved by terrestrial networks. They are able to augment and combine with terrestrial network and once launched can accelerate the availability of high-speed Internet services in such areas. As an added bonus, satellite communication does not have any last mile issues and can provide a high degree of reliability in the event of disasters etc.

There has also been recent technological innovation in relation to satellite technology, similar in a way to wireless broadband communications. The new generation of satellite broadband systems known as HTS (High Throughput Satellite) have a number of new features:

- spot beam technology, where switchable beams illuminate much smaller areas (100s of km^2 instead of 1000 km^2);

- beam coverage forms a honeycomb / cellular pattern with frequency reuse;

- this concept of frequency reuse drastically increases overall capacity;

- use of Ka band leads to smaller antenna dishes; and

- satellite broadband services with frequency reuse, faster speeds and smaller dish antennas in Ka band drive down the costs to a much lower level.

HTS demand is likely to exceed 530 Gbit/s by 2019. Core HTS applications include satellite broadband access, broadband VSAT backhaul and mobility as shown in Figure 10.

Figure 10: Global HTS bandwidth demand by application
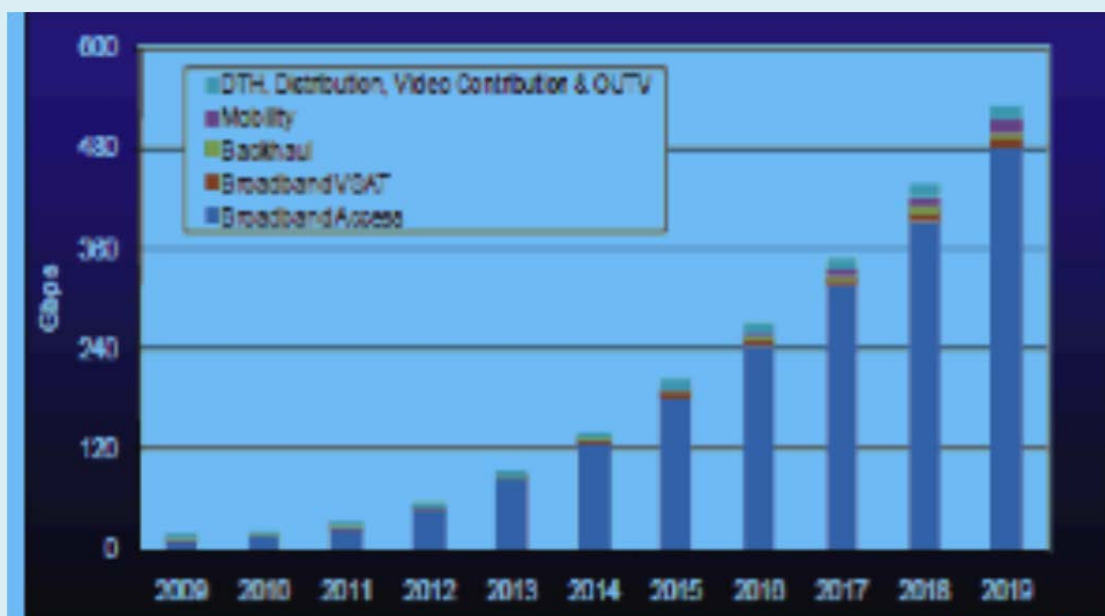
Source: *www.nsr.com/*

5.4   Spectrum management aspects

5.4.1   Background

ITU has been a driving force for over two decades for the development of global broadband mobile telecommunication system. International Mobile Telecommunications (IMT), supported by fixed telecommunications networks (e.g. PSTN/Internet) provides access by means of one or more radio links to a wide range of telecommunications services.

IMT is the generic ITU name for 3G/4G technologies. Radio spectrum below 1 GHz is optimum for the needs of developing countries, due to the ability to serve larger rural areas from a single cell site compared to spectrum above 2 GHz. The 2007 World Radio Conference made valuable strides in identifying additional spectrum for IMT, both below 1 GHz and above 2 GHz. The concept of identifying spectrum for potential use by IMT, in the ITU Radio Regulations, gives global equipment manufacturers some guidance on the range of frequency bands in which IMT services are likely to be deployed, leading to economies of scale and minimizing product costs. The identification "for those administrations wishing to deploy IMT" allows use by other services to which the spectrum is allocated and does not convey any priority for IMT over those other radio-based services. Appendix F details those IMT allocated bands.

"IMT-Advanced" provides a global platform on which to build the next generations of mobile services – fast data access, unified messaging and broadband multimedia – in the form of exciting new interactive services and applications. New studies/techniques are leading to increased spectrum utilization and spectrum efficiency and allowing spectrum resources to be shared between users. Those objectives are detailed in Box 4.

Box 4: Objectives for the efficient management of spectrum

Efficient management of the radio spectrum is a key component for the promotion of broadband access. In planning the implementation of IMT, the following objectives are desirable:

- to ensure that frequency arrangements for the implementation of IMT have longevity, yet allow for the evolution of technology;

- to facilitate the deployment of IMT, subject to market considerations and to facilitate the development and growth of IMT;

- to minimize the impact on other systems and services within, and adjacent to, the bands identified for IMT;

- to facilitate worldwide roaming of IMT terminals;

- to integrate efficiently the terrestrial and satellite components of IMT;

- to optimize the efficiency of spectrum utilization within the bands identified for IMT;

- to enable the possibility of competition;

- to facilitate the deployment and use of IMT, including fixed and other special applications in developing countries and in sparsely populated areas;

- to accommodate various types of traffic and traffic mixes;

- to facilitate the continuing worldwide development of equipment standards;

- to facilitate access to services globally within the framework of IMT;

- to minimize terminal costs, size and power consumption, where appropriate and consistent with other requirements;

- to facilitate the evolution of pre-IMT-2000 systems to any of the IMT terrestrial radio interfaces and to facilitate the on-going evolution of the IMT systems themselves;

- to afford flexibility to administrations, as the identification of several bands for IMT allows administrations to choose the best band or parts of bands for their circumstances;

- to facilitate determination, at a national level, of how much spectrum to make available for IMT from within the identified bands;

- to facilitate determination of the timing of availability and use of the bands identified for IMT, in order to meet particular user demand and other national considerations;

- to facilitate development of transition plans tailored to the evolution of existing systems;

- to have the ability for the identified bands, based on national utilization plans, to be used by all services having allocations in those bands;

- to enforce licensing conditions and adherence to licensed technical parameters; and

- to effect cross border coordination to eliminate / mitigate cross border interference situations.

5.4.2   Spectrum needs and frequency arrangements based on technology selection

ITU-R Recommendation M.1768 contains the methodology for calculation of spectrum requirements for the future development of the terrestrial component of IMT-2000 and systems beyond IMT-2000. This generic methodology can be used for differing market for a range of cellular system architectures.

Specifically, the technical process of estimating spectrum requirements for mobile communications has to be based on four essential issues namely:

- definition of services;

- market expectations;

- technical and operational framework; and

- spectrum calculation algorithm.

In the case of Nepal, given its:

- growing cellular mobile and broadband (including wireless broadband) penetration;

- the lack of detailed and up to date industry statistics; and

- most importantly the fact that government decisions on whether additional competition will be facilitated in the market remain to be seen;

it is difficult to independently forecast the likely demand for wireless and WBB services with any certainty. In such circumstances the key rollout target which needs to be catered for from a spectrum perspective is detailed in the draft Nepal Universal Access to Broadband Policy. In addition, given rapid market growth and projects like the NTC's 10 million line project there would also seem to remain considerable unmet demand for voice services which will also need to be addressed.

Consistent with this masterplan to support this number of mobile subscribers and traffic, the aggregate total of spectrum allocated to wireless services should rise from its current low level of 219.3 MHz (following the recent allocation of 30 MHz in the 2.3 GHz band to NTC) to approximately 442.5 MHz in 2015. Such an increase in spectrum allocations to wireless services can be easily accommodated in Nepal. Existing allocations of 900 MHz spectrum which are wasteful and inefficient in allocating certain 900 MHz frequencies exclusively for rural services and then allowing these key spectrum bands to lie 'fallow' and not allowing such spectrum to be used in urban areas should also be immediately reviewed.

Furthermore, if mobile services growth in Nepal is faster than predicted it is still possible to bring forward the allocation of additional 2100 MHz or 2300 MHz to 2015 (currently scheduled for 2018). This flexibility provides a 'spectrum insurance' for Nepal.

Importantly, the majority of the allocations can occur at lower spectrum bands below 2 GHz (and particularly below 1 GHz). This will mean a faster deployment with greater coverage in mountainous, regional and semi-rural Nepal.[37] It should also mean more affordable services. The additional spectrum to be allocated and assigned from now until 2015 is detailed in Figure 11.

For the longer term up to 2020, this masterplan prefers an approach of using the overall spectrum requirements in a manner consistent with ITU-R Report M.2078 (2006).[38] In the case of Nepal, on balance, the aggregate target for spectrum to be allocated to wireless services ought be the smaller market target of 760 MHz of spectrum (Figure 11).

Ideally this would comprise the 700, 900, 1800 and 2100 MHz allocations. It is likely that only in the 2018+ period that the 2.3 and 2.6 GHz band will be required. Given deployments of 2.3 GHz TD-LTE networks in Nepal's neighbours of China and India, there could be earlier demand for this spectrum band for TD-LTE.

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[37] For example, recent trials by Singtel Optus in Australia of the 700MHz spectrum found that it deliver LTE coverage over a distance twice that achievable using 1800MHz.
The Singtel Optus 700MHz trial saw peak upload speeds of 32 Mbit/s, and demonstrated LTE coverage at some 13 kilometres from a single tower, compared to around 3-6 kilometres over currently available 1800MHz spectrum. See Communications Day, 19 March 2012.

[38] See ITU-R Report M.2078 *Estimated spectrum bandwidth requirements for the future development of IMT-2000 and IMT-Advanced*, 2007

Figure 11: Recommended aggregate spectrum allocations to wireless services up to 2020
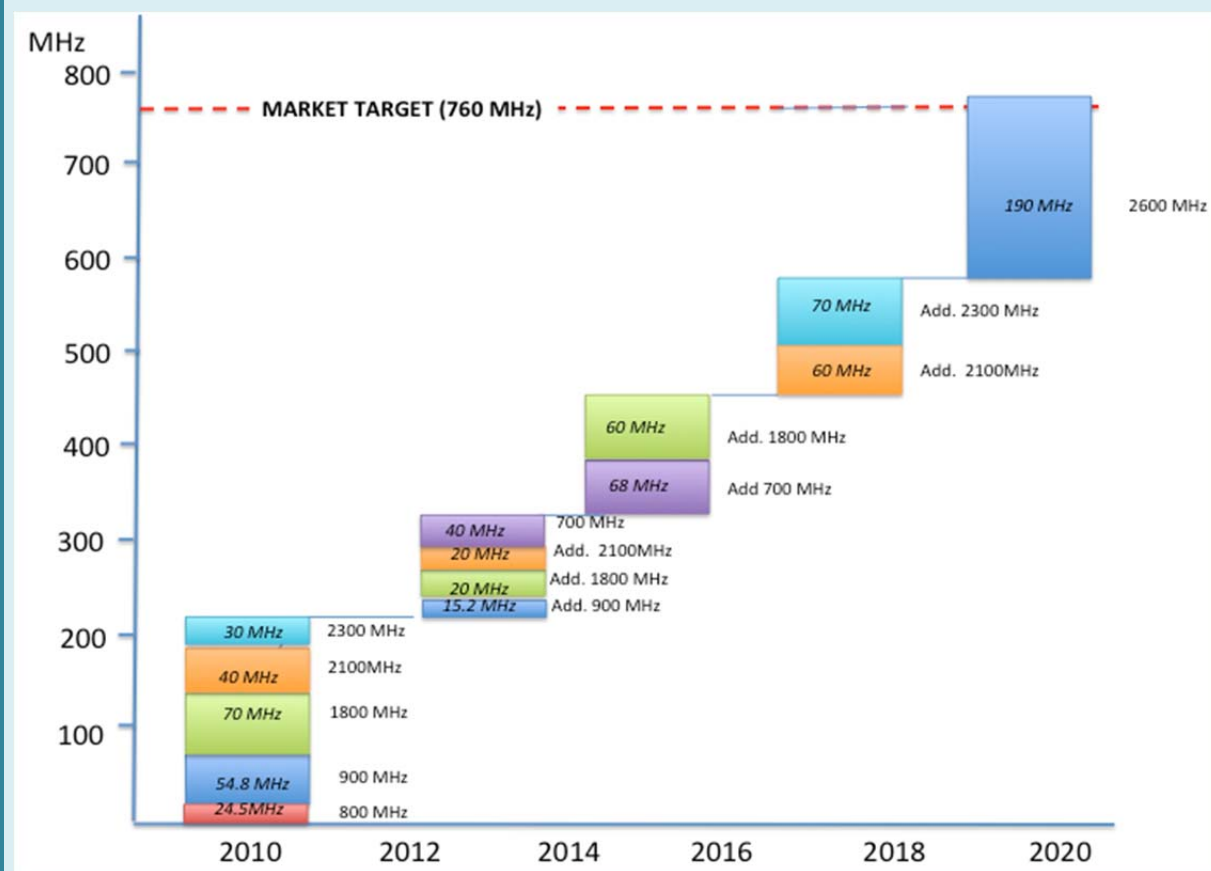
Source: ITU

In terms of the best practice approach, ideally the Nepal Government and the NTA should adhere to the ITU Global Symposium for Regulators 2005 Best Practice Guidelines for Spectrum Management to Promote Broadband Access when allocating spectrum for wireless broadband. Table 7 details a condensed form of the GSR guidelines.[39]

Table 7: ITU GSR best practice guidelines for spectrum management

No	Guideline objectives	Key Provisions
1.	**Facilitate the deployment of innovative broadband services and technologies**	• Reduce unnecessary restrictions on spectrum use • Adopt harmonised frequency plans defined by ITU-R recommendations[40] • Reduce or remove regulatory barriers to market entry • Ensure operators have access to as wide a choice as possible for spectrum

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[39] www.itu.int/ITU-D/treg/bestpractices.html

[40] Refer to the list of ITU-R Recommendations on IMT at www.itu.int/ITU-R/index.asp?category=information&rlink=imt-advanced-rec&lang=en. Harmonised frequency plans are contained in ITU-R Recommendation M.1036-4 (March 2012).

No	Guideline objectives	Key Provisions
2.	**Promote transparent and non-discriminatory spectrum management policies**	• Consult widely and publicly • Implement stable decision making processes • Publish forecasts of spectrum usage and allocation needs • Publish frequency allocation plans and overview of assigned spectrum • Clearly define and implement stable and predictable spectrum authorisation rules and decision-making processes and procedures
3	**Embrace technology neutrality**	• Facilitate spectrum use for fixed and mobile services • Provide guidelines to mitigate inter-operator interference • Adapt to technological convergence and avoid picking winners
4	**Adopt flexible use measures for wireless broadband services**	• Avoid onerous rollout and coverage obligations • Licence conditions that allow operators to provide a full range of converged services • Provide incentives for smaller new operators to deploy infrastructure at low cost • Adopt lighter regulation for rural and isolated areas • Allow secondary spectrum trading • Promote spectrum sharing
5	**Ensure affordability**	• Set reasonable spectrum fees • Design tender or auction processes to ensure affordability of services
6.	**Optimise spectrum availability**	• Facilitate the effective and timely access to spectrum • Spectrum pricing should not be pushed up due to restrictive supply • Accommodate new and emerging technologies
7.	**Manage spectrum efficiently**	• Ensure reliance on market forces, economic incentives and technical innovation • Allocate spectrum in an economically efficient manner • Promote and encourage usage of spectrum efficient technologies
8.	**Ensure a level playing field**	• Prevent spectrum hoarding: regulators should set a maximum limit to the amount of spectrum one operator may obtain
9.	**Harmonise regional and international standards and practices**	• Reflect global technical and security standards in national arrangements • Ensure inter-operability for global roaming • Implement policies and allocations that are consistent with regional and global best practice and standards
10.	**Adopt a broad approach to promote access**	• Introduce supporting regulatory measures such as competitive safeguards, open access and universal service incentives • Lower or remove import duties on broadband wireless access equipment • Coordinate spectrum management policy and practice with other regulatory instruments (i.e. competition and trade policy, universal service measures etc.)

Source: ITU, GSR 2005 Best Practice Guidelines for Spectrum Management to Promote Broadband Access, www.itu.int/bestpractices

5.5   Additional connectivity considerations

As it stands, the Nepal backhaul infrastructure is unlikely to be sufficient to meet medium to long-term adoption broadband targets. Given the nation's landlocked status, policymakers need to address considerations relating to both local and international connectivity. These factors underscore the importance of establishing an effective interconnection/open access regime as well as stimulating the wholesale market in order to reduce market inefficiency and improve competition.

International connection costs pose a major problem for Nepal and adversely affect the quality of service for end users. At present, four operators operate the international connectivity gateways, however, the NTA should consider whether this is in fact sufficient or more competition is needed. In addition, the government should initiate a consultation process with operators in order to determine whether a more open access regime to international gateways is a desirable option.

The landlocked status means that end users are essentially dependent on foreign wholesalers providing domestic operators international access. A possible means of addressing this problem is through greater reliance on mobile satellite service (MSS) systems.

As discussed in section 3.2, two complete east-west networks, owned by Nepal Telecom and Ncell exist alongside a third, owned and operated by the Nepal Electricity Authority (NEA). The NEA has commenced hauling optical fibre cable through its powerlines. Smaller operators operate their own smaller networks.[41] In future years, the NEA may assume an increasingly important role within Nepal's telecommunications sector due to its status in the wholesale market and possession of fibre optical infrastructure.

Consistent with recent ITU broadband policy recommendations[42], there are considerable economic benefits and a high degree of sector support for greater backbone deployment (especially using optical fibre) to support future wireless broadband. Consideration should be given to the possibility of using Rural Telecommunications Development Fund (RTDF) for financial support,[43] and the possibility of linking to South Asia Subregional Economic Cooperation (SASEC) Information Highway (IH) Project. Appendix A details the SASEC IH Project. As detailed in the ITU report *Universal Access to Broadband in Nepal,* a backbone optical fibre network is critical and necessary part of the country's wireless broadband masterplan and indeed its broader National Broadband Policy and implementation. The NTA has estimated that the expending the optical fibre network to all of the district headquarters would cost around NPR 3 billion.

Given affordability issues, an infrastructure sharing avoids the duplication of expensive backhaul networks is preferred. Such sharing can be achieved as other country markets have done by instituting a quality regulatory framework including via a transparent and effective interconnection regime.

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[41]   According to the NTA, the RTDF funded District Optical Fibre Network (DOFN) Program, is currently progressing and is intended to enhance backhaul capacity. In addition, the ADF is funding a project designed to improve last-mile access for e-Government services. See Bijay Kumar Roy, Regulatory Issues: Role of Broadband in promoting UA in Nepal, Presentation, 2 February 2012

[42]   www.itu.int/ITU-D/treg/broadband/broadband_activities.html, and Trends in telecommunication reform 2012 (www.itu.int/ITU-D/treg/publications/trends12.html

[43]   As at March 2012, the RTDF has funds of more than NPR 5.2 billion

6. Facilitating applications and content

6.1 Stimulating the content sector in emerging economies

It is arguable that there is a circular relationship between applications/content and broadband uptake. The higher the penetration of broadband services, the more data /content rich applications consumers demand; whilst the more attractive and relevant applications / content are, the more consumers will demand broadband in order to participate in those markets.

There are a number of means through which the government can intervene in order to create an enabling environment for content production industries and ultimately drive demand for their services.

6.1.1 Educate content entrepreneurs

Governments can work to stimulate the domestic content sector by educating their national ICT workforce with the set of skills and outlook that are necessary for the requisite innovation and technical expertise required for the market to expand.

New courses at existing technical/educational institutions may be developed so as to encompass issues associated with applications/content. It may be necessary for the government to train teachers/trainers with a range of input skills for content production (e.g. graphic design, animation, information technology). An example from Australia is shown in Box 5. Overseas expertise may need to be harnessed for the training of a skilled and dynamic workforce in areas such as management, finance and creative process development.

Box 5: Digital media courses at the Australian Film Television and Radio School[44]

The Australian Film Television and Radio School (AFTRS) offers a number of specialist postgraduate courses within the digital media field of study.

A 'Graduate Certificate in 3D Animation' provides "A comprehensive, specialist course designed to develop the professional skills of digital artists through production-focused learning…. [and] course provides a thorough grounding in the art of 3D animation using AutoDesk Maya software.

The course offers a number of modules aimed at giving students a grounding in both the technical and business side of the 3D animation sector:
- *3D Graphics Fundamentals;*
- *Character Animation Foundations;*
- *Collaborative;*
- *Creative Research;*
- *Industry Brief;*
- *Introduction to Running Your Own Creative Business; and*
- *Key Figures in Animatio*n

…"

The government should also be open to obtaining overseas assistance in developing appropriate competency/skill measures and standards/ certification.

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[44] See www.aftrs.edu.au

6.1.2 Subsidise content production

In order to improve the supply of content, financial tools such as direct outlays and tax measures may be employed by the government. Each tool possesses unique policy design issues that must be properly addressed prior to implementation.

6.1.3 Regulatory options

Regulatory measures provide the means to stimulate content production with relatively low direct costs to governments. For example, local content rules may provide a domestic content quota – in Australia, this was a key driver behind the early development of content production.

As discussed in 6.1.2, policy design issues, such as the location on the value chain where the intervention occurs and preferences for the type of content development will need to be considered.

6.1.4 Direct government action and leadership

Governments can take the lead to develop and deploy online/wireless services. If there exists good access to bandwidth and devices, online and wireless delivery can be a highly cost effective to provide information about government services and some of the services themselves in a much more equitable manner. Initiatives should not be limited to national governments: regional and local government can provide important and useful information to local residents and businesses.

In the ITU Universal Access to Broadband in Nepal Paper of 2011, it was acknowledged that there was 'little regulatory intervention required at the application layer' but there were 'significant roles for the government in:

- promoting digital literacy and skills;

- adopting e-Governance as a means of improving government services, stimulating domestic e-business and developing useful sources of local content online; and

- incorporating e-learning in education programmes and using it to open up new opportunities for professional development of teachers, medical staff, and others interested in obtaining access to current information and expertise online.'

Rewards/recognition was also suggested for areas related to rural communications development, content/applications development and 'broadband readiness' disclosures for residential and commercial developments.

6.2 The prevailing environment in Nepal

Digital media content has its origins pre-June 1994 when the Nepal Academy for Science and Technology (NSAT) and the Nepal Forum for Environmental Journalists (NFEJ) began trialling email services. Table 8 provides a timeline of the growth of such services in Nepal up until present-day.

Table 8: Timeline of the provision of online media content in Nepal

Year	Company / Organisation	Detail
July 1995	Merchantile	• Provides full online access via Nepal Telecom (using Singapore backhaul network)
1997	Himal Media	• Publishers of Himal South Asia began to archive content via its website (www.himalsouthasia.com)
1998	Mercantile	• Establishes South-Asia when its archives seven daily and weekly newspapers
1999	Mercantile	• Shifts South-Asia to www.nepalnews.com

Year	Company / Organisation	Detail
July 1999	Dharma Adhikary	• Establishes www.newslookmag.com, a portal to the largest suite of Nepali news and current affairs.
February 2000	Kantipur Publications	• Establishes KantipurOnline
September 2001	Nepali Post	• Establishes www.nepalipost.com
December 2002	Kamana Group	• Establishes www.newsofnepal.com
October 2004	United We	• Nepal's first ever local blog, 'united we blog' (www.blog.com.np) was established. • A number of other blogs followed: • www.peacejournalism.com, www.nepalinewsusa.com, www.citizenjournalism.com, www.canevision.net, www.dcnepal.com, etc…
2005	Dharma Adhikary	• newslookmag.com established as 'nepalmonitor.com'

6.2.1   Tourism

The tourism industry has a strong web presence in Nepal. Almost all major hotels, guesthouses, travel agencies, trekking agencies and airlines have websites introducing their services and provide online services such as booking and planning. These tourism-oriented websites provide contain aesthetically appealing content, featuring graphics and photographs that highlight the country's culture, adventure activities and the beauty of the Himalayas.

6.2.2   Government

Government ministries, departments and municipalities now have websites with details of policies, speeches, laws, regulations, circulars, manuals, forms, and other information regarding the agency. While a majority of this content is in English, the use of Nepali content is slowly gaining prominence. International and local NGS provide content focusing on their work, sharing knowledge and helping improve public access to quality information.

6.2.3   Media

Many media outlets also provide Internet-based news and content services. Some radio stations broadcast their programmes on the Web and others have also started podcasting music to serve on-demand users. Popular magazines and webzines are likewise increasing their presence on the Web. These online news and current affairs services are useful for the international community, particularly non-resident Nepalese.

6.2.4   Radio

Although Nepal has lagged behind other countries in the use of computer-based ICT, it is one of the countries in Asia where the concept and practice of community radio have been successfully implemented. Nepal's experience in community radio is considered worldwide as an innovative and successful model, particularly for countries with difficult terrain and a dispersed and isolated population. Community radio delivers both entertainment and developmental content. Outside Kathmandu Valley, community radio stations are also now using the Internet to share digital content produced from a central hub in the capital.

6.2.5 Entertainment

Entertainment websites in Nepalese feature sports, music, movies, fashion as well as Nepali artists and models. User-generated content in social networking sites has been increasing as of late. These sites, which are community-focused, feature message boards, discussions, photo galleries and videos by Nepalese living in various parts of the world. A growing number of blog sites are portraying Nepal and the Nepalese as perceived by ordinary Nepali citizens. Sajha.com and weblognepal.com are two examples. Photo blogs are also emerging.

6.2.6 Education

In the education sector, all of Nepal's four universities provide detailed information, including programmes and courses over the Internet. Private schools are also beginning to acquire an Internet presence. Online directories and almanacs currently exist and enable the user to locate local schools, colleges, and training institutions. In addition, the results of university and board examinations are published on the Web on a regular basis. However, the provision of coursework and curriculum material is still in its infancy.

Several major colleges and universities offer several distance learning courses for students. Kathmandu University has created its own courseware server using Moodle, a learning management platform. Additionally, distance-learning courses are available in selected institutions that are affiliated with universities abroad. While a true distance education system has yet to be seen in Nepal, the potential for developing e-learning as a means to expand educational opportunities is high. Providing e-learning in rural/isolated areas would increase equitable access to quality education for all.

6.2.7 Film

In the fiscal year 2009/2010, the Nepali film industry drew investments of NPR 295 million and an estimated profit of NPR 59 million. In the same year, the Film Development Board registered 229 films, including 84 celluloid, 80 digital, and 65 short movies.

Nepali filmmakers have recently unveiled projects with large budgets, incorporating digital technology in film and sound. Recent films have been produced with investments of around NPR 8 million, whereas a big budget film in the past meant investment of only around NPR 6 million. Similarly, popular actors have experienced significant increases (up to 200 per cent) in their remunerations compared to previous years.[45] There are 264 production houses[46], 109 film distributers[47] and numerous Film Location Service Providers and Film Equipment and Editing Service Providers in Nepal.

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[45] http://nepalieconomy.blogspot.com/2010/11/bbc-discussion-on-state-of-nepali-movie.html

[46] www.film.gov.np/film_prod.php

[47] www.film.gov.np/film_distri_list.php

Box 6 outlines two providers of Nepali content, E-Pustakalaya and SongsNepal.com and examines the state of development of the Nepal market for local content.

Box 6: Two illustrations of Nepali content

E-Pustakalaya

E-Pustakalaya is an education-focused digital library containing full-text documents, books, images, videos, audio files, and interactive educational software that can be accessed intra or Internet. OLE Nepal commenced development of the service 2008 with the aim to improve children's' reading skills and develop a reading culture in schools by providing students free and open access to age-appropriate reading materials, to enable students to do research projects and promote a habit of independent inquiry. Teachers, as well as other adults, have also benefited widely from various teaching resources, and educational materials in the areas agriculture, health, environment, and local technologies, etc.

Materials in E-Pustakalaya are organized in six major sections described below:

1. *Language and Arts: Adult and children's literature in Nepali, English and other Nepali languages, along with books and materials on different artistic styles, movements artists, and children's arts and crafts materials.*

2. *Course-related materials: School textbooks, supplementary readings by grade and subject, and interactive learning software.*

3. *Reference materials: Dictionary, school wikipedia, maps, atlas and government documents.*

4. *General educational materials: Awareness-building and advocacy related materials on topics such as agriculture, health, environment, civic duties, disaster preparedness, etc.*

5. *Teaching support materials: National curriculum, teaching manuals, teacher training materials, supplementary readings.*

6. *Newspaper and magazines: Copies of various educational newspaper and magazines*

E-Pustakalaya provides free access to over 3 000 full text documents, books, educational videos, audio books, learning software and reference materials. Users of E-Pustakalaya can browse through these six major sections looking for specified items or utilising sophisticated search features. Users can read books and documents, view videos, listen to audio clips, play educational games directly from E-Pustakalaya, or in the case of books and documents, download and store for later viewing.

A panel consisting of prominent Nepali writers provide advice on the development of E-Pustakalaya. The Nepal Library Foundation, a Canada-based organization, has been supporting OLE Nepal with E-Pustakalaya development since 2009. E-Pustakalaya is accessible on the Internet at www.pustakalaya.org. It can also be installed in low power servers and deployed in schools and community libraries that either do not have Internet connectivity or have low bandwidth connection. Such local instances of E-Pustakalaya will enable better user experience through fast access and quick downloads.

SongsNepal.com

SongsNepal.com aims to provide Nepal enthusiasts' music videos through one source for easy access. It was created by Do Surf In Pvt. Ltd.in 2010. It has 1 071 visitors and 2 463 page views per day and is ranked #321 946 in the world. The site is worth USD 10 475 and advertising revenue is USD 9 per day. It provides free Nepali songs, MP3 and Nepali music videos with lyrics and chords. It is a free resource to watch, listen and download Nepali pop, rock, metal, modern, folk, country, instrumental and movie songs, music videos and MP3.

On 6 July 2011, SongsNepal announced its conversion into a user generated website. It introduced a campaign in which users are allowed to submit the URL of new and existing Nepali music videos. Participants will be accredited for their participation with a biography in the website linking to their Facebook, Twitter and site addresses. In addition, the highest-volume video submitter will be rewarded with NTC, NCELL or UTL mobile 'Recharge Cards.' The next four highest-volume participants will receive NPR 200 Recharge Cards, followed byNPR 100 Recharge Card for other high-volume participants. The videos must be in either Nepali or from a Nepali artist.

This initiative also encourages songs in regional languages such as Newari, Bhojpuri etc. The website operates to improve and personalize the content provided by users fulfilling their requests for products, programmes, and services.

7. Conclusions and recommendations

7.1 Overview

Globally, the early stages of the mobile broadband revolution occurred in 2006/07 as key enablers, primarily around technology, began to converge. These enablers will continue to drive mobile broadband rapid adoption and market share gains from fixed technologies, such as DSL. As indicated by the US Federal Communications Commission (FCC) broadband wireless services are having profound economic and social consequences even in developed country markets:

> *"Wireless mobility has become central to the economic, civic, and social lives of … [our citizens]. We are now in the midst of a transition from reliance on mobile voice services to increasing use of and reliance on mobile broadband services, which promise to connect [our] citizens in new and deeper ways … [the] mobile wireless market will be essential to realizing the full benefits to … consumers and channeling investment toward vitally important national infrastructure. A vibrant mobile wireless market is also essential to driving innovation, not only within the mobile market itself, but also in markets – current and future – for which wireless mobility is a key enabler."[48]*

For Nepal, the stakes are even greater. Wireless broadband – both terrestrial and in more remote mountainous parts of the country satellite services – provided along with high speed international capacity – offers the promise of economic, social and environmental benefits for Nepal and its people.

Although technology neutrality is, and ought to be a widely accepted principle for the efficient allocation of spectrum, the deployment of W-CDMA and LTE wireless technology with the capability of reaching the highest number of people should be seen as a priority for Nepal and is endorsed under this masterplan. Satellite services – perhaps with a local cellular or Wi-Fi hotspot can also provide a critical role in addressing Nepal's digital divide in more remote areas of the country.

Facilitating WBB services in Nepal is best promoted by introducing one national additional cellular mobile operator and by the early allocation of sub-1 GHz spectrum especially additional 900 MHz and the allocation of 700 MHz band spectrum (in accordance with the APT 2 x 45 MHz band plan). However, in order to balance spectrum availability with the legitimate public goal of maximising the price of the country's spectrum resources, it is recommended that a staged approach to the release of new spectrum be adopted in Nepal.

Over the medium term however, there should be a substantial increase in the spectrum allocated to wireless broadband services in the country. Existing allocation of 900 MHz spectrum which are wasteful and inefficient in allocating 900 MHz for rural services and then allowing it to lie 'fallow' and not allowing such spectrum to be used in urban areas should also be immediately reviewed.

7.2 Roadmap for the government/regulator: Action items and timeline for action

The key milestones and actions for the Government of Nepal and the NTA are detailed in Table 9 and Figure 12. Such milestones and actions are consistent with the government's upcoming Universal Access Broadband Policy and the current work programmes of the NTA. It is important that active monitoring be undertaken by the NTA to address the action items and to achieve broadband targets as provided for this masterplan and the government's broader Universal Access Broadband Policy.

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[48] FCC, Notice of Inquiry, *Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless including Commercial Mobile Services*, Docket FCC 09-67, released 27 August 2009, page 2

Table 9: Key recommended action items

Date	Action
Q2 2012	• Undertake spectrum pricing benchmark study • Seek to migrate existing licences into unified licence structure • Motivate amendments to the *Radio Act 1957* for new national telecommunication licence (will assist future spectrum allocations)
Q3 2012	• Announce auction for new national cellular mobile telecommunication licence • Commence pre-qualification phase • Commence refarming of 900 MHz band and maximising efficiency of use of the band
Q4 2012	• Release bidding document for new cellular mobile telecommunication licence • Auction of new telecoms licence with 900 / 1800 MHz allocations • Announce auction of 700 MHz band (assuming legislative changes)
Q2 2013	• Auction of first tranche of 700 MHz spectrum
Q3 2013	• New third national operator commences retail services
2014	• Consider auctioning additional tranches of 700 MHz band
2015	• Broadband access goals met • Conduct review of necessary adoption targets for 2020 • Consider auctioning additional spectrum
2018	• Consider allocating the 2300 MHz and 2.6 GHz bands (if not allocated earlier)
2020	• Adoption targets for 2020 met

Figure 12: Recommended timeline for action
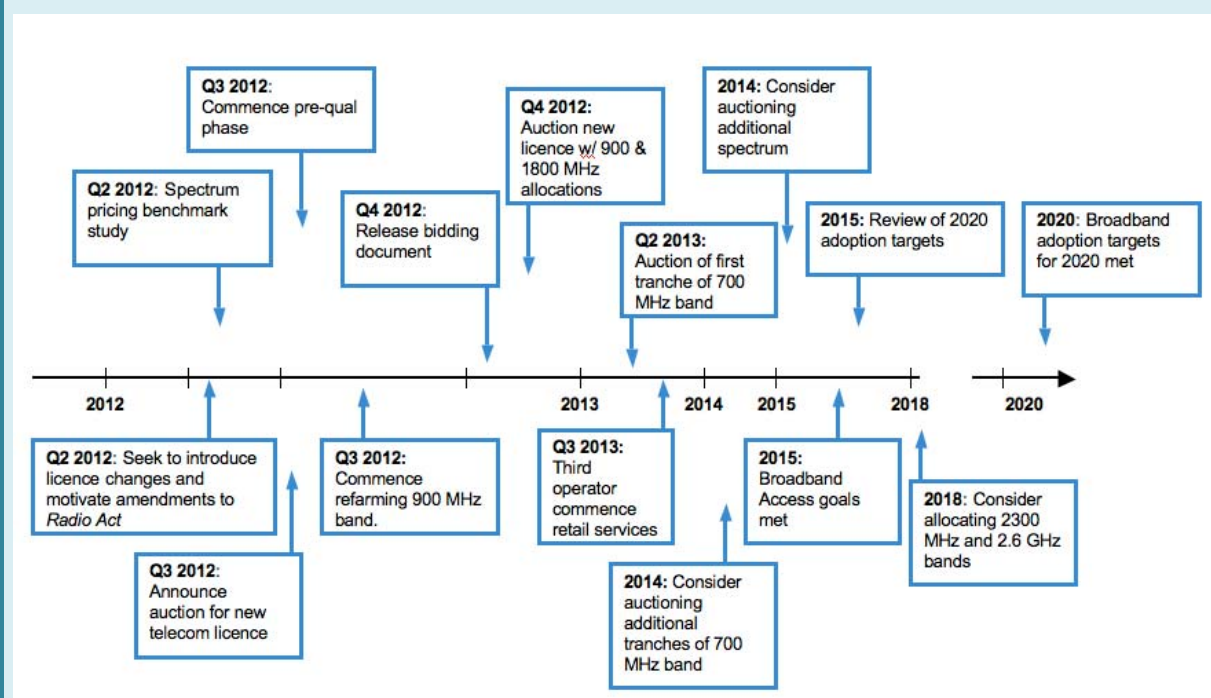
Source: ITU

Appendix A: SASEC information highway project

Nepal is a participant of the South Asia Subregional Economic Cooperation (SASEC) Information Highway (IH) Project. The USD 11.2 million venture, a joint partnership between the Asia Development Bank (ADB) and the Government of Nepal, was approved in 2007 with the ADB contributing USD 9 million and Nepal USD 2.2 million. The two-phase project (phase one, December 2002 and phase two, December 2015) is a sub-component of the broader IH framework for the SASEC Member States, the objectives of which are:

- to improve ICT connectivity between SASEC Member States;

- to provide modern, affordable and reliable broadband information, communication and knowledge-based services within and across the borders to universities and businesses; and

- to expand ICT accessibility in remote and rural areas.

Figure A.1 provides a macro perspective on the broader IH framework and places the Nepal project within the broader context of the other SASEC initiatives.

Figure A.1: The broader SASEC IH framework
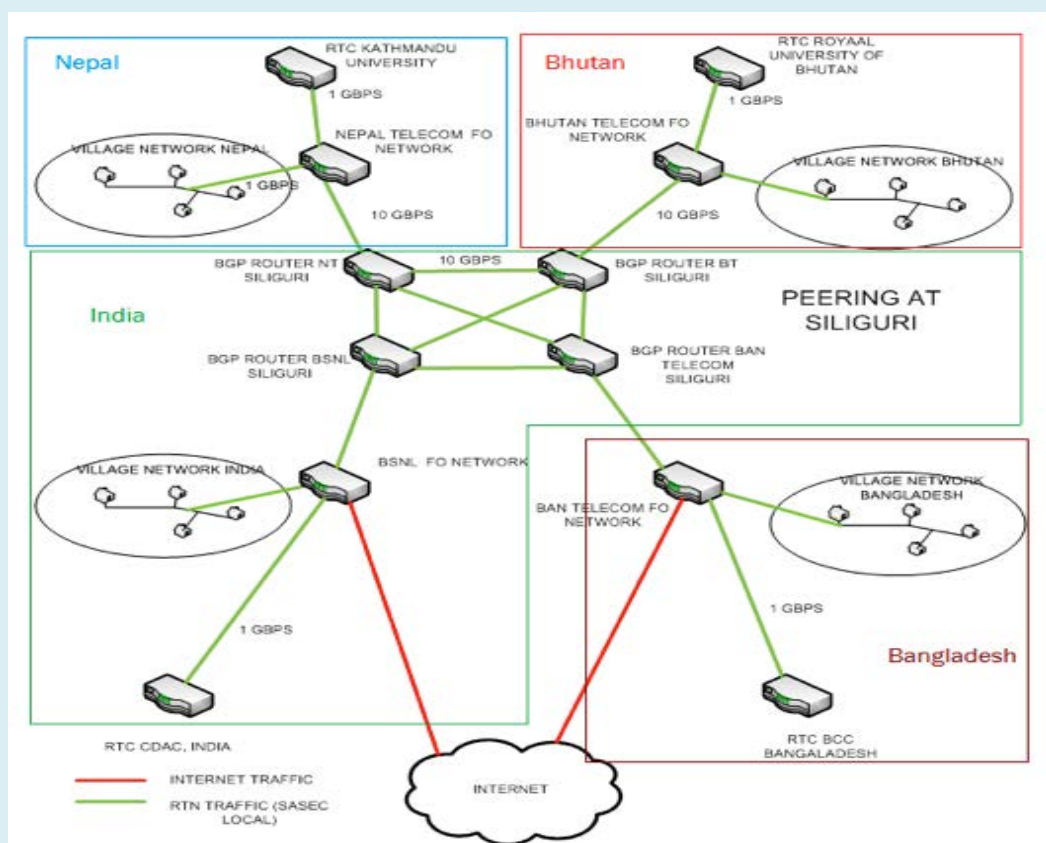
Source: SASEC

The IH project hopes to improve the quality and penetration of IH in rural areas via mobilizing the concept of social capital within rural communities and leveraging the SASEC regional exchange as a sharing facility. ICT human resource capital is intended to be developed through improved local content as a result of raising ICT awareness, e-literacy and training. This will necessitate the establishment of a Research and Training Centre, which will implement the processes that will achieve these goals.

The project will see the establishment of a regional network through the deployment of a transmission backbone for faster flow/access of information and the improvement of cross-border connectivity. The regional network will pave the way for the creation of village networks that will serve as the output for project deliverables (Figure A.2). A research and training network is to be developed. This network is intended to educate and develop services in the areas of telemedicine, e-commerce, distance and learning course and language localisation.

Figure A.2: The creation of village networks

Village networks are to serve as the vehicles for the delivery of key project content to the general public. 30 community e-Centres (CeCs) are to be set up and interlinked via fibre back-haul from SASEC IH hubs. The fibre network is to connect the following hubs and locations:
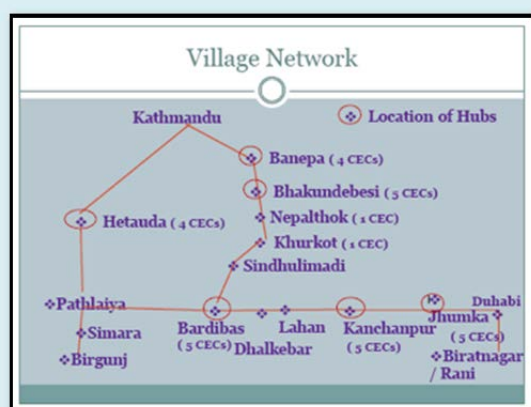
The CeCs will be integrated with two existing government offices: 1) Postal Service; and 2) Village Development Committees (VDCs). The fibre network is to be owned by the NDCL with the following conditions:

(i)   70 per cent of 2.5 GHZ BW that will be procured from India's BNSL will be for commercial use;

(ii)   30 per cent will be allocated for the MoIC's social service obligations under which CeCs will be connected; and

(iii)   2 per cent of the net profit from 70 per cent of the bandwidth that NTC uses for commercial purposes will be allocated to further fund the MoIC's social service obligations.

This project can coexist and even support the masterplan as the provision of wireless broadband services via village networks and education / training on e-services and local content contributes to the facilitation of applications and content, a key pillar of the masterplan.

Appendix B: Table of frequency allocations for cellular mobile service

Band name	Frequencies	Bandwidth	Remarks
CDMA800	824~844 MHz 869~889 MHz	2x20 MHz (2x16 MHz available)	4 MHz Overlaps with EGSM
GSM900	890~915 MHz 935~960 MHz	2x25MHz	
EGSM	880~890 MHz 925~935 MHz	2x10 MHz (2x2.4 MHz available)	Limited to 5 MHz as a result of overlap with CDMA. Out of 5 MHz, 2.6 MHz considered as guard band
GSM1800	1710~1755 MHz 1805~1850 MHz	2x45 MHz	Limited from 2x75 MHz to 2x45 MHz due to CDMA 1900 band use
CDMA1900	1850~1880 MHz 1930~1960 MHz	2x30 MHz	Now occupied by UTL. Need to vacate it for GSM
IMT2000 (3G)	1960~1980 MHz 2150~2170 MHz	2x20 MHz (Could be 2x60 MHz)	If CDMA is vacated, it can be 2x60 MHz (1920~1980, 2110~2170 MHz)

Source: NTA based on the Telecommunications Service Radio Frequency (Distribution and Pricing.) Policy 2068

Appendix C: Draft telecommunication service licence

1.　　Grant of Licence

In exercise of the powers conferred by Sections 23 and 24 of the *Telecommunication Act 1997* ("the Act") the Nepal Telecommunications Authority (hereinafter referred to as "the NTA") hereby grants a non-exclusive licence ("this Licence") to [Company X], a company duly incorporated in Nepal whose registered office is situated at [ADDRESS] (hereinafter referred to as "the Licensee") to operate and provide the Licensed Services within Nepal.

2.　　Interpretation

2.1　　The terms in this Licence shall have the same meaning as prescribed in the Act, unless the contrary intention appears.

2.2　　In this Licence, unless the contrary intention appears:

"**Act**" means the Telecommunications Act 1997 as amended.

"**Billing Process**" means the Billing System and Metering System collectively.

"**Billing System**" means the totality of the equipment, data, procedures and activities which the Licensee uses to determine the charges to be made for usage of the Licensed Services.

"**NTA**" means the Nepal Telecommunications Authority established under section 6 of the Act.

"**Competition Regulations**" means the regulations pertaining to competition matters prescribed or to be prescribed by the NTA pursuant to the Act.

"**Customer**" means a person having a contractual relationship with the Licensee for the provision of the Licensed Services.

"**Exempted Operator**" means a person who has been granted an exemption from licensing pursuant to Section 24A of the Act.

"**Interconnection Agreement**" means an agreement entered into between the Licensee and:

　　(a)　a Licensed Operator; and/or

　　(b)　an Exempted Operator;

pursuant to Section 31 of the Act.

"**Interconnection Regulations**" means the regulations pertaining to interconnection matters prescribed or to be prescribed by the NTA pursuant to the Act.

"**Licensed Operator**" means a person who has been granted a licence under Sections 23 and 24 of the Act to provide or operate telecommunications service in Nepal or to any place outside Nepal any telecommunication service.

"**Licensed Services**" means the telecommunication services which are more particularly described in Schedule A

"**Metering System**" means the equipment, data, procedures and activities which the Licensee uses to determine the extent of any Licensed Services which it has provided.

"**NTA**" means the Nepal Telecommunications Authority established under section 6 of the Act.

"**Radio Frequency Spectrum Licence**" means the licence granted to the Licensee to use the radio frequency spectrum for the purposes of operating and providing the Licensed Services.

2.2   Except where the contrary intention is expressed or arises by necessary implication in this Licence words referring to the masculine gender shall include the feminine gender and references to the singular include the plural and vice versa.

2.3   The interpretation of this Licence shall not be affected by any headings.

2.4   This Licence is subject to the provisions of the Act and is governed by the laws of Nepal.

2.5   In this Licence, all references to an act (whether in conjunction with the title to that act or otherwise) or to the Act mean the legislation as in force from time to time or the legislation in place in whole or in part thereof as well as any subsidiary legislation, regulation, direction, codes of practice or any provisions thereof in force from time to time and those enacted or made (as the case may be) in place or substitution or modification in whole or in part of any other ordinance, the Act, subsidiary legislation, regulation, direction and codes of practice or provision thereof.

2.6   At any time, any terms or conditions of this Licence which are or declared by any court or tribunal of competent jurisdiction to be illegal, invalid or unenforceable in any respect under the applicable law shall be severed from this Licence to the maximum extent permissible by the applicable law without in any manner affecting the legality, validity or enforceability of the remaining terms and conditions of this Licence, all of which shall continue in full force and effect.

2.7   In the event of any conflict or inconsistency between the Schedule and the terms and conditions in another part of this Licence, the latter shall prevail.

3.   Scope of the Licence

3.1   The Licensee shall operate and provide the Licensed Services within Nepal.

3.2   The Licensee shall provide the Licensed Services to every person who requests for provision of such services within Nepal.

4.   Term of Licence

4.1   Subject to Conditions 29, 30 and 32, this Licence shall be valid for a period of 10 years from the grant of this Licence.

4.2   Upon the expiry of the initial term, this Licence may be further renewed for subsequent term of five (5) years or such other period as the NTA thinks fit and in accordance with Section 25 of the Act[49].

5.   Licence Fees

5.1   The Licensee shall pay:

(a) on the grant of this Licence, an approval fee of [   ] or such other amount determined by NTA under Section 24 of the Act;

(b) annually thereafter a renewal fee of [ ] or such other amount determined by the NTA;

(c) royalty to the Government of such amount and at such time as specified by the NTA; and

(d) annually such amount specified by the NTA to a universal service fund.

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[49]   Amended to be consistent with the BTTB PSTN Licence (condition 3).

6.   Description of Licensed Services

6.1   The Licensee shall not operate or provide any telecommunication service not described in Schedule A except with the prior approval of the NTA.

6.2   In the event that the Licensee wishes to make changes to the Licensed Services, or introduce a telecommunication service, the Licensee shall provide the NTA with such information as may be required for the NTA's NTA's consideration and obtain the approval of the NTA prior to making any change to the Licensed Services, or introducing the new telecommunication service.

7.   Licence replaces any other licence

7.1   This Licence replaces any other licence held by the Licensee in respect of the Licensed Services.

8.   Licence is not Transferable

8.1   The issue of this Licence is personal to the Licensee and this Licence shall not be assigned, transferred, sublet or otherwise disposed to any other party except in accordance with Section 27 of the Act.

9.   Submission of Tariff

9.1   Prior to providing the Licensed Services, the Licensee shall submit to the NTA a tariff containing the maximum and minimum charges for such Licensed Services for the NTA's consideration and approval.

9.2   The tariff submitted pursuant to Condition 10.1:

   (a)   shall be in a form approved by the NTA;

   (b)   shall be precise and sufficiently detailed to enable the NTA to work out the nature and the amount of charges payable for the supply of the Licensed Services; and

   (c)   must:

      (i)   state the period for which it shall apply;

      (ii)   state the services and a description of the services that the Licensee proposes to offer during the term;

      (iii) set out the details of the nature and amount of charges payable for the services, indicating where relevant, the services that are provided free of charge; and

      (iv)   where the charges vary in their nature or amount or both in relation to the services, the reasons why and how the charges vary.

10.   Publication of Charges, Quality of Service Standards and Conditions of Licensed Services

10.1   The Licensee shall publish information about the Licensed Services and provides information covering *inter alia* details of its tariffs and fees, quality of service standards, provision of fault repair and other terms and conditions on which the Licensed Services are provided by:

   (a)   sending a copy of the relevant details to the NTA;

   (b)   making them available for inspection at its major places of business during normal business hours; and

   (c)   sending the appropriate parts thereof to any person who makes a request for it.

10.2   The Licensee shall provide a help line service to its Customers whereby any Customer may receive information about any aspect of the Licensed Services.

10.3   The Licensee shall publish, at such intervals and in such a manner as the NTA may specify, *inter alia* the description, the quality of service standards, the charges and terms and conditions on which the Licensed Services are provided[50]

11.   Billing

11.1   The Licensee shall provide its Customers with periodic, accurate and timely invoices which reflect *inter alia* the itemised charges for each Licensed Service provided, the terms and conditions on which the Licensed Services is provided and the due date for payment.

11.2   The Licensee shall maintain in operation such a Billing Process in order to comply with Condition 11.1. For the purpose of clarification, the Licensee may at its discretion outsource the billing processes but shall at all times be responsible for meeting its billing obligations under this Licence.

12.   Customer Service Standards, Consumer Protection and Handling of Complaints

12.1   The Licensee shall develop, publish and enforce guidelines for use by its personnel when handling enquiries and complains from or on behalf of any person to whom it supplies Licensed Services.

12.2   The guidelines must address *inter alia* the following areas:

   (a) procedures for handing of complaints;

   (b) procedures adopted by the Licensee to ensure accuracy of a customer's account; and

   (c) availability to customers of quality of service information relating to the Licensed Services.

12.3   The Licensee shall receive and consider any comment and complaint from or on behalf of any person who believes himself to have been treated unjustly or unfairly in relation to the Licensed Services.

12.4   The Licensee shall keep a complete record in writing of all comments and complaints received by it and submit it to the NTA on demand. In addition, the Licensee shall keep a complete record in writing of information relating to invoices, charges, directories and inquiries received by it. The records shall be retained by the Licensee for not less than six (6) months.[51]

13.   Universal Service Obligation

13.1   The Licensee shall comply with the universal service obligations and contribute to the Universal Access Fund in accordance with the Act.

14.   Access and Interconnection

14.1   Unless otherwise exempted by the NTA, the Licensee shall where reasonably practicable, provide access to its Licensed Services, as the case may be, to other Licensed Operators and/or Exempted Operators on reasonable terms and conditions.

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[50] Section 37(3)(j) of the Act.

[51] Section 37(3)(h) of the Act.

14.2   Pursuant to Condition 14.1, the Licensee shall enter into interconnection arrangements with other Licensed Operators and/or Exempted Operators on mutually agreeable terms and conditions, and in accordance with Section 31 of the Act.

14.3   The Licensee shall comply with Section 47 of the Act in relation to any interconnection dispute.

15.   Operation of Radio Apparatus

The Licensee shall apply for and obtain all necessary rights and licences under the Radio Act or such other subsidiary legislations for the operation of any radio apparatus and shall abide by the conditions imposed thereunder, including the payment of licence fees.

16.   Use of Radio Frequencies

16.1   Subject to the Radio Act and this Condition, the Licensee shall use the radio frequencies allocated and granted to the Licensee pursuant to a Radio Frequency Spectrum Licence to enable the operation and provisioning of the Licensed Services, and shall at its discretion, use any part of the radio frequencies allocated to it for the purposes of managing interferences.

16.2   The Licensee shall take all necessary steps to ensure that the radio-communication apparatus is safe and does not cause harmful interference to other existing radio apparatus in the same or other areas or radio frequency bands.

17.   Technical Standards

17.1   The Licensee shall comply with the technical standards where such technical standards relate to the Licensed Services.

18.   Compliance with Numbering Plans

18.1   The Licensee shall comply with the NTA's numbering plan on the usage, allocation and assignment of numbers in relation to the Licensed Services.

18.2   The NTA may alter and/or relocate and reassign any mobile numbers given to the Licensee at any time provided that prior written notice has been given.

18.3   The Licensee may at its discretion, allocate addresses and numbers to its customers within its allocated addressing blocks.

19.   Restriction against Anti-Competitive Conduct and Arrangements

19.1   The Licensee shall not engage in any conduct or enter into any agreement or arrangement which shall in any way prevent or restrict competition in relation to the provision of the Licensed Services by the Licensee.

19.2   The Licensee shall comply with the Competition Regulations issued by the NTA.

20.   Restriction on Discrimination

20.1   The Licensee shall not show undue preference towards, or exercise undue discrimination against any person or class of persons in relation to the provisioning of the Licensed Service or the charges for such Licensed Service[52].

21.   Ownership, Shareholding, Management and Merger Arrangements

21.1   The Licensee shall obtain the approval of the NTA and observe and comply with the regulations promulgated by the NTA relating to:

(a)   any change in the ownership, shareholding or management of the Licensee at which has the effect of transferring the control over the activities under this Licence; or

(b)   any merger of the Licensee with any other Licensed Operator and/or Exempted Operator.

22.   Direction by the NTA

22.1   The Licensee shall comply with any directions issued by the NTA in exercise of its powers, functions or duties under the Act or in this Licence.

23.   National Emergency

23.1   Where required by the NTA, the Licensee shall participate in any emergency, disaster or security activities in collaboration with other Licensed Operators and relevant agencies, organisations and Government departments. Any such emergency shall only extend for such period as may be reasonable given the circumstances.

24.   Dispute Resolution

24.1   In the event that the Licensee fails to reach an agreement with other Licensed Operators and/or Exempted Operators on matters relating to the Act or this Licence, the Licensee may refer the matter in writing to the NTA to resolve the dispute.

24.2   The decision of the NTA shall be binding on the Licensee and the other Licensed Operators and/or Exempted Operators who are parties to the dispute.

25.   Accounts

25.1   The Licensee shall maintain full and accurate books and accounting records reflecting all financial matters in accordance with sound and acceptable accounting practices.

25.2   The Licensee shall so far as it is reasonably practicable, prepare and deliver to the NTAs separate accounting records as may be required by the NTA from time to time. The Licensee shall comply with all directions issued by the NTA in relation to accounting separation.

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[52]   Sections 37(3)(g) and 50 of the Act.

26. Provision of Information to the NTA

26.1 The Licensee shall deliver at such time and in such manner as may be specified by the NTA, all such documents, accounts, estimates, annual return or other information within its knowledge, custody or control as the NTA may require in connection with the performance of its functions and duties under the Act.

27. Customer Privacy and Confidentiality

27.1 The Licensee and the NTA shall keep confidential all information of the Licensee:

(a) which is disclosed, communicated or delivered; or

(b) comes to its knowledge or into its possession in connection with this Licence;

and must:

(1) not use, comply, reproduce and/or reduce to writing or communicate or otherwise make available such information except for the purposes of this Licence or as required by the Act; and

(2) not disclose or communicate, caused to be disclosed or communicated or otherwise make available such information to third person other than its directors, officers, employees and/or professional advisers to whom disclosure is necessary for the purposes of this Licence; and

(3) apply thereto no lesser security measures and degree of care than those which applies to the NTA's own confidential or proprietary information and which the NTA warrants as providing adequate protection for such information from unauthorised access, copying or use.

28. Safety

28.1 The Licensee shall, in respect of all installations, equipment and apparatus possessed, maintained, operated or used in relation to the provision of the Licensed Services under this Licence, take all proper and adequate safety measures for the safeguarding of life or property, including safeguarding against exposure to any electrical or radiation hazard emanating from the installations, equipment or apparatus so used.

28.2 The Licensee shall comply with any direction of the NTA in respect of any safety matter.

29. Variation or Amendment to the Licence

29.1 The NTA may vary or amend any of the conditions of this Licence in accordance with Section 26 of the Act.

30. Suspension or Cancellation of the Licence

30.1 The NTA may suspend or cancel this Licence in accordance with Section 28 of the Act.

31. Breach of Licence Conditions

31.1 Where the Licensee breaches any condition of this Licence, the Licensee shall be guilty of an offence and shall be convicted in accordance with Section 46 of the Act.

32. Surrender of the Licence

32.1 In the event that the Licensee wishes to terminate this Licence or cease to operate or provide the Licensed Services, the Licensee shall notify the NTA in writing at least three (3) months in advance.

33. Rights upon Suspension, Cancellation or Termination

33.1   Suspension, cancellation or termination of this Licence, in whole or in part, is without prejudice to any rights, liabilities or obligations which may accrue to the Licensee or NTA under this Licence or any written law at the date of the suspension, cancellation or termination, including a right of indemnity.

34. Governing Law

34.1   This Licence shall be governed and construed in accordance with the law of Nepal.

35. Compliance with the Law and International Conventions

35.1   The Licensee shall, unless otherwise directed by the NTA, at all times observe and perform the relevant requirements of the Act and Convention of the International Telecommunication Union including all regulations annexed thereto or made thereunder, and any other telecommunication agreements which may from time to time be acceded to by or on behalf of, or applied to, Nepal.

36. NTA's Powers

36.1   In exercising its powers granted in terms of the Act, and this Licence, the NTA shall:

(a) act reasonably having regard to all surrounding circumstances;

(b) prior to exercising its power, afford the Licensee every reasonable opportunity to be heard and make representations to the NTA in respect of all relevant issues; and

(c) at the request of the Licensee, furnish written reasons for any decision it makes in relation to this Licence.

Schedule A

Licensed Services

The Licensee is licensed to operate and provide any Telecommunication Services within Nepal including but not limited to:

(1)

(2)

(3)

Schedule A

Appendix D: Recommended amendments to the Radio Act 2014 (1957)

1.   *To add new definition to **Section 2: Definition** as follows:*

"'radio frequency spectrum" means the continuous range of electromagnetic wave frequencies up to and including a frequency of 420 terahertz.

"radio machine licence" means a licence issued under Section 6 of this Act.

"spectrum licence" mean as a licence issued under Section 4 this Act."

2.   *To add a new **Section 3 on "Prohibition on using radio frequency spectrum"** as follows:*

"3.   No person shall use radio frequency spectrum to provide telecommunications services except in accordance with a spectrum licence issued under this Act and in accordance with this Act."

3.   *To add a new **Section 4 on "Spectrum Licensing"** as follows:*

"4 (1)   A spectrum licence for a specified radio frequency spectrum may:

   (a)   be allocated by auction, tender including beauty contest or fixed price as determined by the Regulator.

   (b)   confer rights on a person to use one or more specified radio frequency bands for any purpose which is consistent with the licence conditions.

(2)   The fees for a spectrum licence is structured as follows:

   (a)   a price component set by either auction, tender or fixed price payable annually or in a lump sum; and

   (b)   an annual fee component.

4.   *To renumber the existing sections accordingly as follows:*

- Section 4 shall be renumbered to Section 6;
- Section 5 shall be renumbered to Section 7;
- Section 6 shall be renumbered to Section 8;
- Section 7 shall be renumbered to Section 9;
- Section 8 shall be renumbered to Section 10;
- Section 9 shall be renumbered to Section 11; and
- Section 10 shall be renumbered to Section 12.

Appendix E: Proposed confidential competition and spectrum allocation strategy to underpin the Nepal wireless masterplan

E.1 Overview

It is important for Nepal to have a holistic strategy and considered a regulatory approach to increase sector competition and introduce price based spectrum allocations in Nepal. Without such a strategy there will be lower public utility from the release of any spectrum and significantly reduced prices being paid for spectrum and telecommunications licences in Nepal.

Against this background, it is critical to address current spectrum fragmentation and to refarm certain key cellular mobile spectrum in order to promote the uptake of wireless broadband. The key issues that should be addressed in a longer term implementation programme are:

- the allocation of 2100 MHz (3G) spectrum and its pricing;
- a pre-qualification phase designed to allow the highest quality applicants to participate in the telecommunications licence auction;
- auctions for a new national telecommunications licence by December 2012; and
- auction for the first tranche of 700 MHz spectrum by 30 June 2013.

Figure E.1 below illustrates the proposed implementation timeline for the key issues.

Figure E.1: Proposed implementation timeline
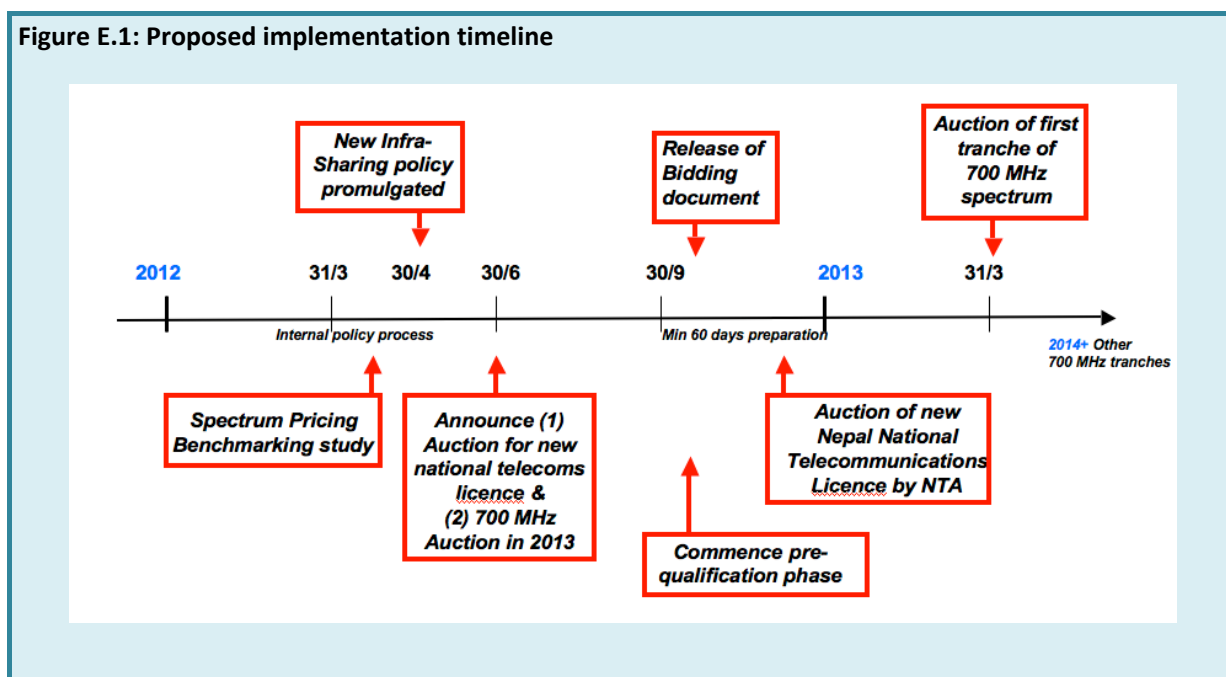
E.2 Allocation of 2100 MHz spectrum and its pricing

Optimally the NTA would prepare a benchmarking study based on international auctions results especially from India and other regional markets. Such results should take into account the lower GDP per capita of Nepal, its demographic and geography etc.

If applying a benchmark rate for 2100 MHz spectrum is not possible, then an auction ought to be undertaken as soon as possible by the NTA. This would, it is understood require a policy. However, to even run a simple auction (e.g. written bids, open cry etc.) it is necessary to determine a minimum pricing threshold[53] for the spectrum. It is suggested that the benchmarking study is therefore done as a key determinant to that process.

Importantly both Ncell <u>and</u> the NTC should be required to pay for the 2100 MHZ spectrum. Payment for spectrum by incumbent operators is standard practice and important from a competition perspective.

Furthermore, it is suggested that successful 900 MHz bidders for the 2100 MHz spectrum will obtain the ability to deploy W-CDMA utilising 900 MHz along with their 2100 MHz deployment. Such a policy changes, supported by global precedent will make the price to be paid for the 2100 MHz more even more attractive to bidders.

E.3 Pre-qualification phase

The NTA may wish to follow a set of established procedures to ensure that the most ideal candidates participate in the upcoming licence auction. The procedures to be followed may be divided into a number of key steps:

(i) preliminary steps;

(ii) request for proposal (RFP) process;

(iii) establishing an evaluation team;

(iv) budget planning / consulting;

(v) defining the investment opportunity;

(vi) inviting applications from prospective applicants;

(vii) preparing an applicant information package;

(viii) developing an evaluation and ranking criteria; and

(ix) receiving and considering applications.

Applicants should ultimately be ranked according to the following criteria specified in Table E.1.

Table E.1: Ranking criteria

Ranking Criteria	Relative Weighting	Numeric Weighting
Technical Quality	High	**20%**
• Network coverage		
• Grade of service		
• Network interconnection		
• Network design and configuration		

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[53] The minimum price in respect of which the NTA will allocate the spectrum to bidders.

Ranking Criteria	Relative Weighting	Numeric Weighting
Financial Capability	High	**20%**
• Financial soundness		
• Extent of financial commitment		
• Access to financial resources		
• Business plan		
Customer Service and Support	Medium	**15%**
• Service range		
• Customer segmentation		
• Retail and service outlets		
Implementation Schedule	Medium	**15%**
• Network roll out plan		
• Ability to acquire and manage telecommunications sites and facilities		
• Ability to manage major infrastructure projects		
Management and Technical Expertise	Medium	**15%**
• Experience in operating public telecommunications services		
• Knowledge of Myanmar's business environment		
• Management support		
• Technical support and personnel		
Industry Development	Medium	**10%**
• Local employment opportunities		
• Local supply		
• Staff training and development		
Corporate Governance	Low	**5%**
• Corporate structure		
• Shareholders' agreements		

E.4 Auctions for a new national telecommunications licence and spectrum in the 900 MHz and 1800 MHz bands

In terms of the offering of any new national telecommunications licence, it should be offered by the end of 2012 at the latest. This is to ensure that the Nepalese market is not already saturated (i.e. at 80 to 100 per cent penetration) because the price for the licence may be accordingly reduced by bidders.

The national telecommunications licence should include 2 x 5.6 MHz of 900 MHz spectrum (in the E-GSM band from 882 to 887.6 MHz paired with 927 to 932.6 MHz[54] and 2 x 10 MHz of 1800 MHz spectrum).[55] Such an allocation of spectrum should be sufficient to attract a new competitive entry into the Nepalese telecommunications market, so long as it is provided on a technology neutral basis. It is highly unlikely that potential new entrants would only be interested in making a substantial investment in the Nepal market unless they are able to deploy new technologies such as W-CDMA utilising 900 MHz and LTE utilising 1800 MHz.

Securing the E-GSM spectrum would require a change of allocation from CDMA to GSM as part by the National Spectrum Committee in accordance with section 49 [see in Nepali – *Telecommunications Service Radio Frequency (Distribution and price related) Policy 2068*]. This should be relatively straight-forward.

E.5   Auction new spectrum in the 700 MHz and possibly the 2.6 GHz bands

Nepal should follow the Asia Pacific allocation scheme for the 700 MHz band of 2 x 45 MHz and undertake an auction of 700 MHz band in 2013. To maximise the competitive tension and proceeds, the new telecommunications licence as addressed in Section E4 above should be awarded before this auction takes place. Further, only one 2 x 20 MHz band of 700 MHz spectrum should be allocated in 2013. This will ensure that the first successful bidder secures the maximum LTE allocation of 20 MHz. Further auctions should be timed for 2014 and/or 2015. This could be one or two blocks depending on demand and prices maximisation objectives.

As LTE technology – even by 2013 – is unlikely to support voice services (which is the predominant service in Nepal) without 2G call fallback then the auction of 700 MHz spectrum is likely only to be of interest to existing operators. This auction can therefore be a purely price based where the successful bidder should not receive a telecommunications licence. Such an approach could be reviewed closer to the auction date, if demand was high.

Similarly, while useful only for deploying hotspots in Kathmandu, perhaps 20 MHz of paired 2.6 GHz spectrum could be offered concurrently with the 700 MHz spectrum auction.

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[54] This would provide a 2 MHz guard band from 880 to 882 MHz paired with 925 to 927 MHz.

[55] One other option would be to utilise the 900 MHz spectrum allocated to STM (2 x 2.4 MHz) and Nepal Satellite Telecom (2 x 4.4 MHz) for rural areas of Nepal in urban areas.

Appendix F: Frequency arrangements for implementation of IMT

Recommendation ITU-R M.1036-4[56], Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications (IMT) in the bands identified for IMT in the Radio Regulations (RR), provides guidance on the selection of transmitting and receiving frequency arrangements for the terrestrial component of IMT systems.

The frequency arrangements are recommended from the point of view of enabling the most effective and efficient use of the spectrum to deliver IMT services – while minimizing the impact on other systems or services in these bands – and facilitating the growth of IMT systems.

General considerations regarding technological aspects:

- IMT (IMT-2000 and IMT-Advanced) radio interfaces currently include two modes of operation – frequency division duplex (FDD) and time division duplex (TDD).

- There are benefits in the use of both FDD and TDD modes in the same band; however, this usage needs careful consideration to minimize the interference between the systems, especially, if flexible FDD/TDD boundaries are selected, there may be a need for additional filters in both transmitters and receivers, guard bands that may impact spectrum utilization, and the use of various mitigation techniques for specific situations.

- That selectable/variable duplex technology is considered to be one technique that can assist in the use of multiple frequency bands to facilitate global and convergent solutions. Such a technology could bring further flexibility that would enable IMT terminals to support multiple frequency arrangements.

- When frequency arrangements cannot be harmonized globally, a common base and/or mobile transmit band would facilitate the development of terminal equipment for global roaming. A common base transmit band, in particular, provides the possibility to broadcast to roaming users all information necessary to establish a call.

- Guard bands for IMT systems should be minimized to avoid wasting spectrum.

- When developing frequency arrangements, current and future advances in IMT (e.g. multimode/multiband terminals, enhanced filter technology, adaptive antennas, advanced signal processing techniques, techniques associated with cognitive radio systems, variable duplex technology and wireless connectivity peripherals) may facilitate more efficient use and increase overall utilization of radio spectrum.

- On the aspect of frequency availability it is recommended that administrations make available the necessary frequencies for IMT system development in a timely manner.

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[56] www.itu.int/rec/R-REC-M.1036-4-201203-I/en

The frequency bands identified for IMT services (that accommodate all the technologies) are shared bands with footnotes:

Band (MHz)	Radio Regulation Footnotes identifying the band for IMT
450-470	5.286AA
694-790/698-806*/790-862*, 806 – 960	ADD 5.3XX, MOD 5.313A, MOD 5.317A
1 710–1 885, 1 885-2 025	5.384A, 5.388
2 110-2 200	5.388
2 300-2 400	5.384A
2 500-2 690	5.384A
3 400-3 600	MOD 5.430A, 5.432A, 5.432B, 5.433A

World Radio Conference – 1992

World Administrative Radio Conference –2000

World Administrative Radio Conference – 2007

World Administrative Radio Conference – 2012 (Allocation shall enter into force on 1 January 2013)

* *790-862 MHz (Allocation for Region 1 and 3)*

698-790 MHz (Allocation for Region 2 and 9 countries in Region 3: Bangladesh, China, Rep. of Korea, India, Japan, New Zealand, Papua New Guinea, Philippines, and Singapore)

By taking these Radio Regulations footnotes and relevant resolutions into account, administrations have the flexibility to decide on using these bands at the national level according to each administration's evolution/migration plan.

A minimized number of globally harmonized frequency arrangements in the bands identified for IMT-2000 by one or more conferences will:

- facilitate worldwide compatibility; and
- facilitate international roaming.

Annex 1 (Sections 1 to 6) of Recommendation ITU-R M.1036-4 describes the frequency arrangements for implementation of IMT in the bands identified for this service in the Radio Regulations (RR).

The order of the frequency arrangements does not imply any priority. Administrations may implement any of the recommended frequency arrangements to suit their national conditions. Administrations may implement all or part of each frequency arrangement.

It is noted that administrations may implement other frequency arrangements (for example, arrangements which include different duplex schemes, different FDD/TDD boundaries, etc.) to fulfil their requirements. These administrations should consider geographical neighbouring deployments as well as matters related to achieving economies of scale, facilitating roaming, and measures to minimize interference.

Administrations should take into account the fact that some of the different frequency arrangements in the same band have an overlap of base station transmitter and mobile station transmitter bands. Interference problems may result if different frequency arrangements with such overlaps are implemented by neighbouring administrations.

Annex 1 describes ten frequency arrangements for the implementation of IMT in the band 450-470 MHz. The number of frequency arrangements help to accommodate incumbent operations, while maintaining a common uplink/downlink structure (uplink in the lower 10 MHz, downlink in the upper 10 MHz) for FDD arrangements.

The recommended frequency arrangements for implementation of IMT in the band 698-960 MHz are summarized in Table F.1 and in Figure F.1.

Table F.1: Paired Frequency arrangements in the band 698-960 MHz

Frequency arrangements	Paired arrangements				Un-paired arrangements (e.g. for TDD) (MHz)
	Mobile station transmitter (MHz)	Centre gap (MHz)	Base station transmitter (MHz)	Duplex separation (MHz)	
A1	824-849	20	869-894	45	None
A2	880-915	10	925-960	45	None
A3	832-862	11	791-821	41	None
A4	698-716	12	728-746	30	716-728
	776-793	13	746-763	30	
A5	703-748	10	758-803	55	None
A6	None	None	None		698-806

Source: ITU

Figure F.1: Frequency arrangements for the 698 to 960 MHz band
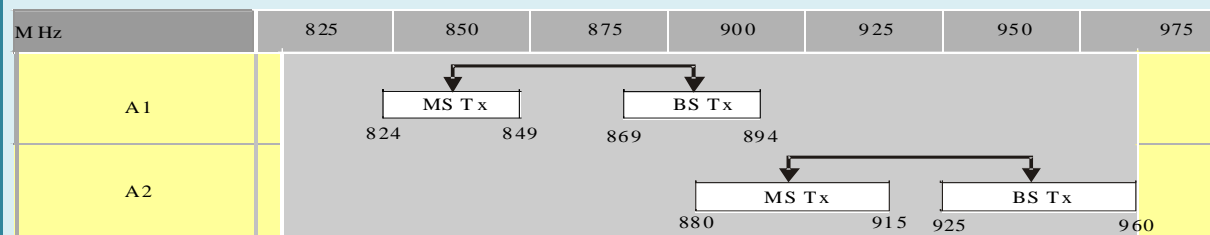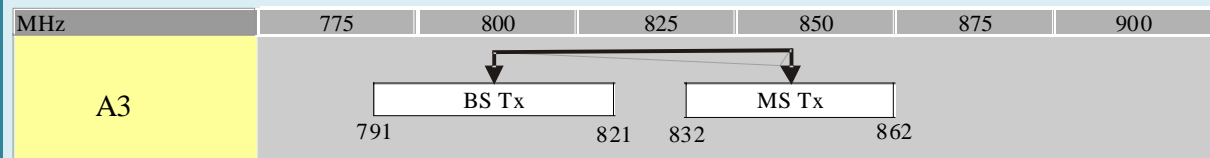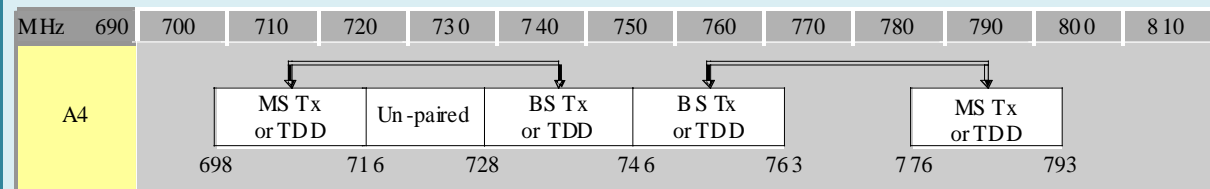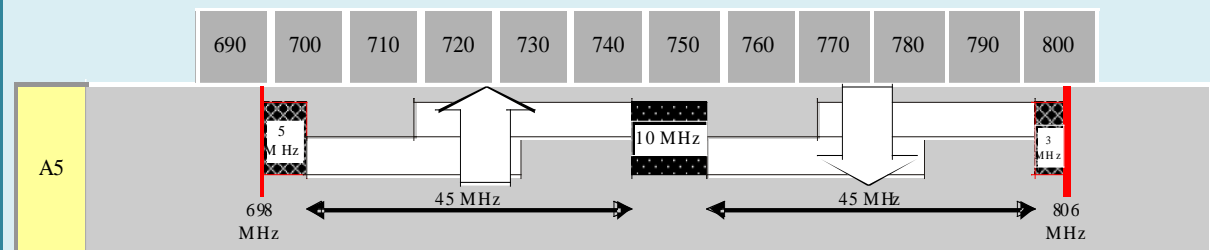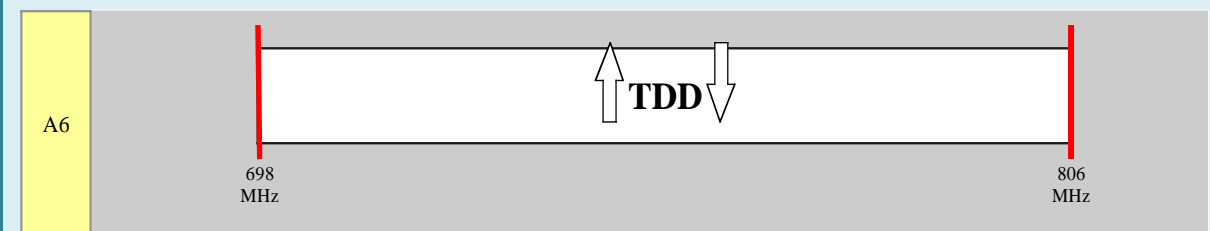
Source: ITU

Due to different usages in 698-960 MHz between regions – no common solution is possible.

In the arrangement A3, reversed duplex direction (mobile transmit in upper band and base transmit in lower band provides better conditions for coexistence with the lower adjacent broadcasting service.

In arrangement A4, administrations can use the band solely for FDD or TDD, or some combination of FDD and TDD. Administrations can use any FDD duplex spacing or FDD duplex direction. However, when administrations choose to deploy mixed FDD/TDD channels with a fixed duplex separation for FDD, the duplex separation and duplex direction as shown in A4 are preferred.

In A5, 2 x 45 MHz FDD arrangement uses sub blocks with dual duplexer solution and conventional duplex arrangement. Internal guard bands of 5 MHz and 3 MHz are provided at the lower and upper edge of the band for better co-existence with adjacent radio communication services.

In A6, taking into account the external 4 MHz guard band (694-698 MHz), a minimum internal guard-band of 5 MHz at the lower edge (698 MHz) and 3 MHz at the upper edge (806 MHz) needs to be considered.

Frequency arrangements in the band 1710-2200 MHz are depicted in the Figure F.2.

Figure F.2: Frequency arrangements in the 1710-2200 MHz band

Source: ITU
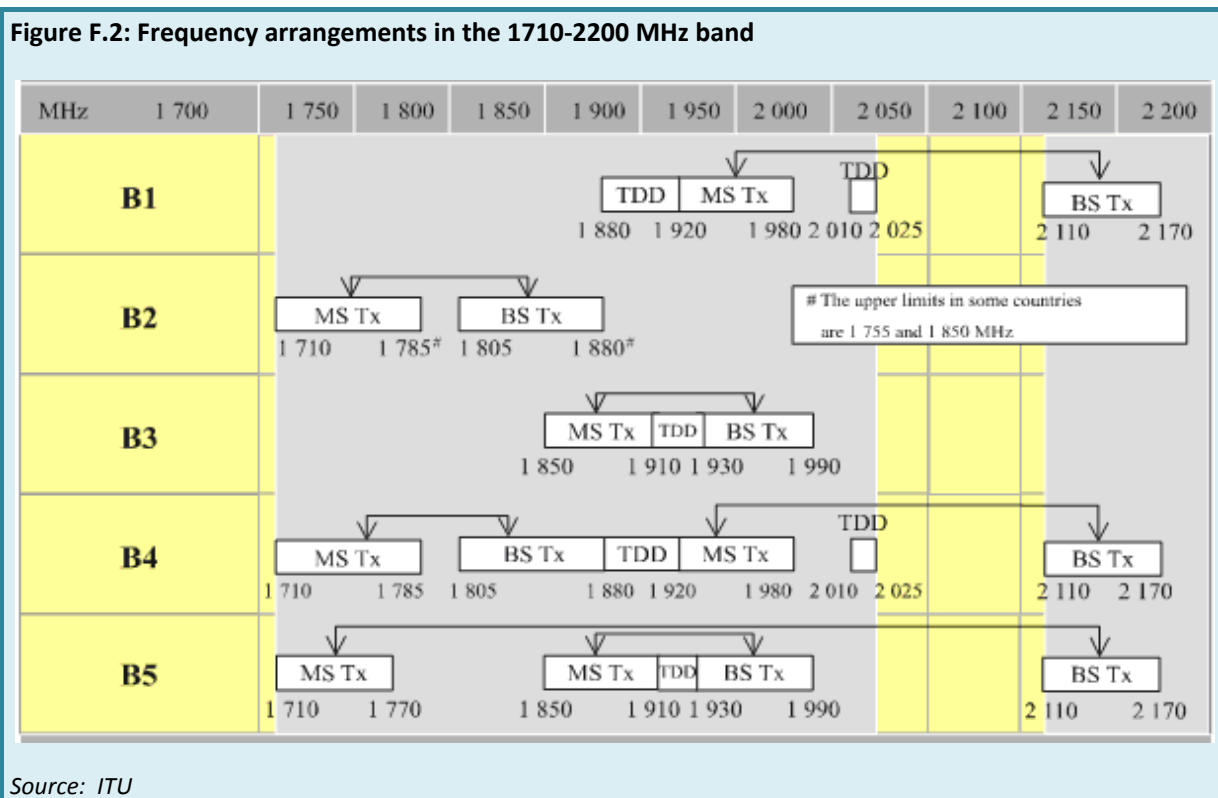
In bands 1710-2025 MHz and 2110-2200 MHz three basic frequency arrangements (B1, B2 and B3) are already in use by public mobile cellular systems including IMT. Based on these three arrangements, different combinations of arrangements are recommended as described in B4 and B5.

Frequency arrangements in the band 2300-2400 MHz and 2500-2690 MHz are summarised in Figure F3:

Figure F.3: Frequency arrangements in the 2300-2400 and 2500-2690 MHz bands

MHz	2 300	2 325	2 350	2 375	2 400

E1

TDD

2 300 — 2 400

M.1036-01-Ann4

MHz	2 500	2 550	2 600	2 650	2 690

C1

MS Tx — TDD — BS Tx

2 500 — 2 570 — 2 620 — 2 690

C2

MS Tx — BS Tx (external) — BS Tx

2 500 — 2 570 — 2 620 — 2 690

C3

Flexible FDD/TDD

2 500 — 2 690

M.1036-01-Ann5

Source: ITU
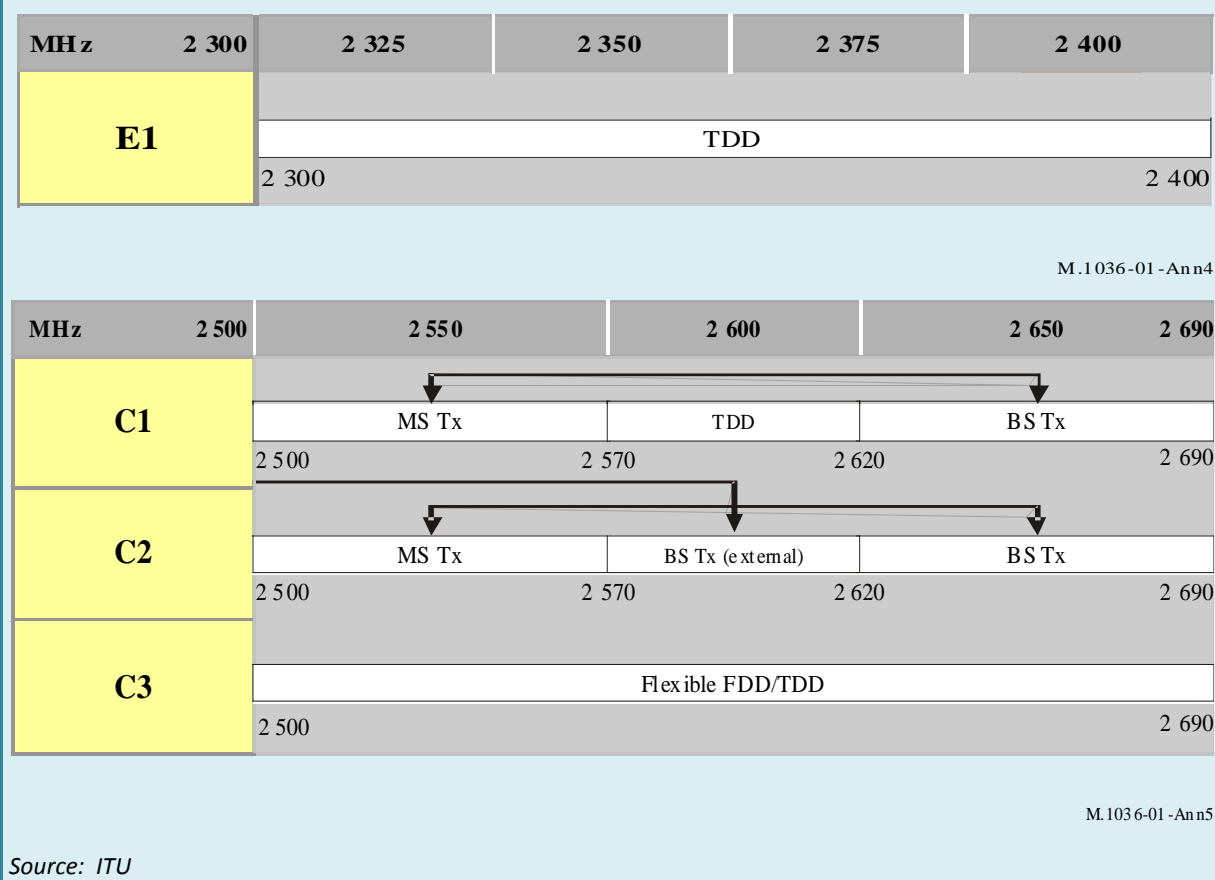
Figure F.4 describes frequency arrangements for the band 3400 to 3600 MHz.

Figure F.4: Frequency arrangements in the 3400 to 3600 MHz bands

Frequency arrangements	Paired arrangements				Un-paired arrangements (e.g. for TDD) (MHz)
	Mobile station transmitter (MHz)	Centre gap (MHz)	Base station transmitter (MHz)	Duplex separation (MHz)	
F1					3400 – 3600
F2	3410 – 3490	20 MHz	3510-3590	100 MHz	None

MHz	3 400				3 600

F1

TDD

3 400 — 3 600

F2

MS Tx — BS Tx

3 410 — 3 490 — 3 510 — 3 590
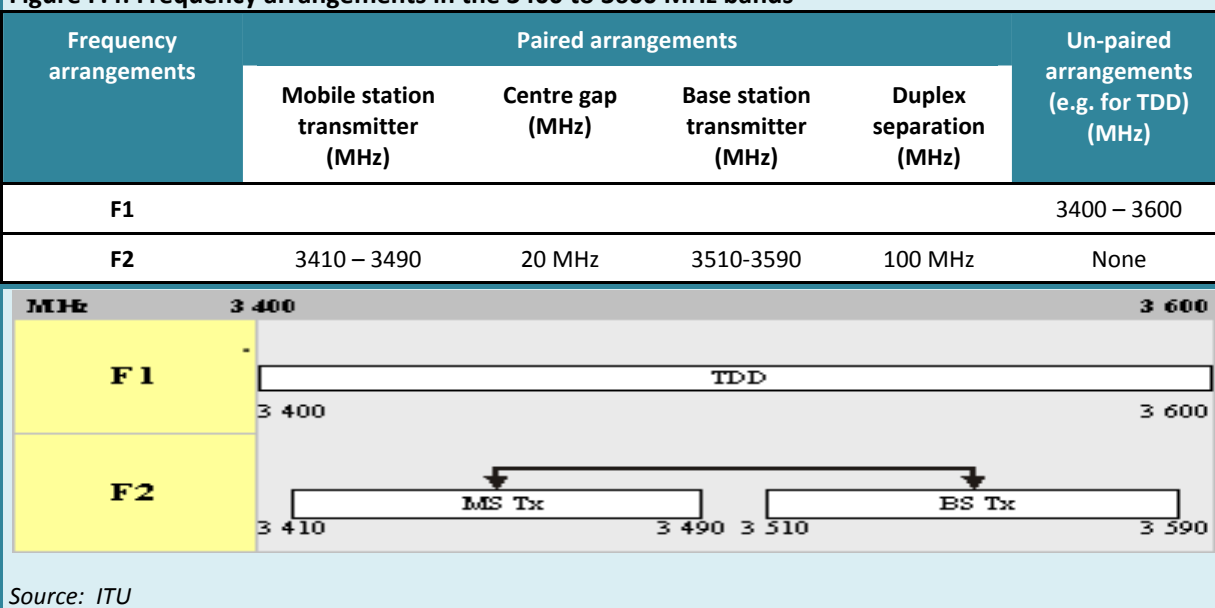
Source: ITU

Appendix G: Addressing spectrum issues and pricing strategy for Nepal

[February 2012]

1. Introduction

If the spectrum resource is to be used efficiently and effectively, the sharing of the available spectrum has to be coordinated among users in accordance with national regulations within national boundaries and in accordance with the Radio Regulations (RR) of the ITU for international use.

The ability of each nation to take full advantage of the spectrum resource depends heavily on spectrum managers facilitating the implementation of radio systems, and ensuring their compatible operation. Furthermore, the imbalance between the demand for radio frequencies and the availability of spectrum keeps growing, especially in urban areas.

According to economic theory, when demand exceeds supply, a price system should be implemented. As the frequency spectrum is a scarce resource, decisions concerning spectrum management should also consider the economic point of view. Therefore, to improve national spectrum management all available means including economic methods are needed.

2. Economic methods

Based on ITU Report ITU-R SM.2012-1 *Economic aspects of spectrum management,* there are three main regulatory reforms that encompass economic aspects of spectrum management:

1. Deregulation – relaxation of rules governing spectrum access.

2. Delegation – transferring of certain spectrum management functions from government to the private sector.

3. Use of the pricing mechanism – ensuring economically efficient use of spectrum.

2.1 Administrative Cost Recovery Price

The simplest method for spectrum pricing (already adopted by many countries) is the Administrative Cost Recovery Price (ACRP) that is based on estimation of the funding required to recover the yearly costs incurred by the government agency for managing the spectrum resource. This has major disadvantages i.e. the fees designed to recover administrative costs not tied to the value of the spectrum used also, may not stimulate spectrum efficiency.

2.2 Spectrum price determination based on system performance

This is based on the amount of spectrum used, number of channels or links used, degree of congestion, efficiency of radio equipment, transmitter power/coverage area, geographical location and other technical parameters for measuring the spectrum volume used or to define the "pollution area" of a radio system as a common basis for establishing spectrum fees.

2.3 Cost of shifting existing users to alternative frequency band

In another approach, spectrum fee is based on the costs when existing users have to be shifted to an alternative frequency band in the short term (few years).

Such reallocation should be financed by interested parties, in particular by the manufacturers of the new equipment and operators of new systems.

Such an approach is very reasonable and indirectly improves spectrum efficiency since the new technology will use the band more efficiently and be of more benefit to society. This is an effective way to free spectrum from incumbents, particularly where military uses are concerned.

2.4   Spectrum price determination based on use of shadow prices

Economic definition of shadow price:

> *"a competitive price for a resource that would be established in an open market if there are many buyers in the market, none possessing any monopoly power to elevate the price of the resource by withholding the resource from the market".*

3.0   Basic principles for financing national spectrum management and establishment of fee system

The following principles should be adhered to when establishing any fee system.

3.1   Legal principles

a) The radio-frequency spectrum is the property of the State. Thus, any spectrum occupancy relating to non-governmental activities is considered to be private occupancy.

b) Belonging as it does to the public domain of the State, the *spectrum must be managed in the interests of the national community as a whole*.

c) As the owner of the spectrum, the State has the right to require private occupants thereof to pay *spectrum fees* (known also as *spectrum occupancy fees*, *frequency availability fees* or *spectrum usage fees*, or simply as *fees* where there is no ambiguity).

d) The planning, management and monitoring of the spectrum are carried out by the State or by entities to which the State has delegated such responsibilities. Those activities, together with the corresponding equipment and investment, are essential to ensuring that the spectrum is used under satisfactory conditions.

e) It is therefore lawful for the authorities to require, moreover, that private spectrum occupants also pay *administrative fees* (known also as *frequency management fees* or *service fees*, as well as *administrative charges* or, where there is no ambiguity, simply as *charges*) to cover all of the costs arising out of spectrum planning, management and monitoring activities.

f) The establishment of spectrum fees and administrative fees must be carried out with due respect for the rules of transparency, objectivity, proportionality and non-discrimination. Where transparency is concerned, it is particularly important that the rules governing the establishment of fees be simple and readily understandable by all concerned.

g) The rules governing the establishment of fees must be relatively stable over time in order to provide spectrum occupants with the necessary visibility and legal security.

h) In return for the fees they pay, users of assigned or allotted frequencies enjoy protection under the relevant provisions of the regulations in force. By contrast, users of freely accessible frequencies (used, for example, for low-range and low-power sets, WiFi, Bluetooth, amateur radio and radio-controlled models) are not protected and should therefore not be required to pay fees. A reality principle unites with this legal principle to dictate that fees should not be applied to freely accessible frequencies.

3.2   Economic principles

a) The frequency spectrum is a limited and, in some cases, scarce resource. The main objectives of the manager are to secure both optimum spectrum occupancy and effective frequency utilization.

b) The reasons for spectrum fees and administrative fees, and the ends to which they are put, are different. That difference should thus be reflected in two distinct approaches for establishing each kind of fee.

c) The sole purpose of administrative fees should be to pay for the service rendered by the authorities.

d) By contrast, the purpose of spectrum fees is multifaceted in that they must:

- enable achievement of the budgetary objective set by the authorities;
- not clash with the economic objectives of the authorities in regard to national development and the development of new services;
- take account of all the benefits that occupants derive from the spectrum;
- constitute a tool for spectrum management.

e) Fees constitute financial resources for the State and for the spectrum manager. The level at which they are set should systematically take account of inflation and the evolving status of the spectrum manager's budget.

3.3 Spectrum pricing factors

There are many factors related to spectrum pricing. Some can be calculated or at least estimated and the others need not to be considered. The table below shows these factors divided into two categories.

Technical factors	Non- technical factors
National Table of Frequency Allocation	Population density
Occupied Bandwidth	Radio Stations Density
Number of Frequency Channels	GDP
Polarization	User's income
Service Area	Duration of use
Coverage Area	Inflation
Power (EIRP)	Type of Radio License
Antenna Height	Geographical and Regional issue
Antenna Pattern	Interconnections among International users
Modulation	
Type of Radio Service	
Service priority	
Type of Radio Application	
Quality of Service	
Coordination	

While the spectrum must be managed in the interests of the national community as a whole, the radio-frequency spectrum is the property of the State and therefore, any spectrum occupancy relating to non-governmental activities is considered to be private occupancy.

3.4 Spectrum fees

As the owner of the spectrum, the State has the right to require private occupants thereof to pay *spectrum fees* (known also as *spectrum occupancy fees*, *frequency availability fees* or *spectrum usage fees*, or simply as *fees* where there is no ambiguity).

3.5 Administrative fees

The planning, management and monitoring of the spectrum are carried out by the State or by entities to which the State has delegated such responsibilities. Those activities, together with the corresponding equipment and investment, are essential to ensuring that the spectrum is used under satisfactory conditions.

It is therefore lawful for the authorities to require, moreover, that private spectrum occupants also pay *administrative fees* (known also as *frequency management fees* or *service fees*, as well as *administrative charges* or, where there is no ambiguity, simply as *charges*) to cover all of the costs arising out of spectrum planning, management and monitoring activities.

Figure G.1: Spectrum planning, management and monitoring
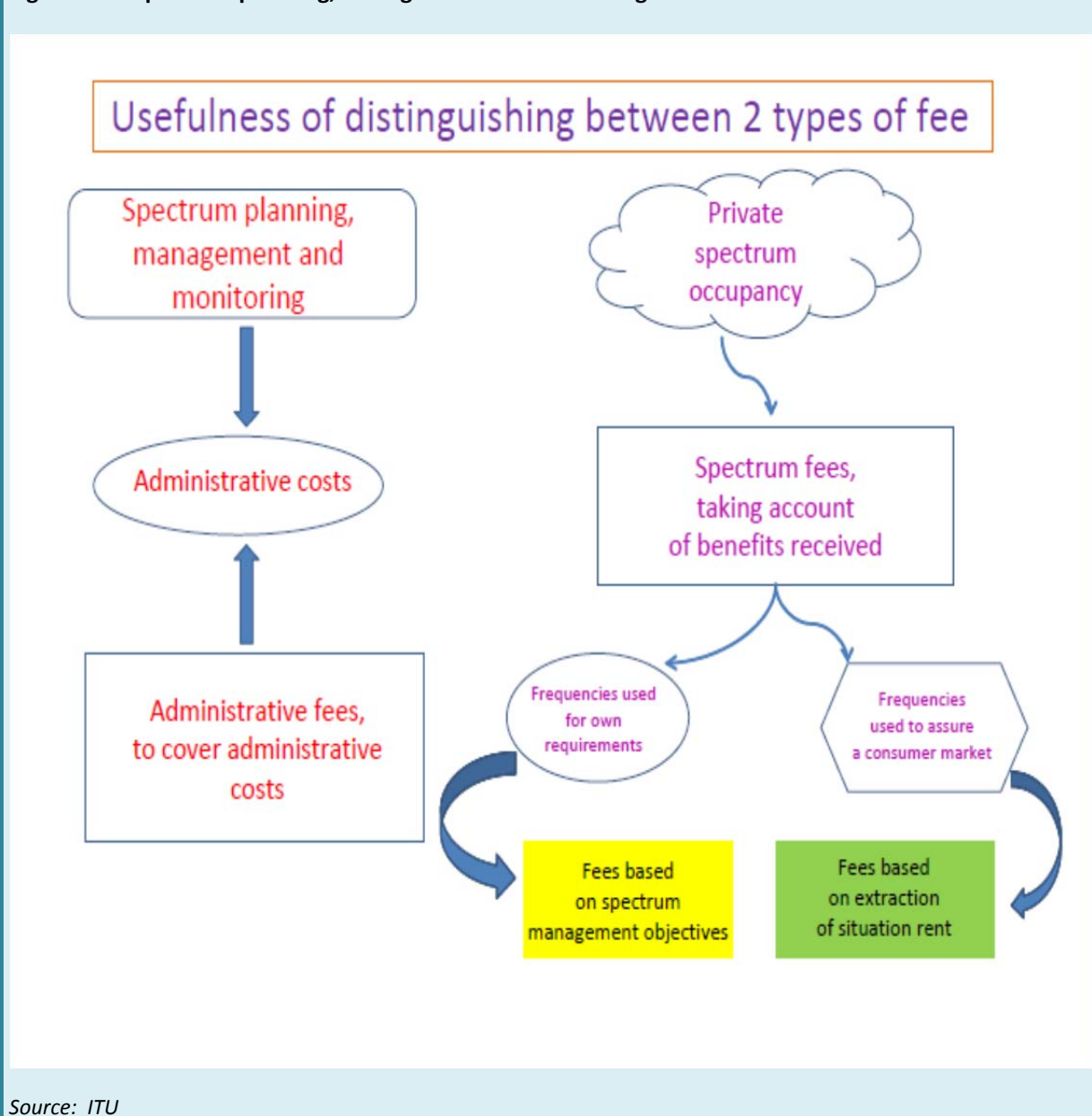
Source: ITU

The establishment of spectrum fees and administrative fees must be carried out with due respect for the rules of transparency, objectivity, proportionality and non-discrimination. Where transparency is concerned, it is particularly important that the rules governing the establishment of fees be simple and readily understandable by all concerned.

The rules governing the establishment of fees must be relatively stable over time in order to provide spectrum occupants with the necessary visibility and legal security.

In return for the fees users of assigned or allotted frequencies enjoy protection under the relevant provisions of the regulations in force.

The reasons for spectrum fees and administrative fees, and the ends to which they are put, are different. That difference should thus be reflected in two distinct approaches for establishing each kind of fee.

The sole purpose of administrative fees should be to pay for the service rendered by the authorities.

By contrast, the purpose of spectrum fees is multifaceted. In that they must enable achievement of the budgetary objective set by the authorities; not clash with the economic objectives of the authorities in regard to national development and the development of new services; take account of all the benefits that occupants derive from the spectrum; constitute a tool for spectrum management.

Fees constitute financial resources for the State and for the spectrum manager. The level at which they are set should systematically take account of inflation and the evolving status of the spectrum manager's budget.

3.6 Establishment of administrative charges

Administrative charges are intended for covering the cost of spectrum planning, management and monitoring. The management function includes activities relating to the issuance of licences and authorizations for spectrum use and to the establishment and collection of the corresponding fees.

Administrative costs are made up of staff costs, operational costs and the costs (amortization) of buildings and equipment corresponding to the aforementioned activities.

3.6.1 Rule for the allocation of administrative costs

The annual administrative costs are in proportion to fee payer's respective turnover.

Thus, for a fee payer whose turnover is equal to *CA*, the annual amount of the administrative fee *Ra* for the year in question is equal to the following product:[57]

$$Ra = \frac{\text{administrative costs for the year in question}}{\text{sum of the turnovers of each of the fee payers for the year in question}} * CA$$

3.6.2 Spectrum fees for frequencies used in the provision or marketing of services intended for a consumer market

Generally speaking, the fees applied in respect of the above frequencies constitute the major part of the budgetary revenue that the State receives by way of spectrum-related fees.

To reflect the income derived from the situation rent, various factors may be envisaged, such as the population covered by the licence, the portion of territory concerned by the licence, or turnover resulting from the provision or marketing of the services.

It is very often the turnover that proves to be the most representative factor in terms of the situation rent. If the turnover is to be used as the basis for fee calculation, it is recommended that its perimeter and content be clearly defined.

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[57] Source: *Guidelines for the establishment of a coherent system of radio-frequency usage fees* – ITU-D STUDY GROUP-2, 4th STUDY PERIOD (2006-2010) – www.itu.int/pub/D-STG-SG02.FEES-1-2010

3.6.3 Fees applied for 2G mobile service

The following equation could be used for determining the annual amount *Rs* of the spectrum fee:

$$Rs = F + t\% * CA$$

Where:

F represents a fixed amount to be paid each year. This amount may be proportional to the total bandwidth allocated to the operator in question for the 2G service.

CA represents the turnover of the operator for the corresponding year in respect of the 2G mobile service frequencies.

t% represents the percentage to be levied on the operator's turnover. Generally speaking, the t% applied by administrations is 1% or close to 1%.

3.6.4 Fees applied for 3G mobile service

The following equation could be used for determining the annual amount *Rs* of the spectrum fee:

$$Rs = t\% * CA$$

Where:

CA represents the operator's turnover for the corresponding year in respect of the 3G mobile service frequencies.

t% represents the percentage to be levied on the operator's turnover.

To this annual fee is added an "entry ticket", payable upon allocation of the licence.

For the 3G case, the fixed amount has been replaced by the `entry ticket' that is proportional to the allocated bandwidth and payable upon allocation of the licence.

The guidelines for the establishment of spectrum fees[58] take into account the economic and budgetary objectives of the authorities, recognition of the benefits derived from spectrum occupancy – that depend on the use that the occupants make of the frequencies allocated to them, allocated bandwidth, area of the allocation surface, location within the spectrum of the allocated frequency band, etc.

The application of an "entry ticket" or excessively high annual fees during the introduction phase of a new radiocommunication service involving significant investment, could have the effect of reducing the investment capacity of the operators concerned.

The amount of the `entry ticket', which may be proportional to the allocated bandwidth, as the case may be, should not hamper the deployment of new entrants' networks.

4.0 Market-based assignment approach: Auctions

In an auction, licences are awarded by bidding among competing spectrum applicants. Auctions award licences to those who value them most highly while simultaneously generating revenues for the spectrum authority.

However, as is the case with an unrestricted spectrum market, auctions may raise competitive concerns if not combined with an active competition policy and limits on how much spectrum an entity may purchase.

Market forces do not ensure economic efficiency or maximize consumer welfare in markets that are not competitive because a dominant service provider or group of providers have market power.

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[58] Ibid.

4.1 Transferable and flexible spectrum rights

While auctions are the assignment mechanism best suited to providing an initial economically efficient distribution of the spectrum resource, they will not ensure that spectrum continues to be used in an economically efficient manner in the future.

As with other resources, economists recommend that spectrum users be allowed to transfer their spectrum rights (whether assigned by auction or some other assignment mechanism) and that spectrum users have a high degree of flexibility in the choice of the consumer services that they provide with their spectrum.

4.2 Advantages and disadvantages of auctions and transferable spectrum rights

Auctions have the advantages of awarding licences to those who value them most highly, while simultaneously generating revenues. When auctions are used to assign licences within a given allocation structure, licences are awarded to those who value them the most only within the confines of the allocation structure.

Other expected benefits associated with auctions may be fairness, transparency, objectiveness, and the speed with which licences can be awarded. Auctions can reduce the opportunities for favouritism and corruption in the competition for spectrum, promote investment, and promote technological advancement.

However, in order to promote competition, it may be necessary to impose additional safeguards, for auctioned services. For example, in some situations some or all of the potential bidders may be dominant service providers who are endeavouring to strengthen their monopoly positions.

Restrictions on eligibility to participate in an auction or limits on the amount of spectrum that any entity may win can alleviate this problem, although this may limit the number of participants.

5.0 Types of auctions

Auction is increasingly being used among new technologies and services such as IMT.

The licence(s) can be assigned on the basis of a so-called 'open bidding' or public process, with bids visible to other parties, or on a 'sealed tender' system, under which each party marks a single private offer; there are numerous alternative variants of open auctioning.

The auction can have a minimum acceptable bid or 'reserve price'.

The choice of auction mode will vary with the nature of licences made available, the number and nature of firms with an interest in theirs and the regulator's or government's objectives.

There are a number of trade-offs between, for example, the advantages which an open auctioning system has in spreading knowledge among firms about other firms' valuations, hence encouraging higher bidding, and the opportunities for collusion among bidders which the communication present in open auctioning may facilitate. As a result, each set of circumstances tends to require an individual solution.

The experience of other jurisdictions and the pros and cons various spectrum auction designs including:[59]

- **English auctions or simultaneous ascending auction (SAA)** – where blocks of spectrum are awarded to the highest bidder remaining who has exceeded the opening price set by the regulator;

- **Dutch auctions** – where the ultimate price paid is determine after succeeding descending rounds from an initial high price set by the regulator;

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[59] Refer to www.acma.gov.au/WEB/STANDARD/pc=PC_300178

- **First-price sealed-bid auctions** – where participants submit their bid without any information on prices and the highest bidders wins;

- **Second-price sealed-bid auctions** – similar to the previous method except the second highest price is selected;

- **Simultaneous ascending auction (SAA) sealed-bid hybrid auctions** – where SAA is used in the first several rounds and first-price sealed-bid is used in the final round.

- **Simultaneous multi-round ascending auctions –** This format is used when there are many spectrum lots to be allocated together across a range of different geographic areas and there are different band segments.

  All lots are simultaneously on offer over multiple rounds of bidding. Bidders may bid on any lot or combination of lots in each bidding round. At the end of each round high bids are disclosed and all bidders can bid again in the next round to become the high bidder. In general, after a round with no more bids, the bidders holding the high bids in the previous round win the lots.

6.0   Spectrum issues and pricing strategy for Nepal

For the terrestrial component of International Mobile Telecommunications (IMT), the following frequency bands are identified in the Radio Regulations:

Band (MHz)	Radio Regulation Footnotes identifying the band for IMT
450 – 470	5.286AA
698 – 806$^{\#}$ / 790 – 862$^{\#}$; 806 – 960$^{\#}$	5.313A, 5.317A
1710 – 1885, 1885 – 2025	5.384A, 5.388
2 110 – 2 200	5.388
2 300-2 400	5.384A
2 500-2 690	5.384A
3 400-3 600	5.430A, 5.432A, 5.432B, 5.433A

$^{\#}$ *790-862 MHz (Allocation for Region 1 and 3)*

 698-790 MHz (Allocation for Region 2 and 9 countries in Region 3: Bangladesh, China, Rep. of Korea, India, Japan, New Zealand, Papua New Guinea, Philippines, and Singapore).

Details of frequency bands planning for use by six service providers for CDMA 800, GSM 900, GSM 1800, CDMA 1900, 3G (W-CDMA) and 3G as provided by NTA are given in Appendix A.

While Appendix A gives the band planning for IMT services in Nepal there is no information available as to how the entire bands identified in the Radio Regulations for IMT purposes (and also shown above) are planned to be utilized in Nepal.

For all IMT frequency bands identified in the Radio Regulations, there is a need to establish suitable `national footnotes' in the revised National Frequency Allocation Plan (NFAP). These would explicitly define the usage of IMT frequency bands and the basis for their sharing by different operators.

6.1   Use of lower frequency bands for IMT services in Nepal

Nepal is currently planning the use of 2.3 and 2.6 GHz bands for IMT applications. While these bands could be useful in large populated cities like Kathmandu, the lower frequency bands with better building penetration and smaller foliage loss are more cost effective and have larger coverage.

IMT advanced technologies can now be implemented at lower bands and 700 MHz is proving to be most effective for deployment in rural or high-cost regions. It is also economically viable – an LTE network at 700 MHz would be 70 per cent cheaper to deploy than an LTE network at 2.1 GHz (GSM Association). Two to three times less sites are required for initial coverage at 700 MHz as compared to 2.1 or 2.5 GHz.
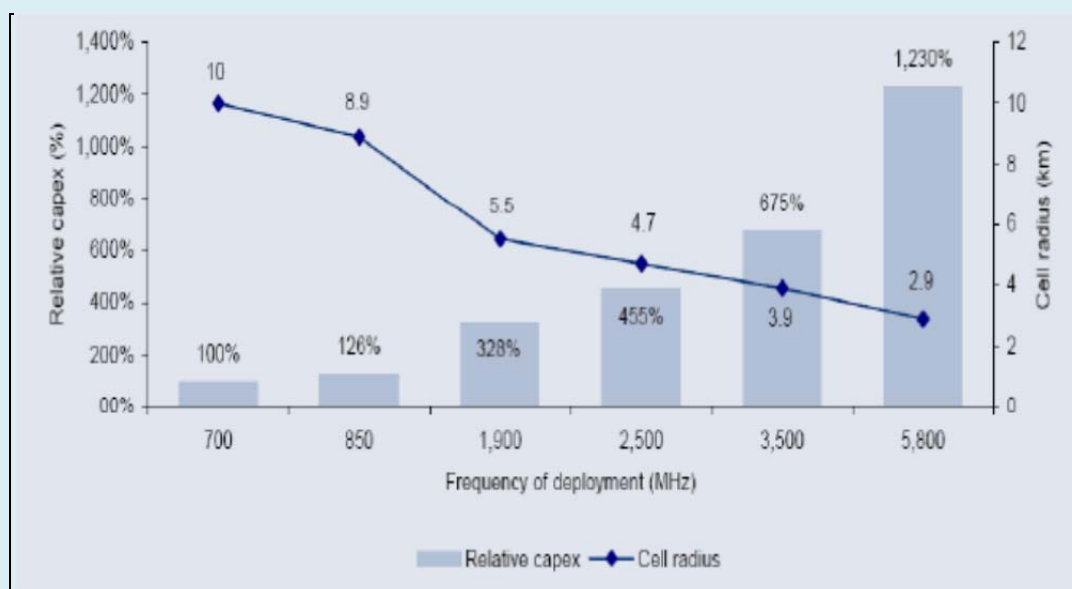
Figure G.2: Comparison of cell site coverage[60]

Source: Aloha Partners

The relative Capex as well as the cell radius favour the use of 700 MHz as compared to higher frequency bands.

Figure G.3: Relative Capex and cell radius

Source: ITU

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[60]   www.alohapartners.net

WRC-07 developed WRC-12 agenda item 1.17 to consider the results of sharing studies between the mobile service and other services in the band 790-862 MHz in Regions 1 and 3, in accordance with Resolution 749 (WRC-07), to ensure the adequate protection of services to which the frequency band is allocated. Later this month (17th Feb. 2012) the WRC -12 make available its conclusions on this agenda item.

With the availability of 790-862 MHz (Allocation for Region 1 and 3) Nepal, as a Region 3 country is well poised to exploit the gains of this band for IMT advanced service in general and LTE in particular.

6.2   Frequency arrangements in the band 698-960 MHz

Preliminary Draft Revision (PDR) of Recommendation ITU-R M.1036-3, "Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications-2000 (IMT-2000) in the bands 806-960 MHz, 1 710-2 025 MHz, 2 110-2 200 MHz and 2 500-2 690 MHz" was discussed at the 12th meeting of Working Party 5D Goa, India, 12-19 October 2011.

The PDR ITU-R Rec 1036-3 has been revised by ITU-R Study Group-5 and the revision is under approval through consultation for which circular letter CAR/ 329 has been issued by Radiocommunication Bureau (BR).

The frequency arrangements in the band 698-960 MHz, contained in the PDR (as revised) is shown in Figure G.4.

Figure G.4: Frequency arrangements in 698-960 MHz
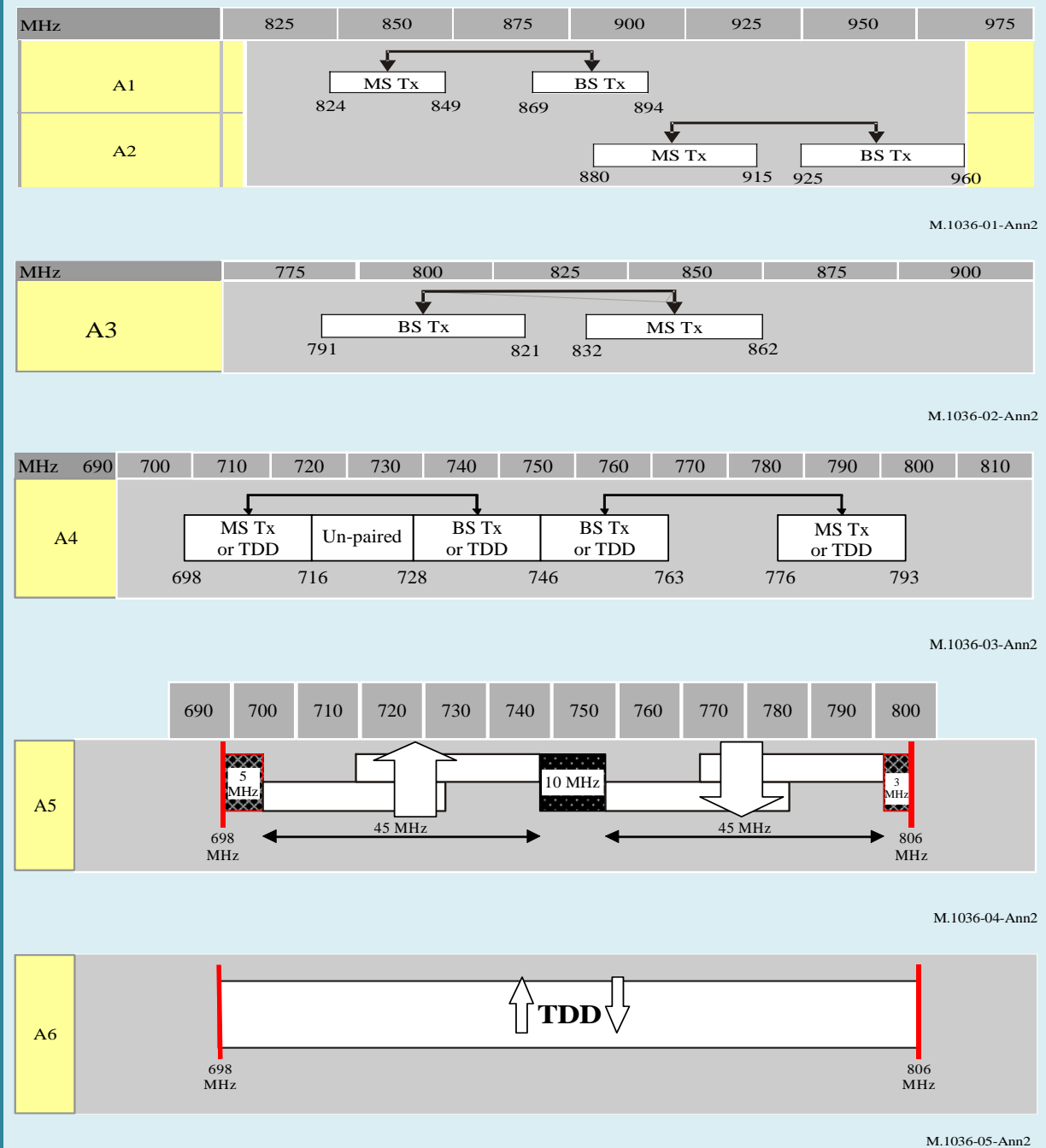
Source: ITU

In the arrangement A3 – reversed duplex direction (mobile transmit in upper band and base transmit in lower band) provides better conditions for coexistence with the lower adjacent broadcasting service.

In arrangement A4, administrations can use the band solely for frequency division duplex (FDD) or time division duplex (TDD), or some combination of FDD and TDD. Administrations can use any FDD duplex spacing or FDD duplex direction. However, when administrations choose to deploy mixed FDD/TDD channels with a fixed duplex separation for FDD, the duplex separation and duplex direction as shown in A4 are preferred.

For arrangement A5, 2 x 45 MHz FDD arrangement uses sub blocks with dual duplexer solution and conventional duplex arrangement. Internal guard bands of 5 MHz and 3 MHz are provided at the lower and upper edge of the band for better co-existence with adjacent radio communication services.

Arrangement A6, taking into account the external 4 MHz guard band (694-698 MHz), a minimum internal guard-band of 5 MHz at the lower edge (698 MHz) and 3 MHz at the upper edge (806 MHz) needs to be considered.

6.3   National Frequency Allocation Table (NFAT) and bands identified for IMT

In the national context and as a part of State rights and obligation it is up to the State, or a delegated regulatory authority, to allocate frequency bands. The managing authority draws up the national frequency allocation table and the national frequency register listing frequency assignments and keeps them up to date.

Allocations are to be listed in a national frequency allocation table, which shall indicate, for each frequency band and, as required, the authorized services with the corresponding authorized categories (according to the definitions contained in RR Article 1) and user categories. The table shall also specify user rights and obligations (such as exclusive use, sharing with equal rights or with priority, etc.).

A national table of frequency allocations is a basic tool for an efficient spectrum management process. It provides a general plan for spectrum use and the basic structure to ensure efficient use of the spectrum and the prevention of RF interference between services.

Through use of the table, manufacturers will have a guide to where in the spectrum to design and build equipment and users will know where to operate. As described in the handbook "National Spectrum Management", the International Table of Frequency Allocations (Article 5 of the Radio Regulations) forms the basis for national tables and in some countries this may be used as the national table.

Nevertheless, other countries have included additional information on national use varying in detail from showing which service operates when the Radio Regulations offer a choice, to spectrum available for government and non-government use, and, for specific sub-bands, channel arrangements and equipment specifications in use.

As part of the Guidance on the regulatory framework for national spectrum management[61], ITU had sought responses from administrations to the question *Is there a national table of frequency allocations?* Responses from 73 administrations showed that 93 per cent have a national allocation table. The score for the countries of Europe is 100 per cent.

The National frequency Allocation Plan/Table for Nepal was updated in 2004 and therefore lacks the details of Article 5 of the Radio Regulations Edition 2008 (latest edition – soon to be revised after the Final Acts of the WRC-12 are released on 17 February 2012 at the conclusion of the WRC-12).

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[61]   www.itu.int/pub/R-REP-SM.2093-2007

6.4 Spectrum auctioning in Nepal

6.4.1 International situation

There is a growing pressure on governments and regulators to make increasingly large portions of spectrum available to the mobile industry to meet its spectacular growth. Regulators all over the world are faced with the underlying question about spectrum: how much is it worth?

In purely financial terms, one can establish the value of a discrete block of spectrum by putting it up for sale and seeing how much anyone is willing to pay to use it.

Broadband services have pushed traditional spectrum assignment processes into obsolescence, leading more governments to overhaul their licensing approaches.

Three basic spectrum management models – *command-and-control*, *property rights* and *commons* – have existed for essentially all of the past two decades of policy change in spectrum management.

While many regulators continue to apply a ` command-and-control approach' to allocation of spectrum, the `Flexible rights of use' model is applied to typical uses such as 2G and 3G mobile services.

Following the `Flexible rights of use' model, many administrations have chosen to auction the spectrum.

Recently, spectrum was subjected to auction / renewal in administrations close to Nepal. Table G.1 brings out the details.

Table G.1: Spectrum releases, pricing and upfront fees in various administrations in the region

Nation	Population (m)	Allocation Type	Allocation Details (band)	Date	Spectrum Allocated (paired)	Total upfront fee (USD million)	Price / MHz (USD million)	Price /MHz/ Population (USD)
India[62]	1,180	Auction	2100 MHz	2010	15-20 MHz	10.938	729.2	0.61
Pakistan	166	Renewal	900/ 1800 MHz	2004	13.6 MHz	291	21.4	0.128
Nepal	28	Auction/ Renewal	900/ 1800 MHz	2009	19 MHz	270[63]	14.21	0.507
Sri Lanka	20	Renewal	900/ 1800 MHz	2008[64]	13.5 MHz	5	0.37	0.018
Indonesia	234	Auction	2100 MHz	2006	90 MHz	1,000	11.1	0.047
Singapore	5	Renewal	900 MHz	2008	30 MHz	5.4	0.18	0.036
			1800 MHz		60 MHz			
		Auction	1800 MHz	2011	5 MHz	17.1	3.42	0.687
Hungary	10	Renewal	900 MHz	2007	8 MHz	49.43	6.18	0.617
Bulgaria	23	n.a	1800 MHz	2008	10 MHz	11.53	1.15	0.050
Egypt	78	Auction	2100 MHz	2006	20 MHz	3,004	150.2	1.925

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[62] Licences issued on a regional basis. 5 MHz paired per license issued. 'Total upfront fee' represents fee for all 5 MHz licences. Please refer to APPENDIX-B for a comprehensive breakdown of India's regional allocations.

[63] Actual payment is we understand much less.

[64] Granted in 2006 but effective in 2008.

Nation	Population (m)	Allocation Type	Allocation Details (band)	Date	Spectrum Allocated (paired)	Total upfront fee (USD million)	Price / MHz (USD million)	Price /MHz/ Population (USD)
Hong Kong, China	7	Auction	1800 MHz	2009	5 MHz	5.99	1.2	0.171
			900 MHz	2011	10 MHz	250.2	25.02	3.575
New Zealand[65]	4	Auction	N/A	2007	Licenses of 1 x paired	N/A	2.9	0.730

Source: Windsor Place Consulting analysis of industry sources, March 2011

A close examination of the state-wise comprehensive breakdown of India's regional allocations leads to the following deductions:

- Given the fact that Nepal has an annual GDP per capita = USD 438 (World Bank: 2010), if the price of spectrum for those states in India with comparable annual GDP per capita, is considered, the price of spectrum in Nepal could be interpolated as 0.12 USD / MHz / million population on average; or it could be in the range of 0.06 to 0.31 USD / MHz / million population.

- Elsewhere in the world there are examples of the exercise of this `Flexible rights of use' model for spectrum management.

- France, Sweden, Finland, Switzerland and the UK- all dedicated spectrum in the 790 MHz – 862 MHz band (known as the 800 MHz band) for wireless services. The UK plans to auction spectrum in the 800 MHz and 2.6 GHz bands in 2012; meanwhile, unlike some other European countries, it is permitting 2G operators to re-farm the 900 MHz band for 3G offerings.

- The FCC completed the auction of spectrum in the 700 MHz band in March 2008. Spectrum allocated to a variety of providers mainly via a technology-neutral approach.

6.4.2   Situation in Nepal

Insofar as Nepal is concerned, the spectrum management and regulatory set up requires strengthening up on many fronts. Besides a better coordination between the MoIC, NTA and the service providers, the primary and secondary level regulation – that forms the essential attributes of a spectrum management system – needs reinforcement. The ITU GSR Best Practice Guidelines for Spectrum Management to Promote Broadband Access[66], were detailed during the workshop organized by the NTA. These need serious consideration.

While there are six service providers who benefit from the band allocation plans by NTA for IMT service (See Attachment A), there is duopoly in Nepal with NTC and Ncell being the major players. There is clearly a lack of competition for mobile service. Plans to auction spectrum for IMT service and the possibility of new entrants in the fray would enhance competition and improve quality of service. The proposition could be more attractive with auction taking place for spectrum in the lower frequency bands – for example 790-862 MHz band. However, before auctions for spectrum take place there would seem to be a need to consider carefully the optimal approach to secure and maintain competitive tension in relation to the spectrum. This could be done, by first auctioning a new telecommunications licence with 900 MHZ

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[65]   Figures for two cells unavailable. Currency converted using average 2007, NZD-USD rates (oanda.com)

[66]   www.itu.int/ITU-D/treg/bestpractice/2005/best_practices_e.pdf

(including perhaps the ability to utilize W-CDMA @ 900 MHz). Undertaking such an auction would be sensible given the voice centric nature of the Nepal market and the availability of equipment and devices to utilise the 700 MHz spectrum band for wireless broadband devices.

For the auction one may consider frequency bands not presently used in the 900 MHz or the vacant band 790-862 MHz. Other bands like 2 500-2690 MHz could also be considered for auctioning.

For competition and fairness, all service providers in Nepal, including incumbents should pay spectrum fee.

A rough assessment of the figure as to what price should be realized in Nepal has been presented above in this section.

It should also be noted that currently there are certain limitations in the Radio Act 1957 which mean that arguably, any auction of spectrum in Nepal would need to be by way of the granting of a separate telecommunications licence under the Telecommunications Act 1997. Optimally going forward, amendments should be made to the Radio Act to provide flexibility in the issuing of spectrum licences including by price based selection mechanisms such as auctions.

6.4.3   Rural connectivity in Nepal and use of satellite option

Using satellites in rural, remote and un-served areas of Nepal as part of a national broadband solution is both good public policy and makes commercial sense. High Throughput Satellites (HTS) especially in the Ka band provide a true paradigm shift from the conventional use of Ku and Ka band satellites. There are 100-to-1 cost advantages since the satellite capacity increases 100 fold as compared to today's conventional satellites.

These could be utilized to provide cellular network connectivity in areas without fibre, or microwave facilities or direct connectivity when mini BTS are not economic to use.

With the `Spot beam technology' utilized by the HTS – downlink beams illuminate a smaller area of the order of 100s of kilometres instead of 1000s of kilometres. Honeycomb – cellular pattern on the illuminated service area – frequency reuse – results in drastic increase in the overall capacity of the satellite. This is analogous to comparing a DTH (direct-to-home) broadcast signal to a cellular phone signal. Faster speeds – smaller dishes – upgraded services at lower costs– time and time zone sharing / geographical sharing are added attributes that make HTS a viable option.

7.0   Summary and conclusions

Spectrum pricing is a national subject and there isn't a universal methodology suitable for all the countries and Member States. However, there are some principles which can be taken into account to reach to more accurate results in estimating the value of spectrum and cost recovery of spectrum management. While this is so, certain steps on a national level would help in meeting the desired objectives.

The deliberations of the Radio Frequency Policy Development (RFPD) Committee in Nepal need to be speeded up to expedite the process of making 700 MHz band available for IMT service.

While the NTC support for WiMAX in 2.3 GHz band is acknowledged and is being actively pursued, the appeal of using a lower frequency band within Nepal for rural and underserved areas, with over 80 per cent population, is indeed very attractive.

Despite starting two years later than WiMAX 2, TD-LTE has now emerged as a viable alternative. TD-LTE commercial service has been launched in Brazil, Japan, Poland, Saudi Arabia, and other countries.

TD-LTE deployments are underway in Australia and Scandinavia and large-scale TD-LTE networks are planned in the United States and India. The frequency bands used by TD-LTE are 3.4–3.6GHz (Australia) 2.57–2.62GHz in the USA and China, and 2.3–2.4GHz in India and Australia.

Nepal can consider factoring in TD-LTE in their band allocation plans since it was only two years ago that most of the WiMAX operators, including operators with unpaired TDD frequency spectrum, were planning to deploy WiMAX 2. Today, most of them have are switching plans and are deploying TD-LTE instead.

As highlighted in section 6.3 above, the National Frequency Allocation Table must be updated. It is a very important national document on which depends the growth of wireless services in general and wireless broadband services, in particular.

A computer record of the National Frequency Register is mandatory and this must include government and private user records. With the possibility of an auction process in Nepal, it is incumbent on the government and regulator to ensure that the auctioned bands are free of any present use – if discovered at a later stage these can pose migration issues and unnecessary legal wrangles.

An understanding of the ITU International Frequency Information Circular (BR IFIC) - Terrestrial Services[67] is essential for all those in Nepal dealing with frequency matters. Keeping up- to-date with the ITU publication (now that the WRC is in progress and the Radiocommunication Assembly[68] is already over), is vital for Nepal – there are many experienced hands in NTA and MoIC who need to follow this up regularly. Participation in ITU activities on a regular basis, is also recommended.

Consideration be given in Nepal to facilitating entry of new entrant as part of the plan to accelerate wireless broadband services in Nepal. Given the dominant position of mobile services in Nepal now (which will grow even more so) and future wireless broadband services, the need for Nepal to utilize key spectrum below 1 GHz spectrum resources (especially the 700 MHz band) is profound.

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[67] www.itu.int/pub/R-SP-LN.IT/en

[68] www.itu.int/ITU-R/index.asp?category=conferences&rlink=ra-12&lang=en

ATTACHMENT A: Nepal Telecommunications Authority

Existing Frequency Assignment Details till 2068/8/14

S.No	Service Provider	Band	Frequency
1	Nepal Door Sanchar Company Limited	CDMA 800	827-835 MHz paired with 872-880 MHz (2x8 MHz)
		GSM 900	890-897.2 MHz paired with 935-942.2 MHz (2x7.2 MHz)
		GSM 900	897.2-899.6 MHz paired with 942.2-944.6 MHz (2x2.4 MHz)
		GSM 1800	1710-1719 MHz paired with 1805-1814 MHz (2x9 MHz)
		GSM 1800	1719-1725 MHz paired with 1814-1820 MHz (2x6 MHz)
		3G(W-CDMA)	1970-1980 MHz paired with 2160-2170 MHz (2x10 MHz)
2	United Telecom Limited	CDMA 800	824-827 MHz paired with 869-872 MHz (2x3 MHz)
		CDMA 800	834.995-836.245 MHz paired with 879.995-881.245 MHz (2x 1.25 MHz)
		CDMA 1900	1853.13-1854.38 MHz paired with 1933.13-1934.38 MHz (2x1.25 MHz)
3	Ncell Private Limited	GSM 900	902.6-908.6 MHz paired with 947.6-953.6 MHz (2x6 MHz)
		GSM 900	908.6-910.6 MHz paired with 953.6-955.6 MHz (2x2 MHz)
		GSM 1800	1732-1741 MHz paired with 1827-1836 MHz (2x9 MHz)
		GSM 1800	1741-1743 MHz paired with 1836-1838 MHz (2x2 MHz)
		3G(IMT 2000)	1960-1970 MHz paired with 2150-2160 MHz (2x10 MHz)
4	STM Telecom Sanchar Pvt. Ltd.	GSM 900	887.6-890 MHz paired with 932.6-935 MHz (2x2.4 MHz)
5	Nepal Satellite Telecom Pvt. Ltd.	GSM 900	910.6-915 MHz paired with 955.6-960 MHz (2x4.4 MHz)
		GSM 1800	1744-1753 MHz paired with 1839-1848 MHz (2x9 MHz)
6	Smart Telecom Pvt. Ltd.	GSM 900	899.6-902 MHz paired with 932.6-935 MHz (2x2.4 MHz)
		GSM 900	902-902.6 MHz paired with 947-947.6 MHz (2x0.6 MHz)

ATTACHMENT B: India 3G auction results

Exhibit 2:   Regional breakdown of Indian 3G spectrum auctions

Circle	INR (Crore)	5 MHz paired Licences issued	INR (Crore) Total	USD Total	Price / MHz (USD)	Population (2011)	GDP per capita (USD) (2010)	Price per MHz / million pop (USD)
Delhi	3316.93	3	9950.79	2,135,592,489	142,372,832.61	18,600,000	1,860	7.65
Mumbai	3247.07	3	9741.21	2,090,613,400	139,374,226.65	21,300,000	2,265	6.54
Kolkata	544.26	3	1632.78	350,419,686	23,361,312.38	15,400,000	2,274	1.52
Karnataka	1579.91	3	4739.73	1,017,218,913	67,814,594.21	61,130,704	1,070	1.11
Tamil Nadu	1464.94	3	4394.82	943,195,925	62,879,728.37	73,383,422	1,320	0.86
Gujarat	1076.06	3	3228.18	692,817,049	46,187,803.26	60,969,392	1,350	0.76
Andhra Pradesh	1373.14	3	4119.42	884,090,852	58,939,390.15	84,665,533	1,077	0.70
Maharashtra	1257.82	3	3773.46	809,842,518	53,989,501.23	92,530,695	1,563	0.58
Punjab	322.01	4	1288.04	276,433,183	13,821,659.13	27,704,236	1,312	0.50
Haryana	222.58	3	667.74	143,307,268	9,553,817.86	25,353,081	1,663	0.38
Kerala	312.48	3	937.44	201,189,034	13,412,602.24	33,452,106	1,250	0.40
Uttar Pradesh (W)	514.04	3	1542.12	330,962,656	22,064,177.08	72,000,000	488	0.31
Himachal Pradesh	37.23	4	148.92	31,960,521	1,598,026.05	6,856,509	1,063	0.23
Rajasthan	321.03	3	963.09	206,693,918	13,779,594.52	68,621,012	722	0.20
Madhya Pradesh	258.36	3	775.08	166,344,082	11,089,605.46	73,652,251	575	0.15
North East	42.3	3	126.9	27,234,691	1,815,646.04	13,810,822	453 to 1090	0.13
Uttar Pradesh (E)	364.57	3	1093.71	234,726,978	15,648,465.17	127,581,477	488	0.12
Jammu & Kashmir	30.3	4	121.2	26,011,383	1,300,569.15	12,548,926	646	0.10
Orissa	96.98	3	290.94	62,440,196	4,162,679.74	41,947,358	702	0.10
West Bengal	123.63	4	494.52	106,131,593	5,306,579.67	76,935,368	876	0.07
Bihar	203.46	4	813.84	174,662,574	8,733,128.68	136,770,875	340	0.06
Assam	41.48	3	124.44	26,706,737	1,780,449.12	31,168,272	574	0.06
TOTAL	na	na	50960.37	10,938,595,645	729,239,709.67	1,176,382,839	1,100	0.61

Exchange rate used INR: USD   46.594985 as at 10 May 2010

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Indian States with annual per capita GDP comparable to that of Nepal – Nepal's Annual GDP per capita = USD438
(World Bank: 2010)

> **The price of spectrum in Nepal could be interpolated as 0.12 USD / MHz / million population on average; or it could be in the range of 0.06 to 0.31 USD / MHz / million population.**

Source: www.dot.gov.in/as/Auction%20of%20Spectrum%20for3G%20&%20BWA/Auction%20results/3G_- 19_May_2010.pdf

Annex 1: List of acronyms and abbreviations

3GPP	*The 3rd Generation Partnership Project*
ACMA	*Australia Communications and Media Authority*
APT	*Asia Pacific Telecommunity*
ARPU	*Average Revenue per User*
AWS	*Advanced Wireless Services*
BWA	*Broadband Wireless Access*
EGAN	*3GPP Enhanced Generic Access Network*
FCC	*US Federal Communications Commission*
FDD	*Frequency Division Duplexing*
GCF	*Global Certification Forum*
GPRS	*General Packet Radio Service*
GSM	*Global System Mobile*
HetNets	*Heterogeneous Networks*
HSPA	*High Speed Packet Access*
ITU	*International Telecommunication Union*
ITU-R	*ITU Radiocommunication Sector*
IWLAN	*Interworking Wireless LAN*
LTE	*Long Term Evolution*
M2M	*Machine to Machine*
MBMS	*Multimedia Broadcast/Multicast Service*
MDGs	*Millennium Development Goals*
MVNO	*Mobile Virtual Network Operator*
NTA	*Nepal Telecommunications Authority*
OOB	*Out-of-band*
PPP	*Public private partnership*
PSTN	*Public Switched Telephone Network*
RAN	*Radio Access Network*
RLANS	*Radio Local Area Networks*
RTDF	*Rural Telecommunications Development Fund*
SMS	*Short Message Service*
SON	*Self Organising Network*
SRSPs	*Standard Radio System Plans*
TDD	*Time Division Duplexing*
UMA	*Unlicensed Mobile Access*
UMTS	*Universal Mobile Telecommunications System*
WBB	*Wireless Broadband*
W-CDMA	*Wideband Code Division Multiple Access*
Wi-Fi	*Wireless Fidelity*
WiMAX	*Worldwide Interoperability for Microwave Access*
WRC-07	*World Radiocommunications Conference 2007*

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