National Spectrum Strategy

(Draft)

Nepal Telecommunications Authority (NTA)

Jamal, Kathmandu, Nepal.

G.P.O. Box No.: 9754

Phone: +977-1-5355474, Fax: +977-1-5355250

E-mail: ntra@nta.gov.np, Website: https://www.nta.gov.np

Table of Contents

Introduction

Background

Information and Communication Technology (ICT) sector is one of the most emerging fields and has exponential growth. The ICT/Telecommunications has been considered as catalyst for the development of vertical industries. According to ITU, 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. As a landlocked country with mountainous topology and relatively underdeveloped fixed-line foundation, wireless communication plays an important role in the development of ICT Sector in Nepal. Basic mobile communication is essential for the social interaction of citizens, but it is widely agreed that mobile broadband assists in the economic growth of the country. Nepal's 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 scalable, achievable and transparent framework.

Radio frequency (RF)

The radio frequency spectrum is a natural, finite, non-depleting and valuable national resource essential for radio/wireless communication. It is a subset of the electromagnetic waves lying between the frequencies from 9 kilohertz (kHz - thousands of cycles per second) to 30 gigahertz (GHz - billions of cycles per second). These radio frequency bands support a wide range of business, personal, industrial, scientific, medical research and cultural activities, both public and private.

Radio spectrum is a scarce/finite resource in terms of instant capacity, inexhaustible when used over time, but can be in short supply in areas of high demand. The scarcity of frequency spectrum is illustrated by more and more wireless applications competing to access spectrum and also by the increased demand for higher data rate and greater coverage.

Spectrum management

Spectrum management is a combination of administrative and technical activities for efficient utilization of spectrum by users without causing harmful interference in their service area. It is the art and science of regulating the use of the radio frequencies to enable the optimum number and types of services to coexist in the same physical space. Spectrum is regulated by the state for coordination of radio emissions so as to avoid radio interference and allocation of scarce resources between competing uses to ensure technical and economic efficiency.

The spectrum management system must provide an orderly method for allocating and assigning frequency bands, authorizing and recording frequency assignments and establishing regulations and standards. The effectiveness of a spectrum management is related to how well the system meets the national needs and how well it is able to safeguard the interests of the public.

Wireless technologies

Mobile broadband services

Mobile communication has started in Nepal from 1999 with the launch of 2G (GSM) service in 900 MHz band. As the technology evolved, other wireless services, namely 2G (CDMA), 3G (WCDMA, EVDO), 4G (LTE, WiMAX) were introduced in following years. Spectrum at 800 MHz, 850 MHz, 900 MHz, 1800 MHz, 2100 MHz and 2300 MHz are used to provide these services.

As the telecommunication industry has started providing mobile broadband, data demand on the network is increasing rapidly. Present demand for cellular spectrum is created mainly by growth in broadband traffic. According to data provided by the operators, approximately 2.5-fold increase in data traffic has been observed in Nepal since the start of the COVID-19 pandemic, and the exponential growth is expected to continue in the future. To address this high traffic demand, small cells and/or more spectrums is required. More than 315 MHz of cellular spectrum has already been assigned to the service provider in the Country till date. The operators are expanding 4G/LTE services in the fast pace. As the penetration and user density of 4G/LTE increases, the operators will need additional spectrum to maintain service quality and provide better user experience. As Nepal is already planning for 5G trials, the trial and eventual commercial operation will require substantially higher spectrum bandwidth.

IoT/M2M Communications

Internet of things (IoT) is a network or eco-system of physical objects (things) that are connected through the internet to exchange data, without any human interaction. Machine-to-machine (M2M) is the one- or two-way exchange of information between devices, using either wired or wireless connectivity without the manual assistance from humans. Globally, vertical industries today from agriculture, manufacturing to transport and logistics have started to deploy IoT/M2M solutions to improve productivity and operational efficiency. IoT/M2M via wireless communication will play a vital role in the implementation of smart cities, smart homes, smart grids, smart wearables etc. As the number of smart devices connected to the internet scales up, they will generate significant amount of network traffic. Adequate planning is required to address this demand for spectrum by allocating/assigning spectrum in cellular and/or unlicensed bands.

Broadcasting services

Broadcasting is the distribution of audio or video content to a dispersed audience using radio waves. Radio and TV broadcasting are two of the most powerful means of communication till date. However, broadcasting is beyond the scope of this report and strategy.

Fixed services

Because of the growth of telecommunication network and difficulty of connecting all network infrastructures via optical fiber, the spectrum for point-to-point microwave is still in demand. Point-to-point nature of the link enables reuse of same frequency for multiple times in different areas and directions. Microwave links generally use spectrum bands above 6 GHz. The demand for lower frequency bands is higher as they provide longer coverage range and is suitable for remote and rural areas. Lower bands are heavily occupied and operators are now moving towards higher bands. Higher frequency bands provide more bandwidth but the coverage sinks as frequency increases. Wireless backhaul with higher frequency band in densely populated cities can be more efficient than fiber-based backhaul. Emergence of new technologies in Wireless may require higher spectrum bands and refarm the existing band.

Satellite services

Either for communications across areas where other means of communications are not available or as a backup to the existing connections, satellite communication remains vital considering the topography of Nepal. Moreover, satellites are still extensively used for broadcasting services to deliver contents across large geographic areas. In addition to broadcasting satellite services, fixed satellite (earth stations at given position) and mobile

satellite services (earth stations in motion) are being used for communication and earth exploration purposes. Using radios on aerial platforms hovering in the stratosphere, high-altitude platform stations (HAPS) can be used to provide both fixed broadband connectivity for end users and transmission links between the mobile and core networks for backhauling traffic. With these new concepts as well as new satellite services in LEO and MEO, satellite services are able to meet the user demand of broadband connection. Among the satellite bands, Ka-band is evolving as a potential band for high throughput. However, some of the existing satellite bands, in particular C-band are touted as potential 5G bands. These bands may have to be refarmed gradually to allow the operation of more viable wireless technologies or the solution has to be sought for co-existence of both services.

Aeronautical services

Aviation sector is a major user of RF technologies on board aircraft as well as for air-traffic control. Given the sensitivity of these services, ITU and ICAO coordinate with each other to secure the radio-frequency spectrum required for aviation purposes. Newer applications include non-safety aeronautical mobile applications for air-to-air, ground-to-air and air-to-ground communications of aircraft systems. With the changes in aviation technologies, there will be new requirements that will impact the spectrum demand and allocation for aeronautical services and this is not the scope of this strategy.

Short range and ultra-wideband devices

Short range devices (SRDs) are low power devices that have low capability of causing interference to other radio equipment. Although these devices operate in radio frequency, short range devices are not regulated by ITU Radio Regulations (RR) but regulated on National basis. The ISM bands designated by the RR are usually used for SRDs as well. Another well-known technology Ultra-Wide Band Technology (UWB) is an active underlay technology, transmitting signals that spread over a large bandwidth (>500MHz). Operating at very low signal levels, UWB emissions appear as noise floor to narrowband radio systems, allowing UWB devices to operate underneath existing services. UWB technology is typically used to transmit large amount of data over a short distance (<15m). SRD and UWB are becoming integral part of modern lifestyle. However, adequate regulation of these devices is necessary to ensure smooth operation of all wireless services.

Public protection and disaster relief (PPDR)

PPDR communications refer to radio applications designed for public safety, security and defense. Relevant authorities and operators use those applications to respond to serious disruption of the functioning of society, posing a significant widespread threat to human life, health, property or the environment, whether caused by accident, natural phenomena or human activity, and whether developed suddenly or as a result of complex, long-term processes. Sufficient harmonized spectrum has to be made available for public safety and protection, civil protection and disaster relief.

Present Status of Nepal

Legislative provisions

Following the establishment of democracy in 1990, the Government of Nepal formulated Telecommunication Policy, 1992, and Telecommunication Act, 1997 and Telecommunication Regulation, 1997 were enacted subsequently. With the spirit of the Policy, Act and Regulations, the telecommunication sector was liberalized and it was open to private sector as well. Consequently, government-owned as well as private operators have been instrumental in developing telecommunication infrastructures across the nation and thereby providing universal access to telecommunications. Section 49 of Telecommunication Act, 1997 made a provision of Radio Frequency Policy Determination Committee, for the purpose of formulating the policy relating to the use of radio frequencies.

Spectrum allocation and usage

The current allocation of spectrum for the different services is as follows:

Cellular Services

Frequency Bands (MHz) and Duplexing			**Allocated Frequency Range (MHz)**	**Total Available Bandwidth (MHz)**	**Total Assigned Bandwidth (MHz)**	**Remaining Spectrum (MHz)**
			Start - Stop			
700	FDD	UL	703 - 748	2 X 45	-	2 x 45
		DL	758 - 803			
800	FDD	UL	852 - 862	2 X 10	2 x 10	-
		DL	811 - 821			
850	FDD	UL	824 - 834	2 X 10	2 x 5	2 x 5
		DL	869 - 879			
900	FDD	UL	880 - 915	2 X 35	2 x 33.6	2 x 1.4
		DL	925 - 960			
1800	FDD	UL	1710 - 1785	2 X 75	2 x 73	2 x 2
		DL	1805 - 1880			
2100	FDD	UL	1920 - 1980	2 X 60	2 x 25	2 x 35
		DL	2110 - 2170			
2300	TDD	-	2300 - 2400	100	30	70

2600	FDD	UL	2500 - 2570	2 X 70	-	2 x 70
		DL	2620 - 2690			
	TDD	-	2570 - 2620	50	-	50
3300	TDD	-	3300 - 3400	100	-	100
3400	TDD	-	3400 - 3600	200	-	200
3600	TDD	-	3600 - 3800	200	-	200

Broadcasting Service

Allocation and assignments of broadcasting spectrum is beyond the scope of current study.

Fixed Microwave Services

Frequency Bands (GHz)	Allocated Frequency Range (GHz)	Assignment
Lower 6	5.925 - 6.425 GHz	Yes (Limited Assignment)
Upper 6	6.425 - 7.125 GHz	Yes
7 GHz	7.250-7.550 GHz	Yes
	7.498-7.554 GHz paired with 7.659 -7.715 GHz	Yes
8 GHz	7.725 - 8.275 GHz	Yes
	8.275 - 8.500 GHz	Yes
13 GHz	12.750 - 13.250 GHz	Yes
15 GHz	14.500 - 15.350 GHz	Yes
18 GHz	17.700 - 19.700 GHz	Yes
23 GHz	21.200 - 23.600 GHz	Yes
38 GHz	37.000 - 39.500 GHz	-
60 GHz	57 - 59 GHz	-
	64 - 66 GHz	-
	59 - 63 GHz (TDD)	-
80 GHz	71-76 GHz	-
	81-86 GHz	-

VSAT and GMPCS Services

Allocated Range	Bandwidth (MHz)	Remarks	Assignment
1525 MHz-1559 MHz	34	Downlink	

1626.5 MHz-1660 MHz	33.5	Uplink	Yes (GMPCS)
2483.5 MHz - 2500 MHz	16.5	Downlink	
1610 MHz -1626.5 MHz	16.5	Uplink	
3600 MHz- 3623 GHz	23	Downlink	
6425 MHz-6443 MHz	18	Uplink	
3400 MHz - 4200 MHz	800	FSS (C Band Downlink)	Yes
5850 MHz-6700 MHz	850	FSS (C Band Uplink)	
10.7 GHz-11.7 GHz	1 GHz	Extended Ku band Downlink	Yes
11.7 GHz- 12.2 GHz	0.5 GHz	Ku band Downlink	
12.2 GHz-12.75 GHz	0.55 GHz	Extended Ku band Downlink	
13.75 GHz-14 GHz	0.25 GHz	Extended Ku band Uplink	
14 GHz-14.5 GHz	0.5 GHz	Ku band Uplink	
19.7 GHz -21.2 GHz	1.5 GHz	Ka Band Downlink	-
29.5 GHz-31 GHz	1.5 GHz	Ka Band Uplink	

ISM Bands

Following bands are identified and allocated as ISM bands in Nepal:

2.4 GHz Band: 2.4 GHz to 2.4835 GHz

5.1 GHz Band: 5.15 GHz to 5.35 GHz

5.8 GHz Band: 5.725 GHz to 5.825 GHz

The frequencies in those bands are used in non-protection and non-exclusive (shared) basis. For 2.4 GHz and 5.8 GHz bands, the transmitter power and effective isotropic radiated power are specified to be within the following given limit:

Maximum out power of Transmitter	1W (30dBm)
Maximum Effective Isotropic Radiated Power (EIRP)	4W(36 dBm)

5.1 GHz band is defined to be used for Wireless Access System (WAS)/Radio Local Area Network (RLAN) as follows:

Frequency Band	Power Limits	Operational Restrictions

5.15-5.25 GHz	Maximum Mean EIRP = 200mW Maximum mean effective radiated Power density of 10 mW/MHz in any 1 MHz Bandwidth	Devices shall be restricted to indoor operations in order to reduce any potential for harmful interference to other operations in this band
5.25-5.35 GHz	Maximum mean EIRP = 200 mW Maximum mean effective radiated Power density of 10 mW/MHz in any 1 MHz Bandwidth	Operated predominantly indoors
	Maximum mean EIRP = 1 W* Maximum mean effective radiated power density of 50 mW/MHz Bandwidth	*Permitted to be used either indoors or outdoors *Shall comply to employ antenna elevation mask for EIRP levels higher than 200 mW but not exceeding 1 W

Need for spectrum strategy

Wireless Communication has become an integral part of our daily life. We are moving towards the Smart City, Smart Society and Smart Nation, This goal is only achievable with the development of Wireless Communication. And in order to develop wireless communication, it is necessary and very important to have the spectrum strategy plan. A well-defined Spectrum Strategy Plan will also help the operators to do their business planning. Spectrum strategy sets the goals of spectrum management and helps to promote the use of spectrum for overall prosperity of the country.

Objectives, Methodologies and Scope

Objectives:

- To promote competition among mobile service providers.
- To provide sufficient amount of spectrum to the licensees for reliable and quality mobile and wireless services.
- To make available the spectrum for new technologies such as 5G and IOT/M2M in timely manner.
- To increase the government revenue through the l spectrum assignment.
- To facilitate r the nationwide coverage of mobile broadband services.
- To ensure interference-free environment.

Methodologies

The following methodologies were adopted while formulating this strategy:

1. Assessment of Frequency policy
2. Analysis of national need
3. Interaction with stakeholders
4. Study of relevant international practices

Scope

. The scope of this strategy is confined only to the radio frequency spectrum allocated for telecommunication services by the Radio Frequency Policy Determination Committee.

Strategies for Optimal use of Cellular Frequencies

Technology Neutrality

As the field of telecommunications is rapidly advancing with the development of new technologies, tying up specific technology with specific band acts as hindrance to the development of telecommunication sector. Allocation and assignment of spectrum on technology neutral basis has many advantages, including:

- It enables service providers to launch new generation services easily and quickly.
- It ensures better quality of experience and quality of service to the end users.
- It optimizes utilization of the spectrum (the limited resource).
- It increases the business opportunity to the service providers.

Therefore, all the frequency bands will be allocated and assigned on technology neutral basis. Any associations between spectrum and a type of technology/service will be avoided.

Band specific approaches

700 MHz, 800 MHz, 850 MHz and 900 MHz (sub-1 GHz Bands)

900 MHz (band n8) still plays a vital role in Nepal to support legacy 2G networks. This band is also becoming a popular band for 4G. However, this band is almost exhausted in Nepal. 4G LTE is in operation in 800 MHz (band n20) while the CDMA service in 850 MHz (band n5) is being phased out. 700 MHz (band n28) is unused till date.

From the coverage prospective, sub-1 GHz bands are considered to be the best. Therefore, the following approach will be taken for frequency allocation and assignment in these bands:

1. To increase the spectral efficiency and to match the carrier format of 4G/5G, the minimum and maximum bandwidth assignment for a service provider in these bands will be fixed as follows:

Frequency Band	Total Bandwidth	Minimum Frequency	Maximum Frequency
700MHz	2x45 MHz	2x5 MHz	2x15 MHz
800 MHz	2x15 MHz	2x5 MHz	2x15 MHz
900MHz	2x35 MHz	2x5 MHz	2x10 MHz

2. Service providers will be encouraged to operate latest technologies in 900 MHz band.
3. The 900 MHz spectrum will be refarmed to cater the new technology.

4. Because of the overlap between 700 MHz, 800 MHz and 850 MHz, full frequency range of these three bands cannot be utilized. Therefore the following band plan will be considered:
    a. Full range (2x45 MHz) of 700 MHz band and upper half (2x15 MHz) of 800 MHz band will be allocated. Upper portion of 700 MHz band will be assigned after the assessment of possible interference from 800 MHz signals.
    b. As the phase-out process of CDMA services operating in 850 MHz band is in progress, further studies for optimal utilization of this band will be carried out.
5. As per the current plan, total spectrum available insub-1 GHz is 2x95 MHz (excluding 850 MHz band). Total spectrum assigned to a single service provider in sub-1 GHz bands will not exceed 25 MHz. This arrangement is expected to ensure quality mobile broadband as well as competitive telecommunication service.

1800 MHz and 2100 MHz

Till date, 1800 MHz (band n3) has been primary 4G band and 2100 MHz (band n1) has been primary 3G band in Nepal. However, 4G deployments in 2100 MHz band has already been started, and it is set to become a significant 4G band due to exponentially growing data traffic. Therefore, following approach will be taken for frequency allocation and assignment in these bands:

1. The minimum and maximum bandwidth assignment in these bands will be set as follows.

Frequency Band	Total Bandwidth	Minimum Frequency	Maximum Frequency
1800 MHz	2x75 MHz	2x10 MHz	2x20 MHz
2100 MHz	2x60 MHz	2x10 MHz	2x20 MHz

2. As 1800 MHz band is almost full, 2100 MHz band will be prioritized for capacity 4G network.

2300 MHz and 2600 MHz (Coverage and Capacity Bands)

For best compromise between coverage and capacity, 2300 MHz (band n40) and 2600 MHz (band n41) are becoming key 5G bands. Currently, portion of 2300 MHz band is assigned for 4G LTE services, while whole 2600 MHz band has no assignments. Present growth of mobile data suggests 2600 MHz band will also be used for 4G services before 5G technology matures. Following approaches will be taken for frequency allocation and assignment in these bands:

1. Current allocation of 2600 MHz in Nepal (FDD band n7 + TDD band n38) will be revised to TDD band n41 to align the regional harmony and get best benefit of the mature ecosystem. All frequency bands above 2300 MHz will be TDD only.

2. The minimum and maximum bandwidth assignments in these bands will be set to 60 MHz and 100 MHz respectively.

Frequency Band	Total Bandwidth	Minimum Frequency	Maximum Frequency
2300 MHz	100 MHz	50 MHz	100 MHz
2600 MHz	190 MHz	50 MHz	100 MHz

3. Total spectrum assigned to a single operator in these two bands combined will not exceed 100 MHz.

3700 MHz: C-Band (Capacity and Coverage Band)

Assignment of frequencies in the 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2600 MHz bands shall address the current spectrum demand in Nepal. Meanwhile, high-speed 5G capacity network are being deployed globally using 3700 MHz spectrum (band n77). It is expected that the demand for spectrum in 3700 MHz will increase in coming years. Therefore, this band will be allocated for mobile services and will be assigned as soon as the demand is generated. The minimum and maximum bandwidth assignment for a service provider in this band will be fixed to 100 MHz and 200 MHz respectively.

Currently, allocation of C-Band for Mobile Service and Fixed Satellite Service (FSS) overlap with each other. Studies will be conducted to determine the possibility of coexistence of FSS and IMT services in C-band. If required, existing licenses of FSS in C-Band will be refarmed and transferred to other bands.

26 GHz: mmWave Band (Capacity Band)

WRC-19 identified various mmWave bands for IMT so that ultra-high-speed service can be realized with 5G. Among the bands identified, 26 GHz (band n258) will be allocated for mobile services in Nepal. However, the use of mmWave is yet to gain global momentum due to coverage limitations of mmWave. Moreover, Sub-6 GHz spectrum is expected to be enough to handle the capacity demand in Nepal for the next few years. For now, the minimum bandwidth assignment for a service provider in this band will be fixed to 400 MHz.

Deployment of 5G

There is a prediction and well accepted fact that 4G and 5G will coexist for at least 10 years. As a result, 3GPP has formulated standards enabling 5G applications such as cellular IOT and massive MIMO available in 4G network. Even in the spectrum level, 4G spectrums are made available for 5G uses. In Nepal, 4G network is being deployed nationwide at the time when early movers of 5G are deploying 5G globally. So, the service providers in Nepal are able to roll out 5G compatible 4G networks protecting investment for network upgrade.

NTA's formulation of Frequency Policies and plans of Spectrum Allocation takes into account the current 4G (and its predecessors) as well as imminent 5G. Following approaches will be taken for 5G deployment in Nepal.

1. The 2300 MHz and 2600 MHz bands provide better coverage than C-Band and also have better compatibility with 4G, so 2300 MHz and 2600 MHz bands will be considered as the primary bands for the introduction of 5G in Nepal.
2. Similarly, 700 MHz and 800 MHz bands will be considered as the primary 5G bands from the coverage prospective.
3. Dynamic Spectrum Sharing (DSS) will be facilitated by allowing multiple generations of mobile technology to share the same carrier.

Regulations for TDD network

Utilization of TDD technology offers significant advantages with respect to spectrum efficiency, network performance and capacity. As such, it offers a viable evolution path from 4G towards 5G networks and services. Therefore, newly identified spectrums above 2 GHz are mostly in TDD mode. Even some spectrum identified for 4G in FDD mode are now being changed to TDD mode. In Nepal, spectrum above 2300 MHz will be assigned in TDD mode.

TDD mode of communication uses same spectrum for UPLINK and DOWNLINK during different time period and these time periods are organized for UPLINK and DOWNLINK as different set of timeslot configurations. So, there is a need to synchronize the uplink and downlink timeslot of each service provider with a same configuration. In case of non-synchronized time slots, service providers need to allocate significant amount of guard band together with customized filters to avoid interference. Such configuration impacts spectrum efficiency and capital expenditure.

TDD Time Slot Synchronization:

NTA will define National Clock Synchronization before initializing the assignment process of TDD spectrum. Service providers are obliged to synchronize TDD UPLINK & DOWNLINK time slots of 4G/5G spectrum band as per the rules set by NTA.

4G & 5G TDD Frame Structure Alignment:

Due to coexistence of 4G LTE and 5G NR in TDD mode, TD-LTE sub-frame configuration and 5G sub-frame configuration shall be synchronized to avoid interference between each other. NTA will define the Frame Structure for aligning 4G and 5G TDD frames.

Strategies for Frequency Management

Goal I: To make mobile communication sector more competitive.

Strategies for goal I:

1. Process will be initiated for the competitive entry of a new entrant to accelerate wireless broadband services in Nepal via auction process.
2. Transparent and nondiscriminatory spectrum management policies will be promoted and service providers will be provided with level playing field.
3. Spectrum hoarding will be discouraged. Instruments will be formulated to monitor the usage of spectrum.

Goal II: To avail the mobile service licensees with sufficient amount of cellular spectrum.

Strategies for goal II:

1. New cellular frequency bands will be identified and allocated.
2. Spectrum will be distributed via auction.
3. The amount of spectrum needed for IMT in different bands will be updated via definition of services, market expectations, technical as well as operational framework and international practices.
4. The efficiency of spectrum utilization will be optimized within the bands identified for IMT.
5. The Authority will actively participate in the identification of new technologies (such as IoT/ M2M) that are beneficial to Nepal's national context.
6. Spectrum for such technologies will be made available for trial and commercial purposes on time.
7. Technologies that boost social and economic growth will be promoted.
8. The authority will update and publish the Spectrum Roadmap regularly to ensure timely availability of spectrum for the operators

Goal III: To provide FS/FSS spectrum to the service providers on demand.

Strategies for goal III:

1. Frequencies for fixed services (including microwave point-to-point links) and fixed satellite services (including VSATs) will be identified and allocated.
2. High frequency bands for future backhaul in microwave will be allocated based on the international best practices.

3. Assignments for FS/FSS purpose will be done on demand. No roadmap will be required for this purpose.
4. Frequencies for less prominent technologies (such as FS, FSS) will be refarmed if the spectrum is essential for more impactful technologies (such as 5G, IoT/M2M). The less prominent technologies will be shifted to other alternative frequencies.

Goal IV: To assist service providers to expand the coverage of mobile services.

Strategies for goal IV:

1. Coverage for each technology will be defined in the form of minimum received signal level.
2. Nationwide geographic coverage of the basic mobile service (2G) will be ensured within 2079 B.S.
3. Universal service will be made mandatory for incumbent as well as new entrants. Timeframes and modality will be agreed with the service providers for gradual expansion of the network coverage in rural areas.
4. Rural Telecommunication Development Fund (RTDF) will be mobilized to install and operate wireless communication infrastructure in underserved (commercially unfeasible) locations.

Goal V: To make wireless broadband services accessible and affordable.

Strategies for goal V:

1. The availability of mobile broadband will be expanded to the rural and remote areas.
2. Wi-Fi hotspots, and community Internet centers etc. will be introduced to make the wireless broadband service affordable and accessible.
3. New ISM frequency bands will be introduced for non-commercial general-purpose usage.
4. Frequency bands for short range and ultrawideband devices and services will be allocated.
5. Standards will be formulated to prevent interferences by any emissions from the ISM, SRD and UWB devices.

Goal VI: To make the radio spectrum interference-free.

Strategies for goal VI:

1. Regular and ad hoc monitoring of the spectrum usage will be performed throughout the country.
2. Studies will be conducted to quantify the status of inter-band and intra-band interference and necessary actions will be taken to mitigate the problem.

3. Measures will be taken to mitigate interference between telecommunication service and other services as well.
4. Coordination with cross-border administration and regulator will be made effective to eliminate /mitigate cross-border interference situations.

Execution and Evaluation

Execution plan

This strategy will be implemented by NTA with assist from MOCIT whenever required. For the effective realization of these strategies, roadmaps, action plans and working methodologies will be formulated.

Progress evaluation

The evaluation of the progress of these strategies as well as roadmaps, action plans and working methodologies based on these strategies will be carried out by a team formed by Nepal Telecommunications Authority (NTA). The team will coordinate with service providers, vendors, consumer and other stakeholders for the effective execution of these strategies and provisions. Any comments and suggestions for amendment and improvement will be submitted to NTA as and when required. The progress status of these provisions will be reported to the Radio Frequency Policy Determination Committee on regular basis.

Annex A: Spectrum Roadmap

By analyzing the current trend of growth in mobile broadband, following roadmap is prepared for the

<table>
<tr><th>Frequency Bands \ Fiscal Year</th><th>2078/79 (till July 2022)</th><th>2079/80 (till July 2023)</th><th>2080/81 (till July 2024)</th><th>2081/82 (till July 2025)</th><th>2082/83 (till July 2025)</th></tr>
<tr><td>700MHz (n28)</td><td colspan="2">Auction</td><td></td><td></td><td></td></tr>
<tr><td>800MHz (n20)</td><td colspan="2"></td><td></td><td></td><td></td></tr>
<tr><td>850MHz (n26)</td><td>Clear CDMA Assignment</td><td></td><td></td><td></td><td></td></tr>
<tr><td>900MHz (n8)</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1800MHz (n3)</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2100MHz (n1)</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2300MHz (n40)</td><td colspan="2">Auction</td><td></td><td></td><td></td></tr>
<tr><td>2600MHz (n41)</td><td colspan="2">Auction</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">3700MHz (n77)</td><td rowspan="2"></td><td colspan="3">Clear FSS Assignment</td><td></td></tr>
<tr><td></td><td colspan="3">Auction</td></tr>
<tr><td>26GHz (n258)</td><td></td><td colspan="3">To Be Decided</td></tr>
</table>

Depending upon the evolution of current and future technologies, international practices, national spectrum usage trends and demand, this roadmap will be revised as and when required.