

ENHANCEMENT OF CABLE TV IN BHUTAN: ITS TECHNOLOGY AND BUSINESS MODEL

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1. Introduction, Methodology and Disclaimer

This study entitled "Enhancement of Cable TV services in Bhutan: Its Technology and Business Model" attempts to look at the various aspects of cable TV industry in Bhutan. M/S iDruk Consultancy is entrusted by Bhutan Infocomm and Media Authority (BICMA) with the responsibility to thoroughly study, within a period of three months, the ground reality in the cable TV businesses in the country. The study aims to identify all aspects of CATV (Community Access Television) such as its history, shortcomings, the emerging environment and its related opportunities, increasing threats due to rapid technical innovations, compare with the global and regional growth in similar businesses and finally come up with a realistic road map for the future.

The main methodology adopted looks at both the supply and demand side of the businesses identifying all the strengths of the current system, apparent weaknesses both within and outside of cable operators' domains as well as existing government's policies, perceived as well as actual threats and opportunities in cable businesses in Bhutan. Starting with independent sampled surveys covering more than 14 dzongkhags, the study followed with the compilation and review of all available literature, consultations with relevant stakeholders and a workshop consultation at a later stage with the representatives of the cable operators and other stakeholders. Meanwhile, several attempts are made to identify relevant best practices in other countries across the globe.

The main concern of the study is to present a strategic plan for the foreseeable future to ensure, as far as possible, a smooth transition of the current predominantly analog based cable business model into the more efficient and preferred digital based model. This transition needs to be undertaken in order to catch up technologically with the global transition into digitization thereby not depriving the Bhutanese households of the many advantages of such developments.

It is of vital importance to note here that the findings, critical analysis, and subsequent recommendations in this report are entirely those of M/S iDruk Consultancy in its capacity as a local consultant having undertaken the study entirely as a neutral entity and thereby, do not necessarily reflect the views and opinions of either the government agencies, the cable operators or any other consulted stakeholders.

2. Background & Current Situation:

2.1. History: Growth of Cable TV in Bhutan.

When it comes to the consumption of ICT services in Bhutan, consumption of television services definitely comes at the top. Ever since the legalization of TV in 1999, the growth in this industry particularly fueled by the rapid emergence of cable TV operators have been substantial. The Bhutan Information and Media Impact Study (BIMIS), 2013 shows that majority of Bhutanese households today own a TV set with 79% of rural households and 68% of urban households possessing TV sets at their homes. The report further notes that the numbers of TV sets ownership have increased steadily from 47,125 in 2008 to 74,846 in 2012 thereby denoting a huge and rising popularity of this media in the country.

Before the legalization of TV, most Bhutanese households, especially in the urban areas, owned analog TV sets with either VCR player or VCD/DVD players and were dependent on video rental houses to watch mostly Bollywood and Hollywood films at their homes. At the time, it was a thriving business for these video rental houses. However, the legalization of TV was followed by emergence of the cable TV operators started initially by Sigma, closely followed by Norling cables in Thimphu. Similar set ups were established gradually in mostly urban and semi-urban settings of other dzongkhags. The Bhutanese consumers welcomed the cable TV and saw them consuming the numerous channels entirely sourced from India, which gradually led to the closure of video parlours. The cable service also meant fewer expenses by the households since at Nu. 200 per month (then), each household would receive more than 40 channels as compared to an average of Nu. 600 on video rentals every month.

The immediate growth of the cable industry, while generally lauded, was not efficient. The cable operators started their businesses in their own locality and were fragmented as was in the neighboring India. However, unlike India where there were many cases of un-registered local cable operators (LCO), because of relatively very small market and areas of operations, all cable operators were registered properly and effectively regulated in Bhutan. Nevertheless, with little or no technical expertise but with a drive to tap this new opportunity, cable operators found themselves initially making investment in wrong technologies such as buying wrong or inferior cables, short-sighted cabling plans, wrong headend equipments etc. On the other hand, because of their fragmented business model, the Indian TV program suppliers took advantage of the situation and were charging unreasonable and ad-hoc fees to each cable operator. In absence of a competent government agency then, the government could only do very little initially to enhance the effective growth of this industry.

Driven by market forces and inefficient negotiations with the Indian program suppliers, the cable operators eventually formed an association among themselves called Association of Private Cable Operators (APCO) to stand as one collective voice when negotiating with Indian TV service providers. This has effectively helped all cable operators towards receiving a uniform rate for the channels obtained from India. It is still the main practice of obtaining TV signals from India today.

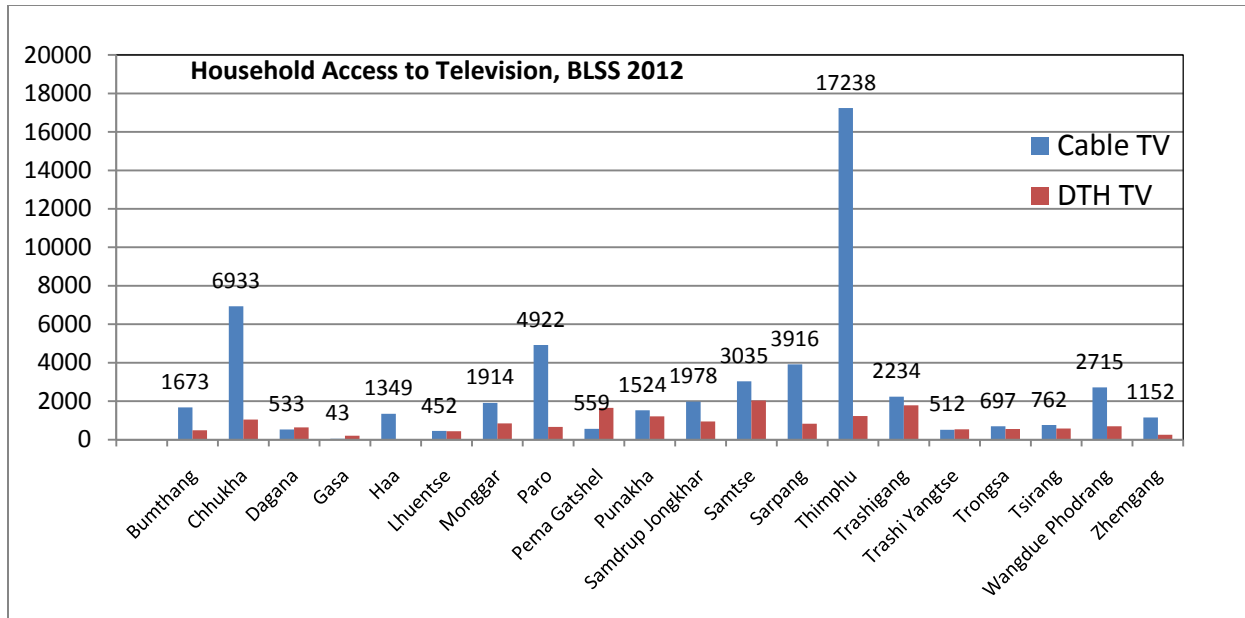
Within a span of 14 years since 1999, Cable TV has become a well-founded business venture in Bhutan. The BICMA annual report 2012 notes that except for Gasa dzongkhag, all other dzongkhags now have commercial cable television operators with multiple operators in major urban centers. There are 63 cable operators providing various television facilities but mostly through an analog system where television programs are distributed as radio (RF) signals through coaxial cables. The licensed operators, as of January 2014, are as follows:

Licensed Cable Operators in Bhutan	
M/s Cable Sat Club (Phuntsholing)	M/s Karma Cable, Chukha
M/s Norling Cable TV (Thimphu)	M/s R.G Cable Service, Gomtu.
M/s Tshela Cable Service (Phuntsholing)	M/s Lekey Cable Network, Haa.
M/s Sigma Cable Service (Paro)	M/S Yuden Cable Service, Tsirang.
M/s SKD Cable TV Service (Samtse)	M/S Punab Cable, Punakha.

M/S TT Cable Service,Wangdue.	M/s Nakchung Cable Service, K/drapchu.
M/s EthoMetho Cable Service,Thimphu,	M/s Tshochay Cables, Thinleygang.
M/s Kalikhola Cable, LhamoyZinkha, Dagana	M/s Damnyen Cable Service, T/yangtse.
M/S TD Metho Cable, Drugyel, Paro	M/s NamselNorbu Cable Service, Lhuntse.
M/S T and T Cable, Dagana	M/s SonamDhendup Cables, Mongar
M/s Damchen Cable Service, Bajo, Wangdue,	M/s N.P Cable Service,Kanglung.
M/s CT Cable, Dagapela, Dagana	M/s S.C Cable Service, Khaling.
M/s Damchen Cable Service, Lobesa, Punakha	M/s Nima Cable Network, Gelephu.
M/s Namgay Cable Service, wangdue	Yoezer Cable, Jigmeling, Gelephu.
M/s Kuenphen Cable Services	M/S Dawa Cable, Yebilaptsha, Zhemgang
M/S Nima Cable, DrujegangDagana	M/s TashiRabten Cable, Chumey, Bumthang.
Migma Cable, Mendeygang, Tsirang	Nima Cable, Nganglam, PemaGatshel
M/S Tee Dee Cable, Kabesa:Punakha	Phakpa Cable ServiceS/jongkhar.
M/s Dragon Cable Service, Wangduephodrang	M/s D.D Cable Service (Buli, Zhemgang)
M/S PhuntshoNgadenCable,W/Phodrang	M/s Yoedssel cable, Gelephu.
M/S Namkhair Cable Service, Dorokha: Samtse	Ms/s Anjan& Bro Cable, Samdrupcholing,
M/s SNS Cable Network, Gelephu.	M/s Dawa Cable Network Nanglam, P/gatshel.
M/s TsheringNorbu Cable, Trashigang.	M/s Yiwong Cable Service Sangore, Mongar,
M/s T.D Cable Network Bumthang.	M/s Menjong Cable, Tshengkari (Nganglam)
M/s K.R Cable TV Service, Mongar.	M/s UphelPelring Cable, Panbang, Zhemgang
M/s J.N Cable Service,Trongsa.	M/s TsheringLhamo Cable, Trahigang
M/s Kezang Cable, Zhemgang.	M/s USD Cable, Bumthang
M/S J ChodaCable ,Sarpang.	M/s Yeshi Darjeeling Cable ,YadiMongar
M/s S.TCable, S/Jongkhar,	M/s KingaCable ,BartshamTashi Gang
M/s Deojung Cable, Rinchenthang (Nganglam)	M/s GakiPhuntsho, DoksumTashiYangtse
M/s TashiWangmo Cable, Jomotshangkha S/jongkhar	M/sTshodak Cable Trongsa

BLSS, 2012 survey report notes that a total of 70,780 households have access to television at their homes with 54,140 households having access to Cable TV and 16,640¹ households subscribing to Direct to Home (DTH) satellite TV access. This is illustrated in the following figure.

¹Note that the BLSS 2012 follows a certain weighted average method to come to the given figure. Meanwhile, an independent study conducted by BICMA recently on DTH shows a rough figure of 5,500 DTH installations based mostly on responses from the gups in the gewogs and LCOs in the twon areas. However, the popular notion still exists that there may be more than 15,000 actual DTH installations in the country.



2.2. Cable TV: Current Business Model

2.2.1. Technology

Most operators use satellite dishes to downlink both the Free to Air (FTA) and pay channels, which are then fed to integrated receivers and decoders (IRD). The signal outputs from the receivers and the IRDs are then modulated and fed into fiber (in larger towns like Thimphu and Phuntsholing) or along the coaxial cables and distributed to the subscribers' premises using certain number of amplifiers along the routes.



In terms of obtaining signals, most cable operators obtain their TV signals through APCO and India. While the channels obtained through APCO follows the usual and proper procedures, the 'backdoor' Indian source is mainly for obtaining the SONY packages since it has become illegal to be used outside of Indian

territory.

It has also been noted during the visits to the LCOs in the dzongkhags that the unforeseen growth of Direct to Home (DTH) in the country has tempted even some of the cable operators resorting to sourcing TV signals from DTH much to the dismay of other cable operators who receive their signals legally (albeit at a higher price) through APCO.

With regard to the actual network architecture, while the last mile is generally connected by copper-based coaxial cables carrying analog RF signals connecting

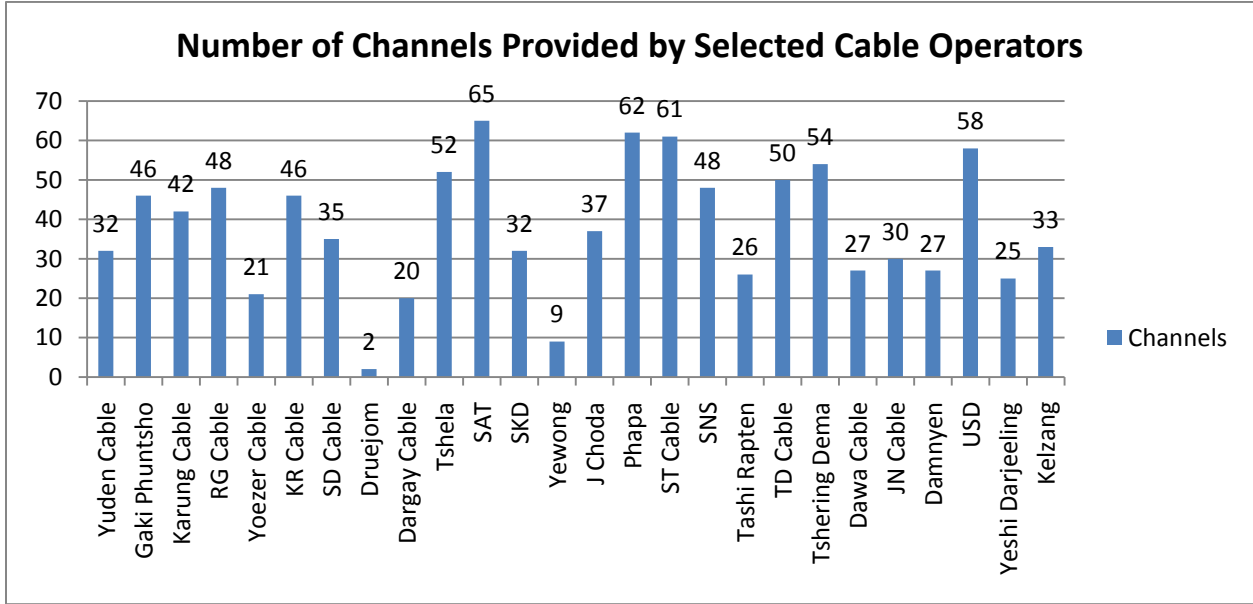


directly to the TV sets at subscribers' homes, some cable operators have already installed fiber optics cables as backbone connection in their network. In this regard, the current model can be classified almost as hybrid architecture. As will be explained later, this system is crucial for a smoother transition to deployment of digital system in the future.

In order to ensure uniformity of the services provided, almost all of the equipments at the headends were approved and monitored by BICMA. However, the subscribers' general views are that the quality of TV signals is still at best satisfactory and are generally perceived as 'poor' in most cases. Some of the customers of cable services opined that the LCOs are not at all consistent in their delivery of programs.

2.2.2. Services

One of most striking observations was the vast differences in the number of channels available to the subscribers across the kingdom even though the monthly fee paid by each subscriber is the same (currently fixed at Nu. 300 per month). The number of channels ranges from as low as below 10 in some localities to 65 in others. The following table presents the current number of channels provided by some of the cable operators in the country.



2.2.3. Content

Since the entire delivery system is based on the analog model, the subscriber has no choice but to accept the entire signal package for a flat fee of Nu. 300 per month.

2.2.4. Business Structure

Today, most cable operators are functioning as single business entity operating star-based cable network architecture in their respective areas. The sizes of the LCOs in Bhutan are directly correlated to the local population and range from more than 5,000 subscribers in major cities to as little as five

subscribers in places like Nganglam. For cases with very little subscriber base, it was found out that the LCO has set up their businesses in anticipation of upcoming new town settlements in the near future. The reported number of subscribers might also be incorrect since it is a typical nature of analog based cable operators to under-declare their actual number of subscribers. Our interviews were no exceptions either.

The cable Average Revenue Per User (ARPU) in Bhutan, while comparable to India, is also one of the lowest globally as compared to, for instance, approximately Nu. 3,360 in the United States. However, the obvious reason for the high ARPU in the western countries are because of substantial revenue generated through cable TV digitization which enabled the provision of value added services such as broadband Internet, Video on demand and Internet telephony (triple play features). This could very well be the most practical transition in the near future where the Bhutanese customers can benefit from better and wider choices of cable services while the cable operators themselves generate more revenue from these value added services.

2.3. Major Drawbacks of Current Cable TV system

While the reaches of cable services have increased over the years, there are notable drawbacks especially when viewed from the perspective of ongoing transitional trends in other countries.

2.3.1. Technology

Most LCO owners in the country have little or no technical knowledge when it comes to effective troubleshooting or deployment of the cable services. Some of the cable proprietors are illiterate and are entirely dependent on the available technical persons in their dzongkhags. For instance, the LCO in Trashiyangtse is entirely dependent on the IT unit of the dzongkhag administration whenever they face technical problems. Lack of technical expertise and awareness of the emerging technological innovations among most of the cable operators in the dzongkhags clearly depicts that they are incapable of making a realistic long-term plan for their businesses.

2.3.2. Services

One of the prominent observations was the disparity in the delivery of services. As mentioned earlier, the numbers of channels as well as the quality of channels are not uniform across the country. Added to this are the drawbacks of capacity constraints of the coaxial cables. Most coaxial cables limit the maximum number of channels up to 100. While 100 channels look as more than necessary, an unexpected challenge facing the cable operators in the country are from the DTH which provides far more channels of better quality than their analog cables because of the latter's digital system. In order to compete effectively against the DTH, offering similar or more channels than DTH is viewed as one of the strategic solutions. Unfortunately, unless cable operators do not digitize their current distribution networks, there seems to be no foreseeable alternatives to compete with DTH.

Finally, one of the most important drawbacks of the current system is its inability to provide value added services. In midst of technological advancement everywhere in the world, Bhutanese population has full

right to obtain any ICT facilities that are feasible to be provided in the country. From the ground up, the analog-based system was not designed for providing additional value added services such as HDTV, Video on demand, broadband Internet, educational channels etc. There are certain technologies which can provide such services through the present analog system but the efforts and resources needed to achieve it is deemed too cumbersome while threatening to make the current system even more complicated and not future proof as compared to complete digitization. In any case, more percentage of the population are becoming aware of the emerging technologies day by day and it will be only a matter of time before they start demanding such services at their premises or they may be tempted to consume alternative entertainment contents provided by new players in the market. If this happens, there is a dearth of mass or notable cases of cable 'cord-cutting' thereby effectively ruining all the future business prospects of cable operators in the country.

2.3.3. Content

Lack of choice for the viewers is another inherent disadvantage of analog distribution system and Bhutan is no exception where the consumers have to accept the entire package whether they like it or not. BICMA has a certain must have channels package which are mentioned under section 2.8 below. Almost all channels are of Indian origins that are meant for the Indian viewers and therefore, are filled with the usual advertisements targeted for Indian market.

2.3.4. Business Structure

There is the issue of non-addressability. Due to a single direction flow of traffic in an analog signals system, there is no straightforward method for the government or any monitoring agency to know exactly how many subscribers are there in each locality. This apparently leads to under-reporting of the actual number of subscribers. In one of the recent developments, as a counter measure to this and to understand the customers' views on current facilities, BICMA has been conducting several surveys which at least gives a near realistic number of subscribers.

The open and transparent licensing policy of the government in view of creating a level playing field for all has not created the optimum condition in those areas where the numbers of potential subscribers are very low. This has generated new entrants that threaten to fragment the already small market and thereby creating an unhealthy environment of conducting cable businesses. The licensing policy, therefore, needs to be revisited from this view in order to avoid more than necessary licenses in a given area of operation.

Due to the non-dependable business model of cable operators in Bhutan, there is hardly any room for a common forum where all cable operators can function as one unit. The APCO was formed mainly as a counter measure to tackle the Indian counterparts and not necessarily to function as a representative body of all cable operators in the country. It was also found that not all cable operators are members of the association. In addition, there is no legal entity assigned to the association. Absence of a well-recognized representative body of the entire cable operators will pose as one of the main obstacles in future especially when collective efforts are required to realize complete digitization of cable networks. Sadly, there are currently signs of non-cooperation and mistrusts among the cable operators themselves

and some operators are unsure of how digitization will actually help or threaten their businesses. In this regard, there is a strong need for BICMA to carry out adequate awareness campaigns on digitization for the cable operators and to encourage formation of a single entity backed by all cable operators. The latter could pave way for an efficient forum where all issues can be solved at one sitting thereby saving time as well as prevent micro-management of conflict resolutions.

2.4. *Major Challenges faced by the Cable Operators*

The following are some of the notable challenges currently faced by the cable operators in the country:

- a) **Threat from DTH:** The rising number of DTH users is a matter of concern for all. Most cable operators noted that the government made a huge mistake by announcing the path to DTH legalization in the media before conducting a proper and thorough in-house research and concludes that the DTH users have actually increased rapidly ever since that announcement;
- b) Non-payment of rental fees on time by subscribers;
- c) **High cost of infrastructure sharing with BPC and Bhutan Telecom:** Cable operators opined that while the current rate of Nu.10/month per pole sounds reasonable on paper, it usually takes a sizeable chunk of their revenues every year;
- d) **Lack of loan and tax exemptions while buying equipments:** Most cable operators felt that there is no tax exemptions on their equipments reasoning that all equipments that are imported by them are not for resale in the market but directly used in order to provide better quality of TV services to their customers;
- e) **Lack of technical expertise:** Even though the rule on cable TV operations set by BICMA requires a technically qualified staff for every 250 subscribers, most cable operators are challenged in this area. As mentioned earlier, they have to rely on the available IT expertise in their areas whenever they face severe technical problems;
- f) **Natural Disasters:** Destruction of equipments by natural disasters especially in summer seasons: This is usually most prominent in the southern dzongkhags where lightning during monsoon season destroy their equipments almost on a regular basis every year; and
- g) **No scope of expansion beyond the urban settings due to highly scattered settlement pattern:** This is seen as a huge challenge by both the government as well as the cable operators themselves. Nevertheless, one optimistic development is the availability of the fibers to the gewog centers, which would encourage some of the cable operators to tap the nearby rural households from these centers.

2.5. *Remedial Measures along with Recommendations by the Cable Operators (Based on the current challenges faced by them)*

The following are some of the remedial measures including the recommendations by the cable operators themselves:

- a. **Issue of DTH:** As one of the biggest threats to their business, most cable operators recommends that the DTH services be either banned or regulated in the country. One of the reasons for the

growth of DTH was its mobility and much higher quality of digital signals as compared to the analog ones. BICMA is currently undertaking a study on DTH and its future.

- b. **Issue of entertainment tax:** There seems to be an inherent misconception when it comes to entertainment tax. Most cable operators are surprisingly unaware that the entertainment tax is levied on the subscribers and not them and thereby strongly recommends that this tax be reduced or exempted. There is a strong need for clarification by the Authority or Department of Revenue and Customs with regard to this issue of entertainment tax.
- c. **Legalization of Sony package:** The other recommendation concerns the legalization of Sony packages through higher levels of dialogues between the two government of India and Bhutan based on the friendly relationship that the two countries enjoy.
- d. **Technical Assistance:** Most cable operators voice lack of well-trained staff with them and recommend that regular training opportunities in skills enhancement are made available for them.
- e. **Review Pole Sharing Fees:** Since most LCOs opined that pole sharing fees takes away a sizeable amount of their revenue when calculated annually, it is high time for reviewing whether the current rate of Nu. 10 per pole per month is levied with much heavier impact on the LCOs than the Bhutan Power Corporation or Bhutan Telecom. The rules on pole sharing allows for such a revision from time to time.
- f. **Review tax incentives and loan facilities:** There is a strong need to review the current taxation policy, especially when importing cable TV equipments that are directly going to be used for effective service delivery to the general households. In addition, since the cable operators are constrained at times due to lack of bank loans to provide additional coverage and better services, there is a need to facilitate, wherever necessary, to make the LCOs avail such loan facilities. In the digitization phase, the success would entirely depend on if the bank loans are available or not by that time.
- g. **Compensation support during natural disasters:** A form of compensation support for damage of equipments during natural disasters is a viable solution for those cable operators facing such problems. However, proper verification procedures should be well established beforehand in order to avoid any false claims. Another option would be to add a clause (in the licensee agreement) that requires any cable operator to insure their equipments with the insurance companies.
- h. **Incentives on rural connections:** Since the ultimate government policy is to ensure universal access to ICT facilities to the entire population, it is recommended that some incentives are provided to the cable operators who connect the households that are designated as rural households by the *Thromdes* or the dzongkhag administrations. The incentives can be in the form of subsidies on equipments purchases for such purposes, cost sharing of the last mile connectivity and tax holidays. This will be a crucial element during the later years of digitization because without government support, the cable operators will not be keen to connect these rural households from economic benefits point of view.
- i. **Separate Fee Structure:** With regard to fees and sales tax, cable operators feel that there can be a separate fee structure for rural and urban subscribers while the BST can be imposed based on the number of subscribers.

2.6. *State of Broadcast Digitization and its Standards*

Bhutan is apparently one of the last few countries with analog broadcast system. While the in-house production of contents of the only broadcaster- BBS itself is digital and even the uplinking of the same, the transmission standard is still in analog form. Supported by ITU, two exercises on digital migration (focused on broadcast system) in Bhutan have already taken place and has proposed January 2017 as the deadline for Analog Switch Off of BBS channels. BBS is currently in active phase of this conversion process and reasoned that most of the transmitters can be easily upgraded to enable digital transmission which is currently proposed to be of most recent generation of DVB-T² standard.

2.7. *Existing Regulatory Framework: BICMA and its Roles*

Ever since legalization of TV and emergence of cable industry, there was an immediate need for an effective regulatory body to ensure that the growth in this industry is properly monitored and that the sudden introduction of foreign TV programs is not detrimental against protecting the country's unique cultural heritage. It was felt that if unregulated, cable TV could create adverse effects on Bhutanese people's (especially the youths) attitudes and behaviors.

In this light, BICMA as a regulatory Authority was established in 2000 to provide a modern technology-neutral and service sector-neutral regulatory mechanism guided mainly by the principles of universal and affordable access of ICT services including cable TV services to the entire population in the country. BICMA as an enabler of efficient ICT service delivery in the country is mainly guided by the policies of convergence of emerging technologies, open and transparent licensing framework, encouragement of investment as well as competition in the private sector while ensuring that the security, national integrity, economic and socio-cultural interests of Bhutan are fully protected.

The radio communication and TV Division within the Authority is responsible for licensing and regulating the cable TV services besides being mandated to manage the scarce natural radio-frequency spectrum. With regard to cable services, BICMA conducts regular surveys on cable industry in order to better understand the ground reality besides carrying out field visits to ensure proper delivery of the services to the subscribers.

In order to ensure a basic TV package for any cable subscriber, BICMA has prescribed the minimum number of channels as follows: BBS channels, 1 News (Pay Channel), 4 entertainment (Pay Channels), 1 Children (Pay Channel), 1 Sports (Pay Channel), 1 Educational (Pay Channel), 2 Free to air (FTA) and 1 Local Channel.

While many cable operators are of the view that BICMA should not limit their total number of channels to 68 as reported in print media³, BICMA clarified that there is actually no upper limit on number of channels but that the cable operators should come up with 'legally obtained'⁴ channels for approval.

²Digital Video Broadcasting-Terrestrial. It is the European based consortium standard which transmits compressed digital audio, digital video and other data in an MPEG transport stream, using coded orthogonal frequency-division multiplexing (COFDM or OFDM) modulation. An extended extension is the DVB-T2 (T2 stands for Second Generation Terrestrial), which transmits compressed digital audio, video, and other data in "physical layer pipes" (PLPs), using OFDM modulation with concatenated channel coding and interleaving. (Sourced from Wikipedia)

³Kuensel, Nov. 26 2013 issue: "No headway on DTH developments in India".

⁴Due to cheaper but illegal source of TV contents available through DTH, cable operators intended to use the same service to increase their number of channels, but which is unacceptable for BICMA to authorize.

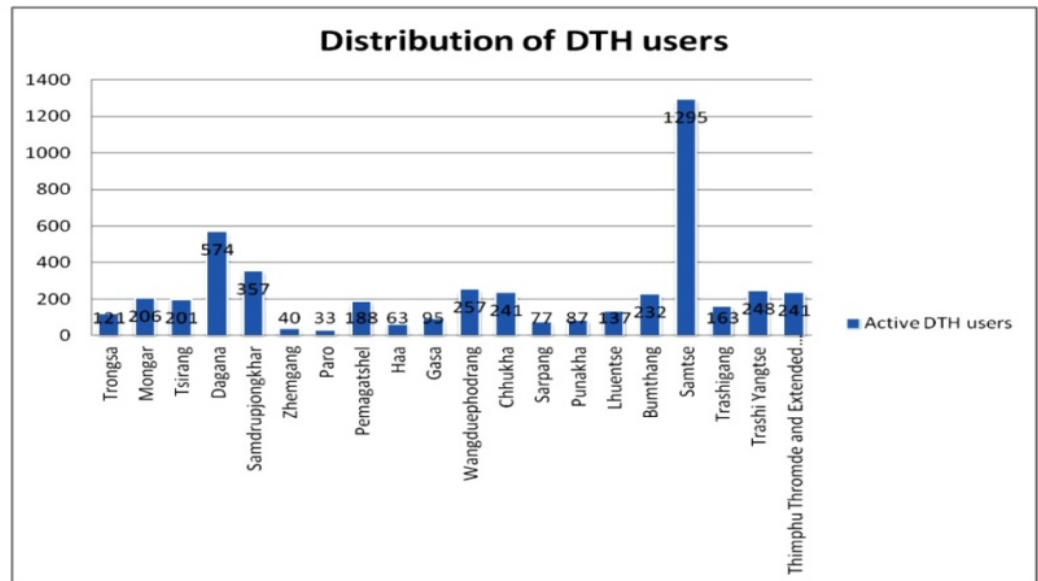
This issue will no longer be relevant once the digital deployment starts since the pay-per view (a-la-carte offering) feature of the digital system will ensure optimal consumption of TV programs.

3. Threats to Cable TV in Bhutan


3.1 Current Threat: Direct to Home (DTH) TV

In India, DTH is one of the biggest winners due to digitization and today accounts for 82 percent of all digital TV subscribers. This successful growth of DTH in India has negatively affected the cable industries in the neighboring countries and Bhutan is no exception.

One of the major areas of unforeseen concerns is the growth of DTH subscribers in the country. Major urban centers such as Thimphu, Chukha (probably centered in Phuntsholing), Paro, Sarpang and Wangdiphodrang show much higher



subscribers of Cable TV than DTH. However, dzongkhags such as Trashigang, Samtse and Punakha show smaller margins between the DTH and Cable TV subscribers with Dagana and Pemagatshel showing even higher number of DTH TV subscribers than Cable TV subscribers.



Airtel Internet Broadband Access Connection through Dish DTH Service Set Top Box future plan
 The latest STB from Airtel is HD Recorder. In this STB there are many latest features available like

1. Full HD Picture Quality, which is 5 times sharper than regular pictures.
2. 7.1 Digital Surround Sound.
3. 3D ready which let view 3D contents in 3D TV.
4. HD Recording Facility with 320 GB HDD.

Besides these all there is one ethernet port in this STB which as i think may be used to access high speed broadband internet connection through DTH, if this facility will be available then there will be Internet Access at very low cost in compare to todays standard costs. But its not sure when this facility will be made available by airtel.



A recently completed independent study by BICMA titled "DTH: Status and Way Forward for Bhutan" notes about 5,438 DTH users in 189 of 205 gewogs in Bhutan. Therefore, the actual number of DTH users will be higher if we account for the remaining gewogs. This has serious repercussions to all sectors of cable businesses. Financially, this indicates an out flow of Rs. 19.5 million (calculated at mean monthly fee of Rs. 300) to India every year and without any tax returns to

the government.

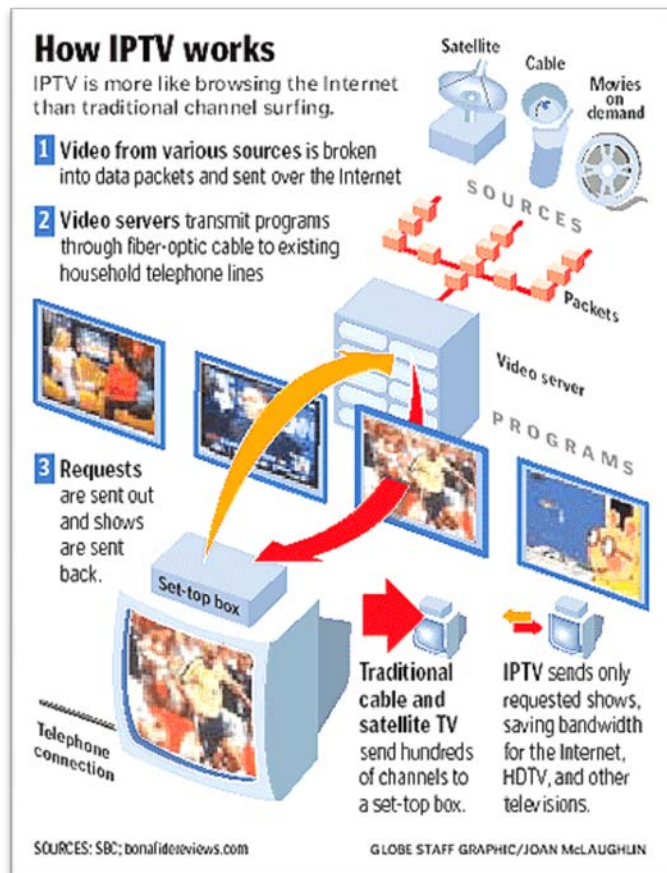
DTH is a threat not only to the cable operators but if they start providing broadband Internet services (they are currently limited by licensing policy only), DTH might be a serious threat to the ISPs too. The logic is that, when DTH can transmit numerous (usually more than 100 channels) digital video signals at such an affordable price, the same will be true for any data service. The adjacent figure shows the upcoming plan of providing broadband Internet services by Airtel, one of the DTH operators in India.

The emergence of DTH is today a serious challenge for BICMA since it is impossible to regulate the contents provided by DTH. Despite several attempts at legalizing DTH which required the BBS channels to be included in the DTH package, it was found out that the procedure to do so is not as simple as it looked in the first place. Given the small market of television viewers in Bhutan, it will be very difficult to attract a national DTH or similar service operator within the country. The same BICMA report highlights that the satellite fees alone for uplinking 2 channels will amount to Nu. 1.9 million each year along with 5% service charge denoting that it is not feasible economically to undertake a DTH business in the country.

3.2. Future Challenge: Streaming contents through OTT and IPTV

"This is the future, streaming is the future. TV will not be TV in five years from now...everyone will be streaming" -- Beau Willimon⁵

One of the immediate observations in many countries especially in the west is what is commonly called as 'cord-cutting' whereby subscribers of cable TV are no longer using the cable TV services opting instead to use the emerging online technologies such as over the top technology (OTT) and Internet Protocol Television (IPTV). Both systems deliver television programs via Internet, instead of the traditional terrestrial, satellite signal and cable TV system. OTT delivers the contents from the provider/content aggregator directly to the viewer using the open network (open ecosystem) while IPTV also delivers the same contents but using the more dedicated and managed network (walled garden ecosystem). While not an issue of



⁵<http://www.dga.org/Craft/DGAQ/All-Articles/1301-Winter-2013/House-of-Cards.aspx>

immediate concern for Bhutan - a country with very small market base, the OTT and IPTV services are growing steadily in most of the developed countries and changing the video consumption habits of the upcoming generations. The number of global IPTV subscribers has grown from 28 million in 2009 to 83 million in 2013⁶. Popular examples of OTT are Netflix, Hulu, Sky Go, Lovefilm etc. while examples of IPTV are U-verse and PrismTV. One of the primary reasons is that Netflix as well as other services have become a total package, featuring an endless amount of television and movies for a cheaper cost. The latter is the key to why people are switching over. This so called 'binge watching' of television program is a growing trend in western countries and has the capability to enter Bhutanese markets. Cable depending on what package a customer has is a minimum of \$50 per month with an upwards of \$150 per month. Netflix, Hulu and other services only cost a customer between \$8 and \$16 per month. That's a big difference and is why people are switching over to OTT and IPTV.

Even within Bhutan, of the two largest ISPs in Bhutan, Druknet (the other being TCell) has been laying fiber optics cables to the curb (FTTC) in urban areas like Thimphu in view of the gradual introduction of better broadband services and if market condition looks favorable, Internet Protocol Television (IPTV) in the near future.

3.3. *Future Threat: Mobile TV through 4G & LTE*

A recent development in the mobile technology is the deployment of 4G LTE (Long Term Evolution) standard which is entirely dedicated to data services. With an average data transfer rate of 80 mbps (the claimed peak downlink rate is as high as 300 mbps), this standard has all the potential to change the entertainment facilities in mobile industry. The process is fueled even faster by rapid emergence of affordable smartphones with large screens which encourages consumption of video contents through this medium.

This can be a huge threat for cable industry since most users then would never feel the need to view TV programs at home. The convenience of mobility, access to privacy and freedom of choice of contents only makes it an even more attractive alternative to cable TV. The only deterring factor would be the actual price of the 4G Internet services which currently is more expensive than the cable services. However, the trend clearly shows that not only will the price drop gradually, the benefits derived from 4G services would actually offset the costs charged by them thereby potentially changing the consumption pattern of the users.

4. Future Scopes for Cable TV Industry in Bhutan

4.1. *Digital Migration*

In view of the emergence of newer technologies in the form of digital signals which are not only efficient in bandwidth usage but also provide much better TV viewing experiences for the consumers, it will be a huge risk for the cable operators to keep assuming that their current analog based systems will be the choice of Bhutanese consumers for a long time. The current business model is simply not sustainable in

⁶<http://en.wikipedia.org/wiki/IPTV>

the long run. Even globally, with or without government intervention, it is being observed that the consumers themselves keep moving on and adapting to newer and better technologies as they keep emerging in the market.

Even though digitization means much higher capital investments, there are many advantages associated with digitization and offers immense opportunities for the cable operators in the long run. In addition, Bhutanese households will enjoy much better quality as well as diversity of ICT services right in their homes. Some notable advantages that are relevant to the cable operators as well as the households are:

- Much clearer picture quality but more importantly, more number of channels will be available for the subscribers. For instance, digitization uses bandwidth efficient digital modulation techniques such as Quadrature Amplitude Modulation (QAM) which enables data rates in excess of 56Mb/s to be transmitted within 8MHz band. QAM coupled with digital compression technologies such as the mpeg-2 and mpeg-4 standards enable, in theory, thousands of video channels to be transmitted, for example, through a 800 Mhz bandwidth, clearly indicating that this is the future proof solution as of now;
- The future trend is now HD (high definition) contents which offers a whole new viewing experiences for the TV viewers and it is only through digitization that HDTV can be delivered affordably;
- The biggest benefit for the cable operators will be increase in their revenues by providing value added services such as high-speed broadband Internet, Video onDemand, Interactive TV, Time shifted TV and Interactive gaming. In fact, providing broadband Internet services through cable is the only alternative for the cable operators to stay in business in the future. This is evident from practices in western nations where if not for high-speed broadband Internet services, cable operators would have already gone out of business as revolutionary alternatives in the form of OTT (Netflix, Hulu, Roku etc.) and IPTV are available to the customers at much cheaper prices. Since most OTT and IPTV services depend on the high-speed Internet access, the cable operators were able to stay in business by Internet access (as against their traditional supply of TV contents). This could be one area where the current cable operators in Bhutan can focus in the digital are in order to sustain their businesses; and
- Cable operators as well as the government will be benefited through a very transparent system enabled by digitization where it is feasible to not only determine the actual number of subscribers at any given point of time but also know of what services/packages these subscribers have obtained from the cable operators.

Digitization of the cable network as well as the headend system is the inevitable next step because there will be simply no more production of analog equipments which might force all cable operators, whether big or small, to upgrade their network to digital or risk losing their businesses to new players in the market. Unfortunately, given the small comparative sizes of most cable operators, the path to digitization might also be out of reach financially for most of the small players in the dzongkhags. Most digitization phase involves higher levels of investment at the headends, purchase of set-top boxes and laying of fiber cables. This will be elaborated further in the road map section below. (Note: a practical approach to setting up a digital headend system is attached, as an example, in Appendix 1).

4.2. Fiber Optics Backbone Connectivity in Bhutan

Unique to Bhutan, there exists a huge fiber optics based national network which is yet to be utilized optimally. Under the national broadband project spearheaded by the Ministry of Information and Communications, Bhutan has achieved commendable fiber connections all over the country. All 20 dzongkhags and more than 185 gewogs now have ADSS connections⁷. Except for Gasa which has a STM-1 (34 Mbps) connection, most other dzongkhags are already connected with either a STM-16 (2.5Gbps) or the STM-64 (10 Gbps) capacity. This facility alone would justify for a rapid drive towards digitization in both broadcast as well as the distribution system of the TV industry. Fiber lasts much longer than most other alternatives and it in itself has almost unlimited capacity thereby proving as an affordable future proof technology. An added advantage of fibers is that they are unattractive targets for cable thefts as compared to other copper-based cables which have been succumbing to cable thefts occasionally.

The following diagram below shows the status of existing and planned fiber optics based network in the country as of November 2013.

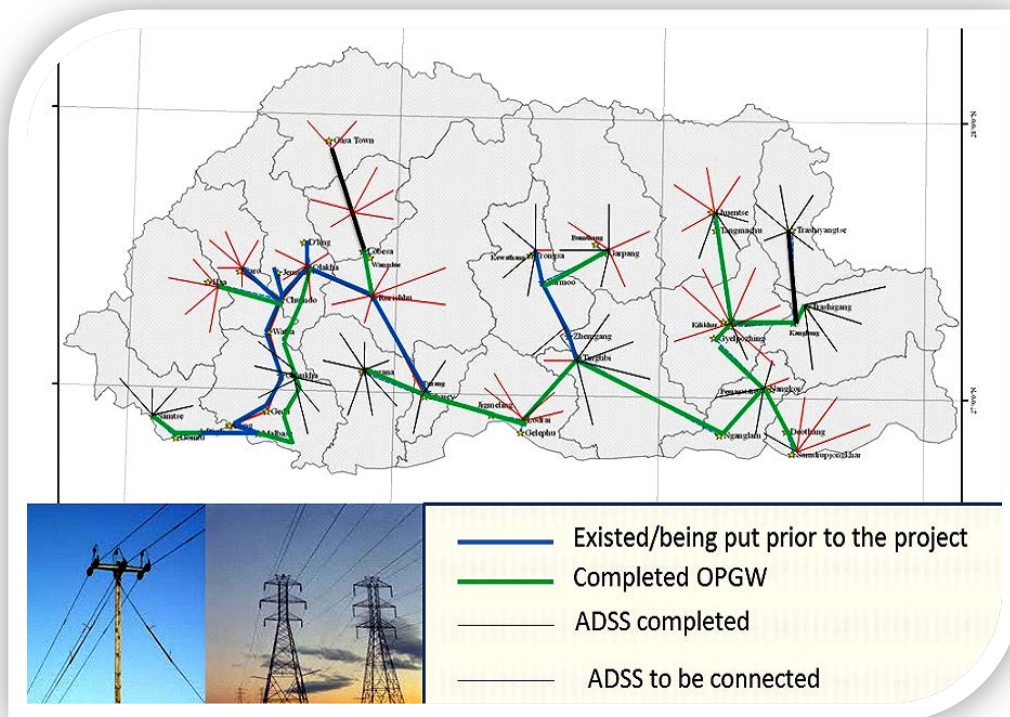
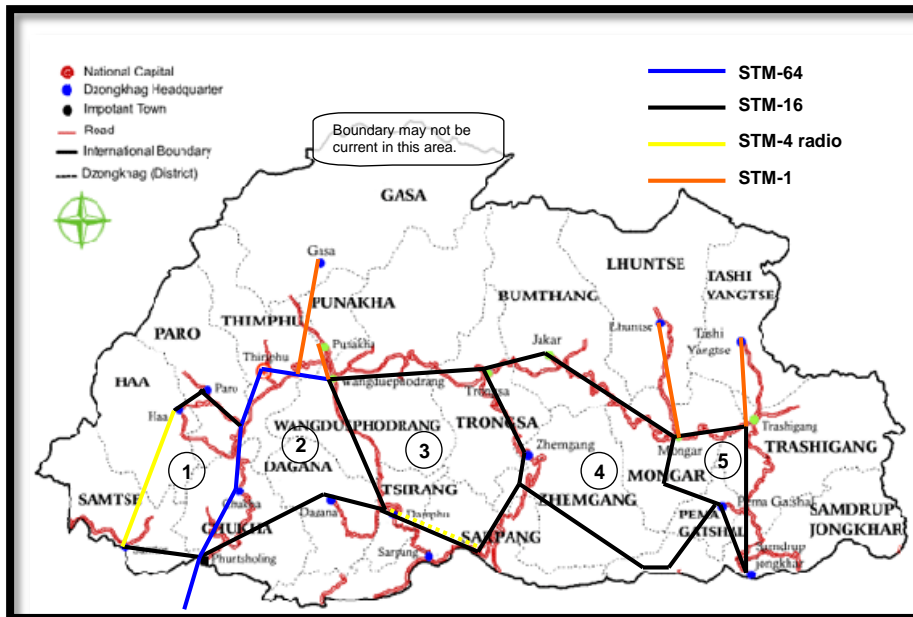


Fig: Existing and Planned OPGW and ADSS. (Source: DITT, MoIC, 2013)

The table below and the following diagram show the existing optical fiber cable (OPGW) connections as per the National Broadband Masterplan.

⁷BPC Annual Report, 2012. p. 8

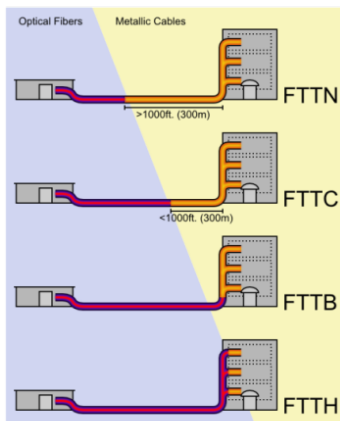
Type of Link	Connectivity	Capacity	Status and Remarks
OPGW Link (24 fiber)	Thimphu – Paro	155Mbps	Over 66kV power transmission lines. Extended to Haa.
OPGW Link (24 fiber)	Thimphu – Wangdue	155Mbps	Over 66kV power transmission Lines
OPGW Link (24 fiber)	Simtokha – Rurichu	155Mbps	Over 220kV Power Transmission Lines. BT is using 4 fibers to link Thimphu to Wangdue.
OPGW Link (24 fiber)	Thimphu – Phuentsholing	622Mbps	Via Simtokha, Khasadrapchu, Tsimasham, Gedu and Pasakha



While the ownership of the fibers still lie with the government, the allocation agreement between the MoIC and BPC shows that out of the 24 pairs of fiber cables, BPC was allocated three pairs in return for installation of the fibers over their power lines and to the two telecommunications companies i.e. Bhutan Telecom and Tashi Cell. The current transmission routes of OPGW are illustrated in the

adjacent diagram.

The current policy dictates that in order to qualify for one of these limited fibers, one has to have an ISP license with national reach and has to lease the same from either Bhutan Telecom or Tashi Cell. There is a need for review on fiber allocation policy by MoIC since it should not be restricted to ISPs alone and that other ICT player such as the future MSO with equal, if not bigger, reach and impacts can be considered.



The ultimate solution for the future: Of the many different protocols and standards of fiber-optics signal distribution, the Bhutan National Broadband Masterplan recommends that the FTTx (fiber to the x) architecture should be the long-term goal of network architecture but acknowledges that the option is very costly and might take a long time to realize. Until then, following a gradual phase-wise deployment towards complete digitization will be most realistic approach given the lack of readiness as well as financial resources in current scenario.

5. At a Glance: A simple SWOT Analysis of Cable TV Digitization

<p style="text-align: center;">Strength</p> <ul style="list-style-type: none"> • Experiences in cable TV businesses (but analog model only) • Subscriber base is already there • Most cable operators have deployed fiber optics network for their core backbone connections 	<p style="text-align: center;">Weakness</p> <ul style="list-style-type: none"> • Fragmented businesses and lack of cooperation among cable operators • APCO has no legal status • Lack of financial resources • Unskilled workforce • Comparatively small market
<p style="text-align: center;">Threat</p> <ul style="list-style-type: none"> • DTH • OTT and IPTV • 4G Technology 	<p style="text-align: center;">Opportunity</p> <ul style="list-style-type: none"> • Technical advances means better products at cheaper prices (Moore's Law) • Extra revenues from valued added services • Relaxed and supportive government policies • Availability of strong fiber connections to the all dzongkhags and more than 185 gewogs

It is evident from the above SWOT analysis that while there are notable inherent weaknesses as well as external threats, the opportunities and the advantages of current situation of cable operators themselves far outweigh those threats and weaknesses. The next section proposes as far as possible, a realistic road map for the cable industry based on the review of all current situations, the above SWOT analysis and the global trends.

6. The Road Map for Cable TV Industry: Pre-requisites and Enabling Factors

6.1. International Experiences

It will be worthwhile to share some of the notable international experiences that are relevant to the current context in Bhutan. Consolidation of various ICT players leading to convergence of services seems to be the norm in recent years in many countries. It is evident, based on the experiences observed in many countries, that the crucial element for the sustainability of cable services lie in their flexibility and the adaptability to change according to the emerging technologies. The cable operators are no longer a single content provider but rather a content aggregator providing a variety of ICT services in order to stay in business. For instance, in the US, cable operators are generating more revenue because they made timely investment as well as network upgrades to provide broadband Internet access rather than depending on providing TV services alone. Today, most cable operators in the US are in fact earning more income through their broadband Internet services than TV services and even with the new and powerful entrants such as Netflix which could have easily shut down any cable TV only businesses didn't have any notable adverse affect on these cable companies. Interestingly, in UK, the cable telephony

revenues are surpassing the revenues generated from cable television⁸. This is a useful lesson for Bhutan, which is yet to embark to digital era and international experiences clearly suggests the formation of a very dynamic cable industry as a future business model.

6.2. Cable has potential to compete with DTH

As another unique observation that is specific to Bhutan, the DTH while having penetrated substantially in the 'grey market' of the country can face serious competition from cable operators in the post digitization era. The inability to include the BBS channels in any of the existing Indian DTH service might be a blessing in disguise for the cable industry as not having the those channels is the single biggest disadvantage of DTH for Bhutanese households. On the other hand, because of the relatively small market, there might not even be a realistic solution to establish a profit-making DTH earth station in Bhutan⁹.

It is a known fact that no satellite based solution can compete, in the near future, with the fiber solutions simply because fiber cables are much cheaper to transmit and have unlimited bandwidth. Therefore, cable operators have potential to provide similar or more number of channels than DTH over time besides providing additional services such as Internet and cable telephony. If digital cable services aided by the fiber connectivity of the gewog information centers (CICs) can penetrate the rural households over time, it is certain that the DTH would cease to exist since cable would, by then, include same packages as DTH along with the highly preferred national channels included in them.

6.3. Infrastructure and Architecture: Technical Options at Hand

When it comes to infrastructure and upgradation of the current distribution model, nothing becomes more feasible and practical in the end than taking advantage of the existing OPGW and ADSS connections. While majority of the fiber cables are dark fibers or in the process of being lighted, it is timely that government seriously consider provision of transmitting TV programs through one of these fibers.

Bhutan is at a right time to realize the policy of ICT convergence in practice. It is high time to adopt the '**one cable for all**' approach where a single cable, preferably a fiber cable, at any connected premise can provide all ICT services such as TV, Internet and telephone. This architecture could potentially save a lot of resources and time by avoiding multiple laying of cables for multiple service providers running unsystematically across the towns and countryside which would look not only aesthetically displeasing to the eye but also create a very complicated service delivery networks.

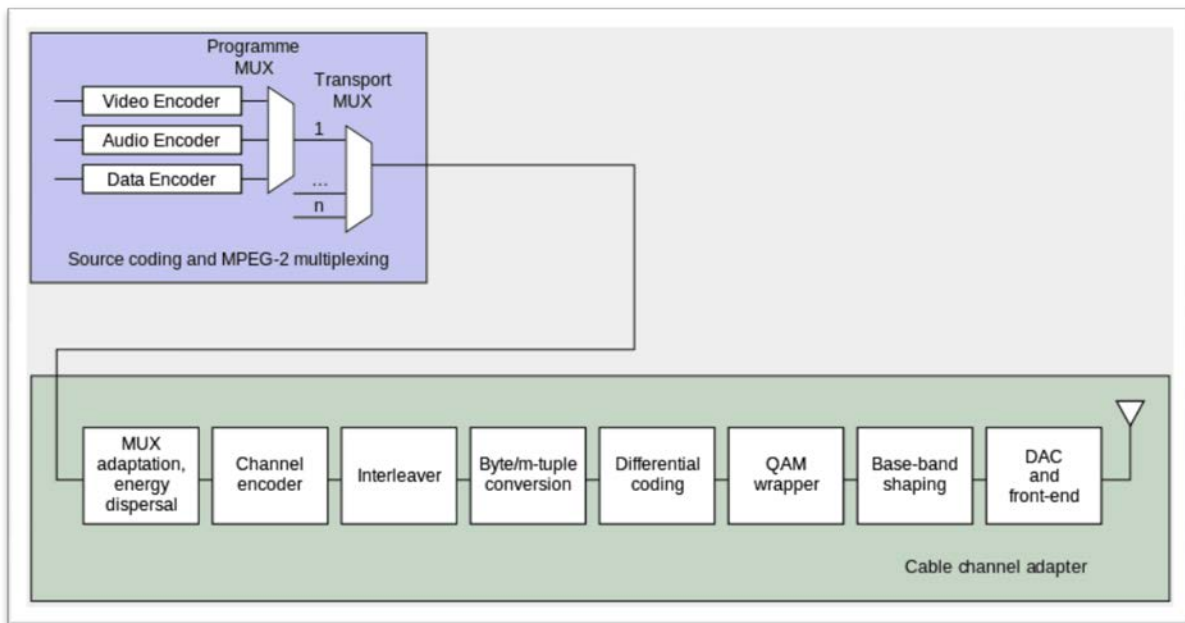
⁸<http://www.indiantelevision.org.in/special/sperep1.htm>, accessed 4th April, 2014.

⁹BICMA's report on 'DTH and the way forward' mentions of Nu. 1.9 million per annum as satellite fee alone paid by BBS for its two channels. Assuming that a DTH operator has to at least uplink a few dozens of channels, the operator would face substantial escalation of the cost of uplinking. Other additional costs such as purchase of programs from abroad, set top boxes and headend system only indicate that, for Bhutan, any satellite based system would not be economically feasible, at least for some time to come.

6.4. Future Cable TV Standard

The most appropriate standard for the future cable TV transmission is the European standard called Digital Video Broadcasting - Cable (DVB-C). The first and foremost is the compatibility issue since most countries in the region has adopted the broadcast standard of Digital Video Broadcasting - Terrestrial (DVB-T) and the joint exercise of the ITU and MoIC for broadcast digitization in Bhutan has recommended the same broadcast standard for the country.

DVB-C standard (the latest variant is DVB-C2)¹⁰ typically use the Mpeg-2 or the Mpeg-4 compressed streams of video signals using a QAM modulation with channel coding (error correction in data transmission). The following diagram shows the architecture of a DVB-C standard:



Source: http://en.wikipedia.org/wiki/DVB-C#mediaviewer/File:Dvbc_tx_scheme.svg

The latest variant is the DVB-C2, which allows bitrates up to 83.1 Mbit/s on an 8 MHz channel bandwidth when using 4096-QAM modulation; future extensions will allow up to 97 Mbit/s and 110.8 Mbit/s per channel using 16384-QAM and 65536-AQAM modulation.¹¹

Notable countries in the region that uses this standard are India, Nepal, Pakistan, Singapore, China and Sri Lanka.¹²

6.5. Indicative Cost of Setting Up a Digital MSO System

Obtaining an accurate price for the complete digital system is very difficult. Unlike analog system, numerous options while setting up a digital headend system depending on the features sets and brands

¹⁰ <https://www.dvb.org/standards/dvb-c2>

¹¹ Dirk Jaeger : DVB-C2 Gets Reality - Facts and Figures on a New Transmission Approach, 2nd Sept. 2010

¹² <http://en.wikipedia.org/wiki/DVB-C#DVB-C2>

are being desired. The core technology of TV services (video delivery) currently revolves around the two digital compression methods of either mpeg-2 or mpeg-4 standards. Systems based on mpeg-4 standards are more expensive because of more complex hardware required to achieve the compression but has the advantage of sending about twice the number of channels over the same bandwidth consumed by mpeg-2 based system. A sample digital headend architecture is explained further on Appendix 1, for reference.

The bulk of the cost would be on the headend equipments which would require extra equipments such as CAS, SMS, Server components, scramblers, optical transmitters etc. The dark fiber, even if granted by the government, needs to be fitted with optical transmitters and receivers at both ends, which, depending on the need of the cable services, would again be very expensive. The last mile connectivity is another area where the biggest bulk of investments will likely be incurred. The mandatory set-top boxes installation will only increase the cost further. For Thimphu and Phuntsholing alone with a rough assumption of 20,000 potential subscribers, the cost of set top boxes alone (at an average price of Nu. 1000 per box) would mean an investment of Nu. 20 million.

However, besides the huge capital investment that is being required initially, it is worth considering that the MSO will gradually penetrate across the entire country with the optimum subscriber base of more than 50,000. In that case, the rate of return to the investment indeed looks very optimistic in the end¹³ due to economies of scale.

During the course of undertaking this study, various cost estimates were obtained that range from little less than Nu. 10 million upward to Nu. 350 million. The BBS had made a thorough estimate for a digital MSO back in 2009 -10 and have arrived at a rough total of Nu. 350 million which includes headend with triple play capability and last mile connectivity including the cost of set-top boxes. Most sources on Indian media indicate an average of Rs. 3 crore for setting up an MSO¹⁴ although some quote an estimate as high as Rs. 12 crore. It was interesting to note that cable operators in the country were approached by a few Indian digital cable dealers with estimates well below Rs. 1 crore for the headend solution. However, BICMA, as the regulatory authority has to view any 'lower than normal' cheap offers from some Indian dealers with skepticism as that must be at the cost of compromising the quality of such equipments and thereby their long term reliability.

Nevertheless, it is still assumed that with the improvement in technology and the declining prices of digital equipments over the years, it will be within the affordability of the upcoming MSO operator in the country.

¹³For instance, at 2008 price, BBS while estimating the total cost of setting up a MSO with digital head end system, have arrived at a capital investment figure close to Nu. 350 million (note: figure obtained through verbal interviews only) which includes the cost for network upgradation as well as set top boxes for the viewers. Now, even after assuming that the subscriber base absorbed is only 50% of today's potential subscribers i.e. 25,000 and the charged fee assumed at Nu. 350 per month, the investment would be safely returned within a period of five years during which a gross revenue of Nu. 525 million would have been generated. In addition, this does not include the potential revenue from value added services.

¹⁴<http://www.indiantelevision.com/technology/hardware/uplinking-and-downlinking/digitisation-at-one-third-of-the-investments-by-msos-claims-jainhits-140502>

7. The Road Map for Cable TV Industry: Business Models

7.1. Priority 1: Consolidation of Existing Cable Operators into a Single MSO with all LCOs as shareholders.

7.1.1. Rationale

Considering that the cable operators in Bhutan has the first mover advantage with significant penetration in all urban centers of Bhutan, it will be certainly hard for the cable operators to witness an external MSO taking over all of their hard-won subscribers. However, at the same time, it is risky for LCOs to assume that they will keep acquiring and maintaining customers as they do today, especially in view of the rapid changes that are being witnessed both within and outside the country.

Given the huge amount of investment required for digitization, there is a serious doubt if any of the existing LCO is capable of effectively digitizing the entire cable networks individually.

Given this rationale, the first proposal of business model is that of consolidating all LCOs into a single MSO the formation of which are elaborated in the following series of steps.

7.1.2. The Business Model and Choice of Technology

7.1.2.1. Step One: Formal call for expression of interest by the Authority for formation of digital MSO by the cable operators' association

Given the above rationale for giving first priority to the existing cable operators, the formal call for expression of interest to form a digital MSO can be made to the Association of Private Cable Operators. However, in interest of all existing cable operators in the country, certain prerequisites such as a proper nationwide awareness campaign on digitization of cable TV must already be concluded to ensure that all cable operators are aware of the inevitable transition in one way or the other. At the moment, some of the smaller LCOs in the dzongkhags are of the view that they need not join any association but rather continue their analog businesses, not understanding that they will be left with no options but to join the association, as far as digitization is concerned.

7.1.2.2. Step Two: Formation of formal cable operators' association

For this business model to be a success, the first and the crucial step would be a formation of a formal association of cable operators and one that is legally recognized (most probably as a business entity). The current business model of relatively fragmented and independent cable operators has replaced with a strong association where all the cable operators are members (shareholders) of this association. Most cable operators indicate that it should be APCO which should take the lead role towards formation of the MSO. APCO on the other hand acknowledges that not all cable operators are its members on top of not having a legal status itself.

There needs to be a series of mutual dialogues among the cable operators themselves on how to form a successful association and how they would operate in the future.

The conglomeration can be based primarily on each LCO's potential subscriber base i.e. the percentage to contribute as well as reaping benefits later is higher for those who have larger number of subscribers and vice-versa. In India, such an arrangement was already witnessed in Kolkata where about 100 LCOs, as a direct competition to external MSO, have merged to form their own MSO¹⁵.

There must however, be provision for this MSO to apply and function as a publicly listed company, especially if the financial resources are not within the reach of the members. This would ensure financial viability as far as forming a successful MSO is concerned. This can have the added benefit of the public shareholders owning the company even if there is only a single MSO license in the country.

7.1.2.3. Step Three: Presentations on the choice of technology to the Authority by the association

Based on the adopted standard of DVB-C and any of its latest variant, the would-be MSO (the association in this case) will have to undertake its own intensive market researches in the applications of reliable and affordable technology for transitioning to digital standards. This paper can only indicate the currently available technologies and are explained under Annexure 1. However, by the time of actual implementation, the same technologies might be outdated due to rapid innovations in digital technology.

The research on potential choices of digital technologies by the association can include but not limited to seeking suppliers of headend equipments, network solutions from abroad and conducting several field trips to the neighbouring India. India looks as one of the most promising sources of technology since the cable operators are already using digital technology and given India's similar cost of living and purchasing power to Bhutan, there is a potential for the same business model to be adopted in Bhutan. India is still in the phase of full digitization which would be a good opportunity for Bhutan to observe and learn the various opportunities and pitfalls during this period. However, when applying certain technology to Bhutan, the economies of scale have to be borne in mind since unlike India, the subscriber base in Bhutan is comparatively very low. The important element, therefore, will be a good selection of technologies that are 'sufficient yet affordable' for the Bhutanese scenario.

Once the association obtains all information about practical set up of a digital headend as well as deployment methods, a detailed presentation on how it intends to move forward in the transition can be made to the Authority. A thorough consultations with the authority and other relevant stakeholders will have to be conducted if the association intends to function as a publicly listed company in future. All these measures are necessary to ensure that the association is technically and financially competent to undertake the transition smoothly.

7.1.2.4. Step Four: Negotiation for government incentives

The next appropriate step would then be a negotiation for government supports in the initial transition phase. Digitization of cable services is a very expensive process and for Bhutan, the transition would be

¹⁵<http://www.indiantelevision.org.in/digital/y2k13/nov/novdig73.php>

questionable without effective government interventions. Even in developed countries like Japan, the digitization was possible only due to strong support from the government.

Most supports from the government could be in the form of tax incentives, subsidies and availability of loans for the MSO and this might require several rounds of fruitful negotiations between the MSO and the government. However, given the available resources (or resource constraints) of the government and various ground realities as well as the future outlooks of cable industry at the time, these supports may or may not necessarily be realized.

However, one of the most important supports from the government would be leasing one of the fibre cores to the MSO. Without leasing this connectivity to the MSO, there is virtually no scope for a smooth and effective digitization in the country. As a matter of fact, the MSO (if licensed) would actually fulfill the main existing criteria for obtaining a fibre core i.e. having a nationwide coverage with provision of ICT facilities including Internet. The added fact that this MSO will be only one of its kinds in the foreseeable future, it should be an encouraging factor for the government to lease the fibre on this ground.

7.1.2.5. Step Five: Formal proposal for digital MSO license and granting of the same by the Authority

A thorough proposal and application for a digital MSO license is submitted during this step and following the usual procedural scrutiny by the Authority, the license is granted upon fulfilling the licensing criteria. Some important changes that will be required under the licensing policy, especially, from the point of view of preventing monopolistic practices by the MSO and avoidance of pseudo-MSOs, are explained under section 7.1.3 below.

7.1.2.6. Step Six: Phase I - Deployment of digital video service in the core Thimphu areas

A well-planned phase-by-phase transition to cable TV digitization can start from the core areas of Thimphu. This is primarily based on the assumption that the existing cable operators in Thimphu already have a reliable fiber-based network in the core areas. If the triple play headend solution is cost-prohibitive, the services at this stage can be focused on delivery of digital videos alone to the subscriber premises. There are however, several prerequisites that need to be fulfilled by now:

- a) While the services desired in this pilot phase would be of digital video content only, it must be left to the decision of the MSO if it wants to roll out triple play features simultaneously. This might be the case if the headend solution is much cheaper if the MSO installs an all-in-one solutions rather than going component wise for triple play services;
- b) While a simulcast of both analog and digital signals is desired in order to present a choice of analog signals for those consumers who cannot pay for the digital services, it must, however, be left to the market forces and the affordability of the cable operators to provide these services simultaneously;
- c) The entire existing coaxial cables are either converted into two-way hybrid cables or replaced completely by fibre ones. This last mile connectivity will be one of the most expensive investments for the MSO and without cost sharing by the subscribers and the government,

connecting each and every households, even in core urban areas, will be a huge challenge for the MSO as was observed in other countries¹⁶;

- d) Appropriate set-top boxes are already procured and ready for distribution to the households. While a set-top box with digital video capability only is sufficient at this moment, it will be a far-sighted investment to procure those with triple-play capability since digital set-top boxes can last for a long period. This would prevent unnecessary purchase of set-top boxes in the future and avoid a sizeable amount of e-waste once the 'digital video only' set-tops become obsolete and need to be replaced; and
- e) Since the intention is for the formation of a single but well-regulated MSO in the country, measures should be undertaken to ensure that no other business establishments are granted a similar license and that any third party cable TV providers (if it exists and do not belong to the association) can only obtain their video signals from this MSO and from nowhere else.

A new MSO with digital headend solutions possibly providing triple play services of video (TV), Voice (Telephone) and Data (Internet) can be established in Thimphu. There is no change, as far as reception of TV signals are concerned and the same method of obtaining signals from India can be followed. The additional requirement would be to identify a proper source for other value added services such as Internet, video on demand and telephony.

At a basic tier, the transition can start at least with providing digital video only service but with enough room for upgrading to provide value added services as soon as demands arise in the market. This way, the initial investment for the MSO need not necessarily be very substantial. The preferred subscribers will be those households who are closest to the nearest fibre curbs.

An encouraging observation worldwide is the gradual drop in prices of digital equipments due to technical innovations and mass production of these equipments thereby denoting potential scopes in the future.

7.1.2.7. Step Seven: Phase II - MSO transmits its first digital signals over OPGW to Phuntsholing.

This phase will be the first test for successful transmission of signals over OPGW over a long distance using a combination of optical converters, transmitters and receivers. Here again, it is assumed that the government has already leased one of the fibre cores to the MSO. Once the signals are received successfully by the LCO in Phuntsholing, similar deployments can be carried out in the core urban areas starting with those who are closest to the fibre curbs.

There are two major options for the LCOs in other dzongkhags (including Phuntsholing) under this business model:

- a. **Become a franchisee of the parent MSO:** Here, the LCO sets up a mini headend system in their designated areas which subscribes to the contents from the parent MSO in Thimphu and distribute the same in their areas. The immediate disadvantage is the substantial investment

¹⁶ <http://arstechnica.com/tech-policy/2010/03/fiber-its-not-all-created-equal/>

that will be required to set up the headend although it will be much less expensive than that of the parent MSO systems. However, since the pricing under the digital system will be based on pay-per-usage system, there are opportunities for these franchisees to generate good revenues in their designated areas.; or

- b. **Become a designate agent of the parent MSO:** Under this system, the LCO now becomes a designate agent of the parent MSO in Thimphu. The advantage is that there will be little or no investment required for the local headend system since that will be borne by the parent MSO. However, it also means that any potential profits that are generated will go to the parent MSO leaving the local agent with certain percentage of commissions only. It is vital to point here that due to unacceptable sharing of revenues between the MSO and the LCO, this has led to a series of court cases in India. Therefore, a proper and well-informed agreement has to arrive between the MSO and LCO beforehand so that the actual implementation takes place without any unpleasant scenarios in the future.

It is evident from the above perceptible choices for LCOs in the dzongkhags that the awareness /advocacy campaigns period is very crucial and must be conducted in a comprehensive manner outlining all the pros and cons of the above options so that the LCOs are capable of making well-informed decisions.

7.1.2.8. Step Eight: Phase III - Deployment to other dzongkhags

The final deployment phase will be the transmission of signals through the nationwide fiber-optic network. How the LCOs want to tie up with the parent MSO is same as under section 7.1.2.6.

7.1.3. Role of BICMA: Licensing, Pricing and Regulatory framework

In view of government's policy of convergence as well as need for an effective regulation, a single MSO license jointly owned by all cable operators would suffice for Bhutan. However, in case of Bhutan, there arise a tricky situation where if left to one MSO creation, there is a looming threat of monopolistic practices creeping in the future which will only affect the customers ultimately. On the other hand, if multiple MSOs or pseudo-MSOs are allowed, the sustainability of business operation will be a serious issue since the already small market will be further fragmented. This is a delicate borderline on which BICMA has to mediate in such manner that MSO's sustainability as well as consumers' interests are protected.

One of the measures to tackle against monopolistic practices would be a proper tariff fixation on various services which can be obtained through a thorough study of the market situation as well as consultation with the MSO itself. This tariff fixation coupled with strict monitoring of the quality of services provided to the subscribers would ensure a well regulated MSO on one hand and an affordable but higher quality of services for the consumers on the other.

There is a strong need to include a clause which must require that the licensed MSO must not only cater to digital videos alone but to triple play features as and when necessary in the future. As stressed several times in this paper, it will be only through provision of value added services, especially the

broadband Internet services, that the MSO generate revenues to sustain for a long period. In addition, it will certainly be beneficial to the Bhutanese consumers in general, as this would provide an additional option for obtaining broadband Internet services for them.

In case of long-term sustainability, appropriate mechanism has to be in place to ensure that there will be uninterrupted cable services for the consumers at all times. This is of vital importance since any unforeseen disruption by the MSO in delivering its services, at any given point of time in future, would have huge impact since there won't be other MSO by then to provide similar services. In this regard, an eligibility criterion for MSO licensing would be the requirement of guaranteeing a certain minimum number of years of uninterrupted services for the consumers.

While there are certain existing rules on infrastructure sharing, having an exclusive 'right of way' for the MSO while deploying its digital network installation would go a long way to a more efficient and time-saving method of laying cables. In view of protecting the aesthetic views of the cities as well as the countryside, cables should first be encouraged to be laid underground as much as possible or otherwise properly laid with the existing power or telephone lines. BICMA and the respective municipal authorities in each locality can jointly monitor these activities.

In the digital era, the current pricing of a flat fee can be removed and replaced with the ability to pay (a-la-carte offering) system where each consumer pays for whatever service he uses. However, there is a need for a basic service tier (BST) which should be a bouquet of channels available for all customers and for which a minimum flat fee is charged by the cable operators. Normally, all FTA channels can be bundled in this package which should mandatorily include the BBS programs. As a comparative point of reference, this rate is currently fixed at Rs. 100 per month (excluding taxes) in India where a cable operator has to compulsorily offer a BST of 100 FTA channels and while the cable operators has to offer this BST, it is not obligatory for the consumer to subscribe to the same¹⁷. After the BST, there can then be a dynamic price system where each consumer will pay for which pay channels or value added services he wants to subscribe over the given period.

The possibility of providing value added services such as high-speed broadband Internet and cable telephony by the MSO would require granting of telephone as well as ISP license for the MSO. Similarly, assuming that Bhutan Telecom's ongoing fiber to the curb (FTTC) project is with intention to provide gradually IPTV to its customers, it would also mean granting of TV licenses to Druknet. In this regard, there is a need to revisit the licensing policy to either enable cross-ownership of ICT services by the ISP and the MSO or avoid potential conflict of interests in the future.

Another important area of concern will be the standardization on the quality, brand and specifications of the digital equipments. Proper brands of equipments and set-top boxes have to be decided and adopted by the MSO. This would ensure proper monitoring and not leave any room for the MSO to manipulate their system in the future.

¹⁷http://www.trai.gov.in/Content/faq_subcat_details/159_2_0.aspx

In terms of content regulation, BICMA has to continually access the increasing number of available channels and barring those which are deemed inappropriate for the Bhutanese public, grant the subscribers to choose any number of channels from the approved pool of available programs depending on each consumer's preferences and his/her ability to pay. Similar progressive approach can be adopted while fixing the entertainment taxes where the tax can be a very small percentage for the BST and can increase accordingly to the packages subscribed by the consumers.

7.1.4. Government Incentives for Digitization

In order to ensure a smooth transition to digitization of the cable networks, government support in the form of subsidies, tax exemption, distribution of set-top boxes and loan facilities have to be seriously considered given the government policy of ensuring affordable connectivity for all population and to catch up with the rest of the world. Government will have its own benefits subsequently from the revenue generation from the fact that there will be a very transparent system by then. However, as mentioned earlier, this must also conform to a proper negotiation, resource availability, the ground realities and future outlooks of cable industry.

There is a strong need for providing technical assistance to the cable operators given the fact that most if not all LCOs have little or no technical know-how when it comes to digitization. Side by side, enough staff of the LCOs have to be trained properly to ensure that cable operators are not hindered by lack of technical expertise later in the future.

As justified above, the government will need to consider leasing one of the national broadband fibers for the cable industry. Cable industry in post digital phase will not be a TV centered company but will rather be a multiple services provider with even larger impacts than any of the ISPs on the Bhutanese consumers. Since their area of operation covers the entire nation, granting of fibers and access to the gewog information centers would in fact enable them to reach even the rural households thereby realizing the government's objective of ICT for all at affordable price. This might even positively contribute to curtail the rural-urban migration in the end and provide more youth employment in the rural areas.

7.1.5. Tentative Timeline for Digitization

A tentative timeline for digitization is explained in detail under Appendix 2. It must be noted that the timeline is based on the Indian digitization timeline which is a little more than three years. Several verbal interviews are being conducted with the major cable operators on their rough estimation of time period if the digitization process gets started. However, several factors such as the actual on set of the digitization process by BICMA, choice of technologies, MSO's on-ground capability and the readiness of the general public would mean that the timeline will have to be reviewed again to make it more realistic.

7.2. Priority 2: A single regulated MSO with national permit.

This second priority is only to ensure a level playing field for all and only on condition that priority 1 is not realized. All the functioning, choice of technology as well as the regulatory aspects and government support are the same as priority 1. The only difference here is that the MSO concerned here can be formed and owned by any qualified Bhutanese citizen or company and not limited to the cable operators' domain alone. In absence of a potential single player, this can again be a publicly listed company (existing or new) where any Bhutanese citizen can be its shareholder.

It is imminent that such an arrangement could lead to serious conflict of interests with the existing LCOs but in the larger interest of the Bhutanese consumers, government may have to resort to such approach in absence of options mentioned under priority 1. However, government can ensure well in advance that any individual or a company willing to start the MSO have enough financial as well as technical capability to undertake this huge task.

The MSO can negotiate with each LCO on infrastructure sharing based on the existing government rules and regulations or to function on a partnership basis. However, it is important to note here that only the existing fiber core network of the LCO will be of most use for the MSO and that too is subjected to MSO's purposes. Since the entire headend system as well as the last mile connectivity has to be upgraded or replaced entirely in any case, the LCO has indeed very little bargaining power in reality.

One of the important roles for BICMA would be to avoid unnecessary emergence of 'pseudo-MSO' set-ups by taking advantage of any loopholes in the existing licenses. This can be addressed by ensuring that the entire TV signals or any other value added services by any upcoming similar establishments (i.e. pseudo-MSO) must be obtained only through the now established MSO and not from other unauthorized sources. This would effectively prevent emergence of grey market as well as help sustain the established MSO to function without future uncertainties.

7.3. Priority 3: The Upcoming Private TV broadcaster as MSO

Bhutan is already in an advanced phase of introducing a private TV broadcaster. In this regard, it will be a realistic option to grant this new station with the MSO license if it has the extra financial and technical capability to be one.

There are many success stories around the world where a TV station is a successful cable operator at the same time. One of the most prominent examples is the HBO in the USA. HBO finances most of its high quality TV serials with the revenues earned from its cable subscriptions contrary to the popular assumption that the programs are primarily funded through advertisement revenue. The fact that US has huge number of subscribers numbering in millions might have contributed to this substantial budget for quality production of programs but at a smaller scale, the new TV broadcaster in Bhutan can also generate extra source of revenues through cable services which can then be used similarly to produce higher quality of local video contents.

All other aspects regarding the choice of technology, regulations and government support are similar to those mentioned under priority 1.

Here too, a similar conflict of interests might occur with LCOs as detailed under priority 2 but the decision again has to be made in the larger interests of the entire Bhutanese consumers.

8. The Way Forward and Conclusion

Bhutan cannot afford to leave the cable industry simply to market forces. The country's small market base and relative lack of technical expertise as well as awareness about the future of TV services among the existing cable operators would only lead to an inefficient industry if left unchecked. In this regard, the first priority, for now, for the government or the regulatory body like BICMA would be the creation of awareness among the LCOs about the changing patterns of TV consumption and the many benefits that the digitization will ultimately bring to all the stakeholders.

8.1. BICMA's Initiatives to Conduct Pilot/Demonstration Projects on Digital System

If no MSO comes forward with a realistic proposal, there is a need for BICMA to initiate and conduct, possibly in collaboration with an able and interested local cable operator(s), a pilot project on digitization. Preferably targeted to a smaller groups of households in Thimphu due to close proximity of the Authority's office as well as existence of a good fiber network of the cable operator in the city, the pilot project can be funded either through an external source or by a potential supplier of the digital cable service from abroad. The pilot project will not only demonstrate the benefits of digitization to the general public but also attract and encourage potential MSO to come forward with proposals.

Even though, given our country's small size and the already existing good ICT infrastructure, there is potential to achieve complete digitization at a shorter period than in many other countries, it will be a realistic practice to approach the same on a phase-by-phase basis. There are positive indications of a few big cable operators already exploring options to digitize their cable systems and providing them all possible assistances by the government would only encourage them to undertake transition smoothly.

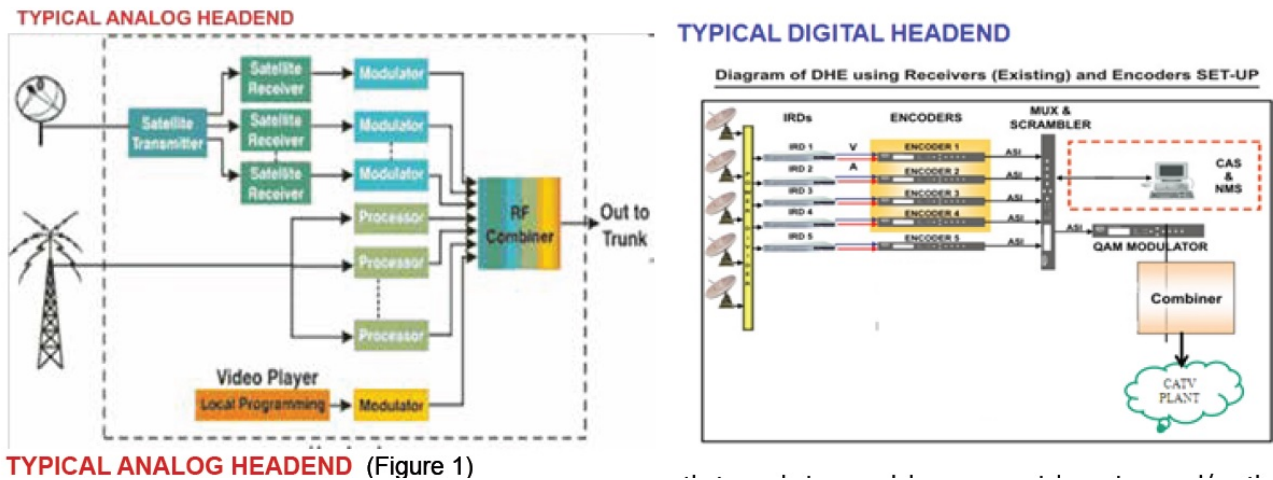
Side by side, all future rules and regulations must be framed keeping in mind that the cable operator's roles are no longer going to be those of providing TV programs alone but various multiple value-added services.

The tasks at hand for both the government as well as the cable operators are easier said than done. As mentioned above, there exists a number of potential obstacles on the way such as increasing penetration of DTH, lack of cooperation among the LCOs, huge cost of digitization and certain degree of uncertainty from online threats such as OTT and mobile TV. However, there is no denying the fact that if properly planned and implemented collectively through the participation of all cable operators and the government stakeholders, all of the above obstacles can be easily overcome over time mainly due to the huge number of opportunities and benefits that digitization can bring to the society.

Appendix 1: A Sample Digital Headend Solution (with indicative cost of components)

The primary reason for including the digital headend solution in the appendix section and not in the main report is mainly because, due to rapid technical innovations, the concept might be outdated or replaced by an even better system by the time of implementation.

The following diagram briefly presents the main differences between an analog headend system and a digital headend system.



The first pre-requisite for a digital headend would be the local encoding and conversion of analog signals that are being received via satellites to digital through the use of either a mpeg-2 or mpeg-4 encoder. Mpeg-4 encoder is far more expensive than the mpeg-2 encoders because of the better compression hardware. In India, an mpeg-2 encoder can cost anywhere between Rs. 20,000 to Rs.2 lakhs depending on the brand and quality¹⁸. Since one encoder is typically needed per channel, the need for multiple encoders for multiple channels mean that the cost of digital encoders typically account for majority of the headend cost. Currently, most digital satellite receivers provides an analog outputs rather than a digital (Asynchronous Serial Interface - ASI) output. In case the receiver provides and ASI output, substantial cost can be saved since no encoder would be required and the digital signals can be directly fed to the digital combiner (Shown in the figure).

¹⁸<http://dreamdth.com/Thread-Article-BASIC-ARCHITECTURE-OF-A-DIGITAL-CATV-HEADEND>

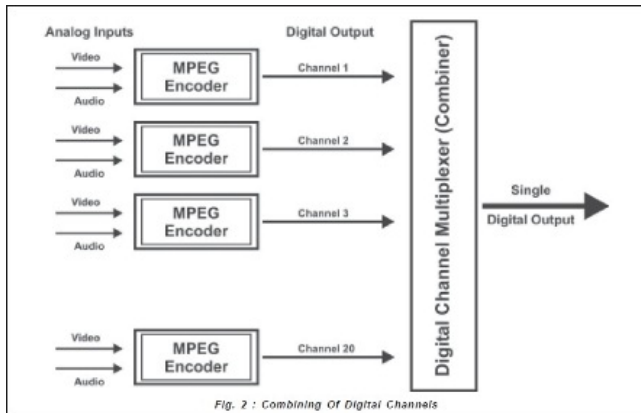


Fig. 2 : Combining Of Digital Channels

Source: <http://www.scattmag.com>

In the next step, the digital combiner (multiplexer) then combines the entire digital signals and outputs a transport stream (TS) which not only includes all the digital signals but also a summary page like the index of all the available programs in that package. Normally, a single multiplexer combine anywhere between 12-20 channels.

One of the main features of digital CATV is the conditional access system (CAS) which are provided through a process called scrambling where all pay channels are scrambled with the help of a computer connected via an Ethernet protocol and using the Subscriber Management System software along with the Electronic Program Guide (EPG) and are decoded (unscrambled) by the set-top boxes depending on the channels that are being paid for by the customer. The standalone software also is usually very expensive since they are specifically made for cable networks management.

Since each multiplex output requires a separate scrambler, there might be need for multiple scrambler depending on the desired number of channels. A scrambler today costs about Rs. 2 lakhs in the Indian market¹⁹ implying that the cost can escalate substantially if multiple scramblers are required.

The figure below shows where the scrambling takes place at the headend.

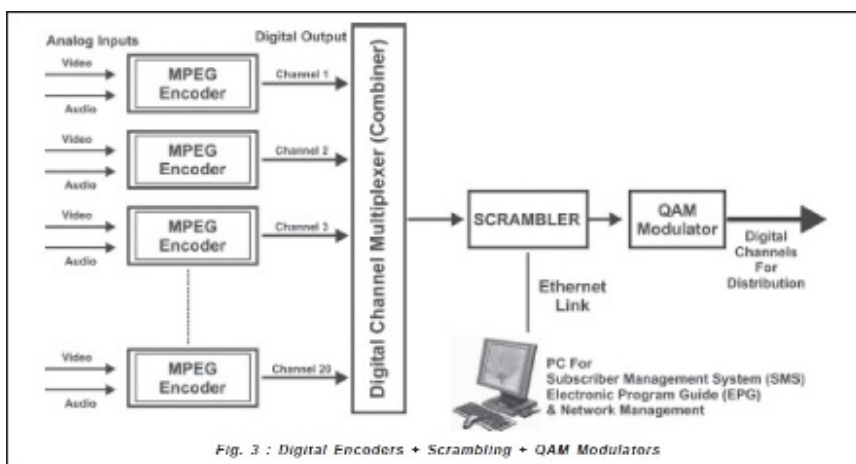


Fig. 3 : Digital Encoders + Scrambling + QAM Modulators

¹⁹<http://dreamdth.com/Thread-Article-BASIC-ARCHITECTURE-OF-A-DIGITAL-CATV-HEADEND>



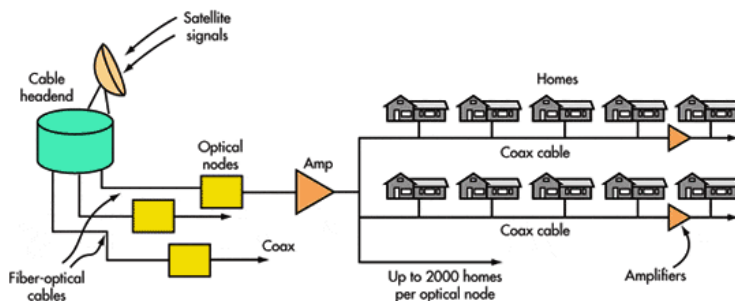
Figure 3. A typical setup of digital headend equipment offering maximum channel capacity of 100.

The actual carriage of the scrambled signals over a given bandwidth are undertaken by the Quadrature Amplitude Modulation (QAM) modulator. When the cables in the network are of poor quality, normally QAM 64 (with average bitrate of 38 MBps) is used which is more tolerant to external noise but offers an inferior compression as compared to QAM 256 (with bitrate of 51 MBps) which offers more number of digital channels but are susceptible to external noise. Given the fact that most network in Bhutan would be based on the reliable fiber networks, it is safe to adopt the QAM 256 Modulation standard.

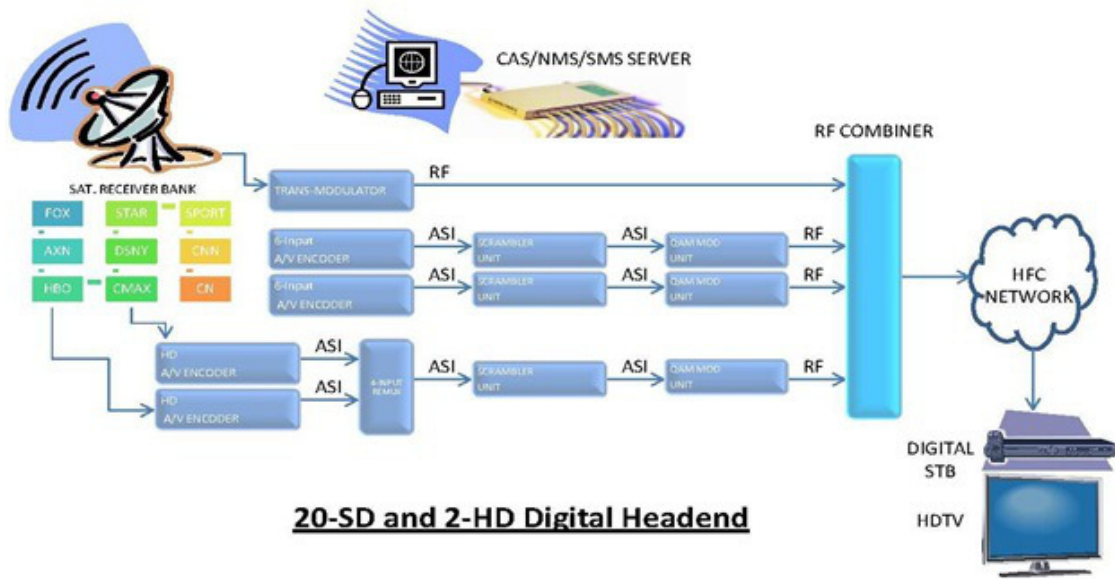
Another strong alternative in the market is the use of IP Digital signals. In this case, the equipment converts the analog output signals from the receivers into an IP digital data stream instead of an ASI digital data stream which can then be multiplexed and modulated for transmission. Some manufacturers like Teleste offers a combined multiplexer and QAM modulator for about Rs. 15 lakhs²⁰.

With regard to transmission of the TS from the headend, in Bhutan's case, the deployment can start with the provision of digital signals through a hybrid system where the existing coaxial cables can be converted into hybrid cables by using two-way amplifiers saving enormous cost on last mile connectivity and gradually adopt fiber to the home (FTTH) as and when time and resources permit.

A few self-explanatory architecture of digital headend and distribution system are illustrated below:



²⁰<http://dreamdth.com/Thread-Article-BASIC-ARCHITECTURE-OF-A-DIGITAL-CATV-HEADEND>



Source: http://aegistechnotes.files.wordpress.com/2011/10/digitalhe3_thumb.jpg?w=625&h=328

An example of how cable telephony and broadband Internet would work:

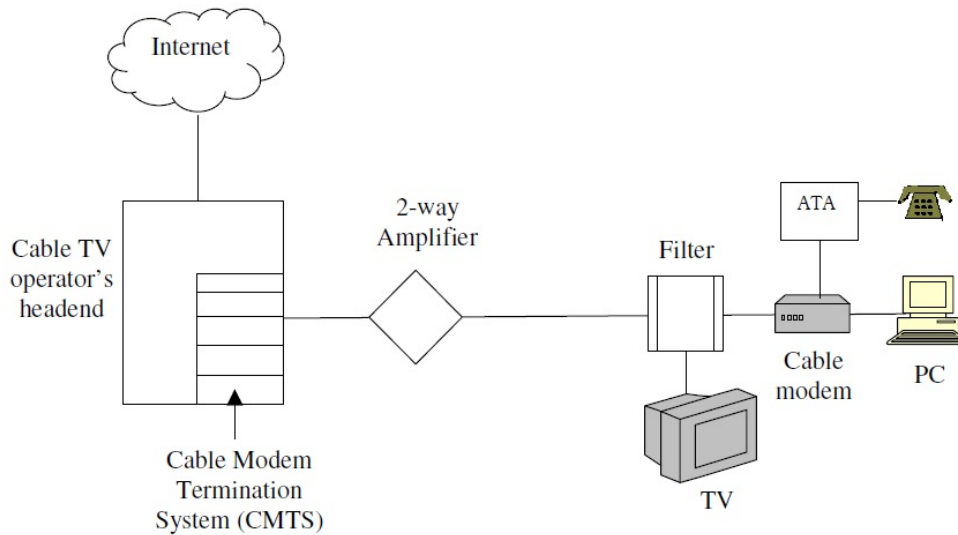
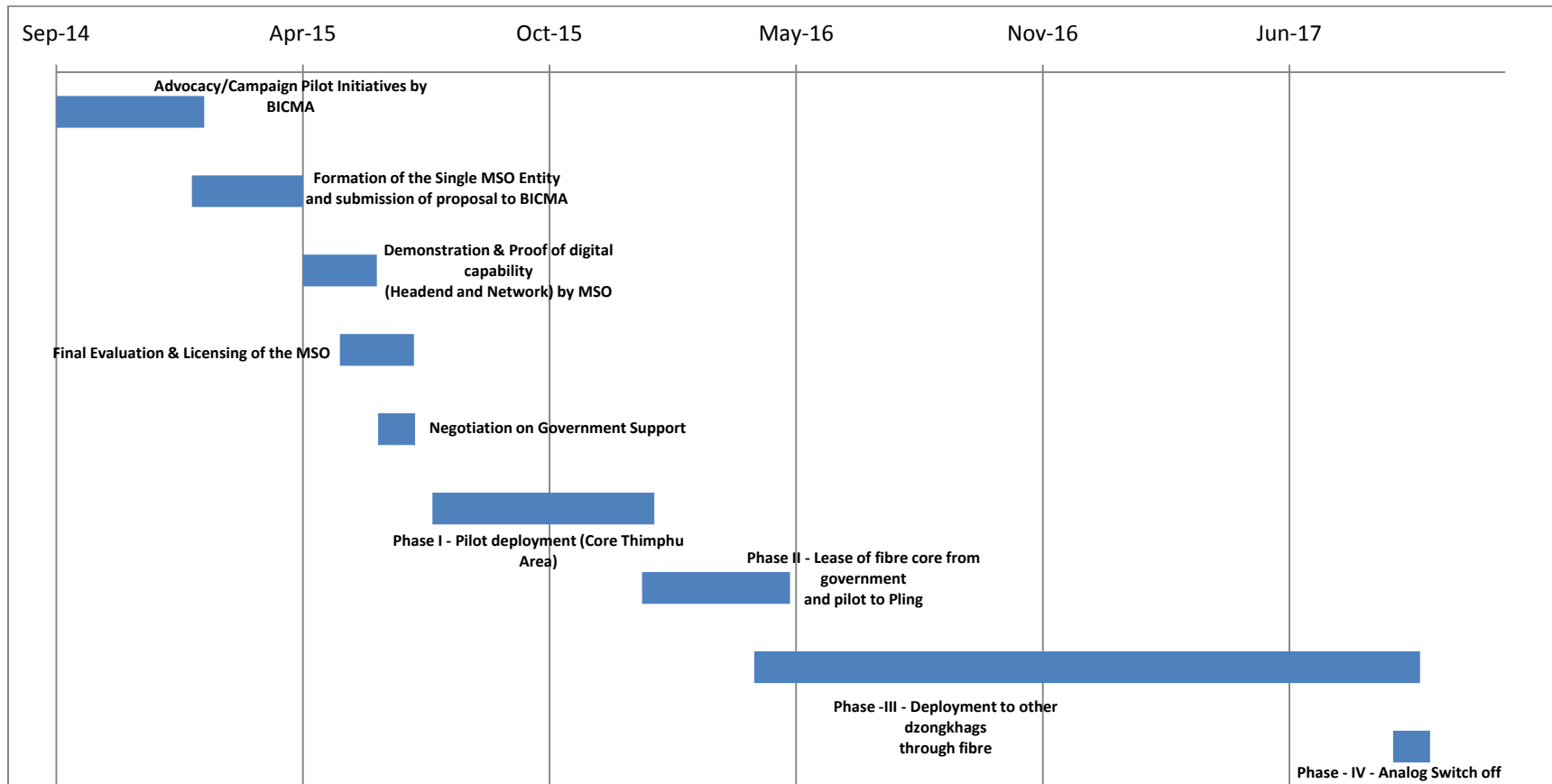


Fig 3: Broadband & Internet telephony through Cable TV Network

Appendix 2: Tentative Roadmap for Digitization of Cable TV in Bhutan

The following Gantt Chart plots the tentative timeline for the digitization of Cable TV network in Bhutan. The standard is assumed to be of the DVB-C variant. Depending on the decision and capability of the MSO, the deployment and compression standards can be either based on mpeg-2 standard or the mpeg-4 standard. The actual transition period is proposed from January 2015 - October 2017 the grounds for which are explained in the following paragraphs.

Gantt Chart depicting the Timeline for Full Digitization of the Cable TV (Headend and Network Deployment using Fibre-optics cable) in Bhutan. Standard: DVB-C/C2 - Mpeg 2 or Mpeg-4



The Gantt chart for the tentative roadmap for cable digitization above is derived from the following data:

Tasks	Start Date	Duration	End Date
Advocacy/Campaign/Pilot Initiatives by BICMA	Jul-14	180	Jan-15
Formation of the Single MSO Entity and submission of proposal to BICMA	Jan-15	90	Apr-15
Demonstration & Proof of digital capability (Headend and Network) by MSO	Apr-15	60	May-15
Final Evaluation & Licensing of the MSO	May-15	60	Jun-15
Negotiation on Government Support	Jun-15	30	Jul-15
Phase I - Pilot deployment (Core Thimphu Area)	Jul-15	180	Jan-16
Phase II - Lease of fibre core from government and pilot to Pling	Jan-16	120	Apr-16
Phase -III - Deployment to other dzongkhags through fibre	Apr-16	540	Sep-17
Phase - IV - Analog Switch off	Sep-17	30	Oct-17

Rationale behind the proposed timeline

This tentative timeline is based on interviews with the existing major cable operators in the country as well as close observations on the digitization phase in India. While the entire period of digitization in India is three years and four months (November 2011-March 2015), a relatively shorter period of two years and nine months (excluding the advocacy/awareness campaign period by the Authority) is proposed for Bhutan. The shorter period is based on the fact that there are far fewer number of cable operators in the country which are comparatively easier to monitor and regulate than in India. Moreover, the availability of a reliable and strong nationwide fiber connectivity backbone is assumed to facilitate an even faster transition.

It must, however, be noted that given the initial resources as well as time constraint of the Authority, the timeline will shift proportionally according to the on set of initial task. For instance, if the awareness/pilot demonstration task is postponed by certain number of months due to emerging inevitable circumstances, the timeline for other tasks as well as the deadline will shift accordingly. In addition, in absence of a similar deployment of services conducted in the past, the actual time for completing the mentioned tasks may not necessarily correspond to the proposed timeline above. This calls for a review on the timeline once the upcoming MSO is identified and all stakeholders consulted thereafter.

Advocacy / Campaign/Pilot Initiatives by BICMA

It will be a crucial task for BICMA to properly disseminate the entire aspects of digitization to both the cable operators as well as the general public. This will ensure that everyone is aware about the pros and

cons of digitization. Most contents can be dissemination on know-how of standard technologies related to the headends and network deployments, use of set-top boxes and triple play features. However, immediate promotion of triple play features is not advisable, at this period, without understanding the full capability of the MSO since triple play system costs much more than standalone digital video systems. A duration of six months is estimated for this awareness activity in order to cover the entire country.

As mentioned under section 8.1, BICMA can take the initiative to conduct its own small-scale pilot project in Thimphu in absence of a realistic proposal for MSO.

Formation of the Single MSO Entity and submission of proposal to BICMA

The next three months can be the period of formal conglomeration of all cable operators to form a single association that will function as the MSO with all current LCOs as its shareholder. The hierarchy of allocating both the investments and dividends are based on a transparent basis of the number of subscribers. BICMA, in the interest of the cable operators as well as avoidance of pseudo-MSOs in the country, has to ensure that only a single MSO license will be issued (provided the licensee is not an individual person or a single private company) during this digitization phase.

Demonstration & Proof of digital capability (Headend and Network) by MSO

In order to ensure proper service delivery, a demonstration of the digital cable distribution system can be made by the MSO during this phase. This can be in the form of either a presentation on the confirmed choice of technologies, equipments, standards, set-top boxes and how the entire distribution networks function or can involve field visits abroad (India, for instance) for the Authority and the association representatives to gain first hand experiences on similar applications on ground. The expensive headend equipments might deter any MSO to make a large-scale demonstration. The main reason for such a demonstration is to ensure, that the MSO once licensed, is fully capable of deploying digital CATV system.

Evaluation, Licensing and Government Support

Since most of these tasks are overlapping in nature, the timeframe is also reflected as such. For instance, it would be most appropriate if the licensing process were undertaken with evaluation and negotiation of possible support from the government. The stakeholders would include the MSO, government agencies and local cable operators. The primary government agencies would be the Ministry of Finance (tax, subsidies etc.), MoIC (for lease of fiber optics and other technical support) and BICMA (for licensing and regulatory purposes).

Three Phases - Thimphu (Core) -->Phuntsholing (Core) --> other dzongkhags and peripheries of major urban centers

It will be most practical to deploy the Phase I to the core areas of Thimphu for pilot purpose only. This pilot phase is easier to implement because the current LCOs in Thimphu have a reliable fibre optic network already in place. It will be only a matter of changing the headend equipments and the last mile

connectivity and installation of set top boxes. By this time, the set-top boxes should already be deployed (most probably with government support) in these areas. All subscribers can register on a voluntary basis and criterion such as the proximity of the households to the nearest fibre curb can be considered at first.

It will be crucial to tackle all troubleshooting during this phase and given the long duration for this phase (six months), it should be possible to address any major issues that might crop up.

The digitization of cable services in the urban centers of Phuntsholing is pushed to a separate timeframe mainly because the source of digital contents will be routed through the single MSO and not through simultaneous receptions as practiced today. This would very much depend on the successful transmission of signals from Thimphu to Phuntsholing via the optical fibre cable between the two cities.

Successful pilot testing in the two core centers of Thimphu and Phuntsholing would pave way for nationwide deployment for which a realistic timeframe of one and a half years has been set for the given task.

The next step would then be the gradual introduction of triple play features by the MSO in order to diversify its product and generate extra revenue through these value added services.

Acronyms:

ATSC:	Advanced Television Systems
BICMA:	Bhutan Infocomm and Media Authority
BPC:	Bhutan Power Corporation
BTL:	Bhutan Telecom Limited
CATV:	Community Access Television
DITT:	Department of Information Technology and Telecom
DOCSIS:	Data Over Cable Service Interface Specification
DTH:	Direct to Home
DTMB:	Digital Terrestrial Multimedia Broadcast
DVB-T:	Digital Video Broadcasting – Terrestrial
EMI:	Electromagnetic Interference
Gbps:	Gigabits per second
ICT:	Information and Communications Technology
IPTV:	Internet Protocol Television
ISDB-T:	Integrated Services Digital Broadcasting
ISP:	Internet Service Provider
LAN:	Local Area Network
LCO:	Local Cable Operator
Mbps:	Megabits per second
MoIC:	Ministry of Information and Communications
MSO:	Multiple Service Operator
OPGW:	Optical Ground Wire
OTT:	Over the Top
STM:	Synchronous Transport Module
ToR:	Terms of Reference
TWAN:	Thimphu Wide Area Network

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