FULFILLING NEEDS FOR DIGITAL MEDIA

Ahmad Nasruddin shares details of implementation, challenges and digital dividends arising from migrating to digital terrestrial television in the country.

The world has gone digital in a virtual flash. Every conceivable communication service has gone or is going through a rapid digitization and even the word analogue feels odd and ancient. Well, not quite all. One of the last remaining bastions of old analogue technology is our free-to-air (FTA) television service which is still in analogue format but not for much longer. In December 2006, then-Deputy Information Minister, Datuk Donald Lim announced that analogue TV broadcasts in Malaysia will be phased out by 2015, less than 10 years from now.

This is not to say that digital television has not made an appearance in this country yet. Digital television technology is not exactly new to Malaysians as there are three operators that offer digital pay-TV. As of now, Astro has over 100 television programmes, 17 radio and 4 pay-per-view channels plus various interactive services utilising the KU band satellite transmission technology.

This is in addition to the previous offering by MiTV which had 41 programme channels running on IP over UHF and FineTV's 19 channels via broadband. Radio Televisyen Malaysia (RTM) started its trials for digital terrestrial TV (DTT) in early September 2006 as a step in the plan to move to a fully digital service by 2015.

What exactly can consumers expect and what are the dividends we stand to gain when the country goes fully digital?

DTT in brief

According to Wikipedia, digital TV (DTV) is a telecommunication system for broadcasting and receiving moving pictures and sound by means of digital signals, introduced in the late 1990s. DTV uses digital modulation data, which is digitally compressed and requires decoding by a specially designed digital TV set or our existing TV set with a set-top box or a PC fitted with a television card.

Like any other services, the existing television service is going through rapid changes due to rapid digitization and technological development. This evolution includes the introduction of digital TV to replace analogue TV, from standard definition TV to High Definition (HD) TV, from passive viewing to interactive TV and TV on the move and video on demand. This has contributed to the onset of convergence of broadcasting and telecommunications i.e.

Figure 1: Evolution of TV services

towards a new TV experience. It can be seen that interactivity, mobility and video on demand services are traditional services of telecommunications. Whereas more channels, larger screen and local area TV services are traditionally the domain of TV broadcasters. This new TV service evolution can be summed up in **Figure 1**.

There are many standards adopted by countries around the world such as ATSC in North America, ISDB-T in Japan, DVB-T in Europe and Australia and DMB-T in China and Hong Kong. As for us, the industry has decided that our DTT will be using the DVB-T standard which is a standard widely used in Europe.

This service is transmitted on radio frequency (RF) similar to the traditional TV with the dividend of carrying multiple programme on a single RF channel. Essentially this gives both broadcasters and consumers more channels to play with.

At the moment, the Malaysian national broadcaster RTM is conducting a six-month trial on 2,000 selected households in Kuala Lumpur and surrounding areas. The trial service offers the current two analogue TV channels, RTM1 and RTM2 in digital and two new digital-only channels, RTMi and Music Active. RTMi is broadcasting from 7pm to midnight daily while Music Active is on from 9am to midnight. Also there are seven FM radio stations in digital audio and interactive services. The viewers' response and opinions will be polled after the trial.

Digital TV Standards

ATSC	Advanced Television Systems Committee
ISDB	Integrated Services Digital Broadcasting
DVB	Digital Video Broadcasting
DMB	Digital Multimedia Broadcasting

Around the world

Deployment of DTT is mushrooming especially in Europe as the European Commission (EC) has expressed its commitment for a swift "switchover" with the beginning of 2012 as the deadline for the switch-off of analogue TV for EU Member States.

Countries such as Luxembourg, the Netherlands, Finland, Sweden and Andorra have completed their transition to DTT. Others like UK, France, Germany, Belgium and others are in the transitional process.

As for Asia, South Korea, Japan, Singapore, Saudi Arabia and Taiwan are in their last phases of simulcast and certain DTT services are already available. The region has a mixture of standards including DMB, ATSC, DVB-T and ISDB-T.

Many countries faced difficult challenges during initial migration efforts due to poor awareness programmes and take up, availability of attractive content, high cost of set top boxes and ability to tap the full benefit of the technology.

Mobile TV

Mobile TV is no stranger when discussing the DTT evolution. But what is actually defined as mobile TV? Mobile reception is broadly defined by the European Broadcasting Union (EBU) as "reception while in motion, covering speeds from walking to motorway driving". However, mobile TV is a name used or generally understood or described as a service to subscribers via mobile telecommunications/broadcasting networks. Mobile TV involves bringing TV services to the mobile phones. It combines the services of a mobile phone with television content and represents a logical step both for consumers and operators and content providers opening up new opportunities.

The DTT (DVB-T) standard initially addressed all the modes of reception from fixed to mobile but not to mobile handheld devices. Handheld device reception has additional issues which are quite different from mobile reception in vehicles. Issues such as battery life, in-built antenna and difficult reception indoor and on small devices are significant factors to be addressed. This was addressed by adding

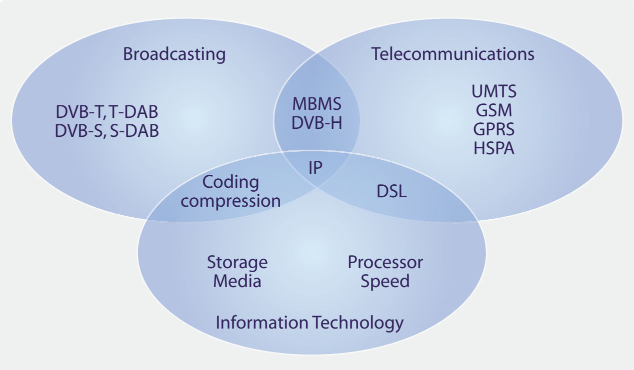

Figure 2: Convergence between broadcasting, telecommunications and IT and the available technology

more robust techniques to the DVB-T standards and is now known DVB-H (DVB-H is a family member of DVB-T).

It can be noted that convergence through mobile multimedia services are brought in from developments in broadcasting, the technology DVB-H which is a broadcasting technology. From telecommunications it is the MBMS (an evolution of 3G). From IT, is the IP platform, compression (MPEG4), processor and storage technologies allowing the possibility to view TV on mobile handheld devices. **Figure 2** illustrates the convergence of the 3 services/technology.

Some key characteristics of reception by mobile handheld devices are:

- Lower in resolution than for fixed reception mode which is meant for smaller screens. There are four classes of resolution in mobile handheld reception as follows:
  - Class A (128 kbps/10-12 fps),
  - Class B Low (256 kbps/15-20 fps),
  - Class B High (384 kbps/20-25 fps),
  - Class C (768 kbps/30 fps)
- Required to operate from walking pace to high vehicular speeds and with highly variable reception conditions.
- The planning for mobile reception for handheld reception of TV will be more challenging than in-vehicle using external antenna. The approach used is normally similar to the cellular network with dense SFN networks of low power transmitters with low antenna height.

Digital dividends

With the high level of technology and services maturity in the country, it is about time to go digital especially when analogue TV is not spectrum efficient and occupies a lot of spectrum. In the analogue world, each RF channel can only support one TV programme whereas one digital RF can carry multiple TV programme channels. The savings in spectrum arising from digital technology give rise to what the industry terms as the 'digital dividend'. Spectrum is a very valuable commodity and DTT assists in freeing spectrum resource which could be used to carry more TV programme channels and accomodate other services such as Mobile TV and High Definition TV.

In the Standard Radio System Plan (SRSP) for DTT published by SKMM, it specifies the following broadcasting bands for DTT (there are a total 42 RF channels) when the full migration completes which are:

- VHF Band III: Channels 5-12 (8 x 7 MHz); and
- UHF Band IV/V: Channels 21-54 (34 x 8 MHz)

SKMM has analyzed and estimated the requirements for the analogue digital migration and future needs of DTT and the above bands are adequate.

DTT migration

Completing the migration of analogue FTA TV to digital is a major challenge as it is a combination of efforts by all stakeholders i.e. the government, viewers, transmission distribution network owners, vendors, manufacturers and TV stations.

Existing spectrum allocation involves a slew of different parties such as TV stations, radio navigation services, public land mobile operators, aeronautical radio navigation services, personal radio services and so on. Reallocating this chunk of spectrum users and migrating to DTT is a major exercise and to handle the migration effectively, it is divided into several phases (**Figure 3**).

Phase I started with the trials and deployment of DTT network and will end by 2015. In this phase which is also known as the simulcast period, both analogue and digital TV will co-exist. Analogue TV will be shut down in stages during this phase. SKMM will also vacate Land Mobile Services (LMS) and radar services from the band.

Phase II will pick up in 2016 to 2020 where analogue TV will be fully shut down and any DTT services using channels 56 and above will be moved to within channels

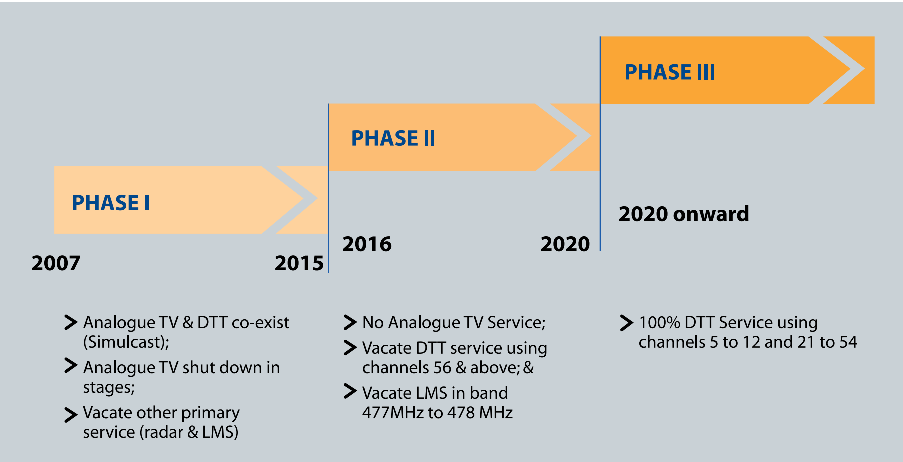

Figure 3: Phases in the DTT Migration Plan

21 to 54. LMS operating in 477 MHz will be moved out to an alternative band. Finally, DTT services will operate from channels 5 to 12 and 21 to 54 beyond 2020 (Phase III).

Several criteria have been taken into consideration during the DTT migration plan, namely, number of programme channels, extent of coverage, degree of regionality, whether portable and/or mobile reception, required picture quality (which will be standard definition and in future some High Definition), degree of cross border coordination and reuse of existing analogue sites.

Technical considerations

The digital transmission capacity and spectrum needs must be confirmed to be available to carry all existing TV programmes and new programmes. In the digital world of TV, multiplexer (MUX) is used to aggregate multiple programme channels that are to be transmitted via RF channel. The estimated capacity needed for HD and SD using MPEG4 compression are about 3 Mbps for a SD programme and 6 Mbps for a HD programme.

Assuming six current programmes (RTM1, RTM2, TV3, NTV7, TV8 and TV9), and all on SD, the total capacity required is 18 Mbps. Based on a study, for the migration to be attractive to consumers, more programme channels are needed. Assuming another 10 additional channels are phased in, this would mean a total of 48 Mbps will be required.

To ensure that future FTA is competitive and attractive to consumers, some capacity for HD is needed. Assuming, at least four to six programmes will go HD, the additional capacity need in the future will be about 36 Mbps. Other supplementary services like textual information services, Electronic Programme Guide (EPG) and interactive services will require some additional transmission capacity and may take up as much as 10 Mbps.

It is estimated that the total aggregated capacity will be 94 Mbps comprising about 30 Mbps (10 programmes at launch) initially for SD with another six programmes (18 Mbps) at a later date, another 36 Mbps later for HD and some (10 Mbps) for data services.

For DTT planning, the consideration on various reception modes i.e. fixed (10m), portable indoor/outdoor (1.5m), mobile (in-vehicle and handheld) will require very complex coverage planning and lead to different spectrum requirements. For FTA capacity planning, reception for fixed, mobile (in vehicle), portable indoor/outdoor and reuse of existing analogue high transmitter power and high antenna sites are considered. It is also assumed good nationwide coverage is needed with some regionality.

The choice of DVB-T parameters is the deciding factor for the number of program channels that can be fitted in an RF channel. It is a trade off between bandwidth efficiency and extent of frequency re-use. This is estimated by an initial study that indicates the use of 16 QAM and ¾ code rate will give a data capacity of 18 Mbps per each RF channel. This means two layers of MUX are needed (total 36 Mbps; needed is 30 Mbps) for the initial launch and at a later phase another MUX will be required to accomodate 6 additional programme channels or 18 Mbps.

To cater for the future needs of HD, a further two layers of MUX will be required. Thus the total estimated capacity is 5 layers of MUX nationwide to fully accomodate the needs of FTA programmes.

Technical challenges

There are some concerns about the "hole punching" effect which is due to adjacent channel interference between FTA (high transmitter power, high antenna height network) and mobile broadcast TV (low transmitter power, low antenna height network). This happens when the required protection ratio is compromised and it usually happens at the edge of the reception area when the signal level is lower.

A DVB-T signal will require a protection ratio in the order of 10-20 dB, for co-channel interfering signals. The precise figure will depend on the modulation level, code rate and propagation channel characteristics. This means that the power of the interfering signal should be 10-100 times less than that of the wanted signal.

For a signal on the adjacent UHF channel (i.e. with a centre frequency 8 MHz away from the wanted signal), the protection ratio reduces to around -28 to -42 dB. This apparent tolerance will allow DTT transmissions to be used adjacent to existing analogue signals from the same site.

Where both wanted and adjacent-channel signals originate from the same site, their powers will clearly fall off 'in step' as distance from the site is increased. If the ratio of powers (including the effect of aerial radiation patterns) at the site is correctly chosen there will be no risk of interference.

A different situation will result where wanted and adjacent transmissions are made from different sites. The possibility then exists that the wanted signal is relatively weak, perhaps at the edge of coverage of a distant transmitter, while the adjacent signal may be from a very local transmitter. In this case, there is a real possibility that the >-28 dB protection ratio will be exceeded.

An example where this hole punching scenario could possibly happen when a DTT transmitter and Mobile TV transmitter co-exist within a geographical area and the RF channel used are adjacent channel (e.g. DTT Transmitter using RF channel 30 and Mobile TV transmitter using RF channel 31 as illustrated in **Figure 4**).

High Definition Digital TV Set-Top-Box

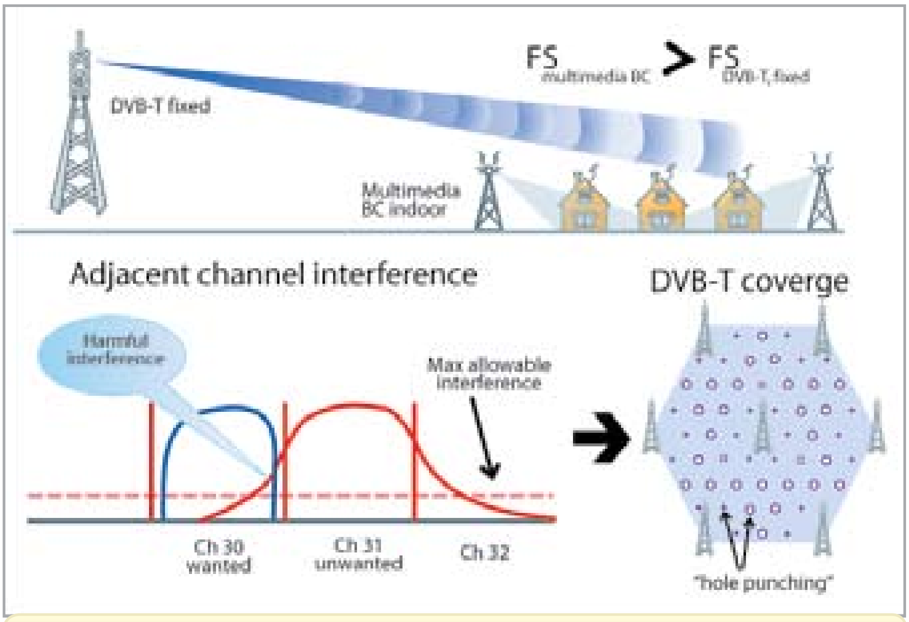

Figure 4: Illustration of hole punching in DTT and Mobile TV ecosystem

Source: CEPT/ECC Task Group 4 Report A

Financial costs

For consumers, the most basic set-top box known as the minimalist set-top box will cost about RM150 but set-top boxes that support interactivity will cost much more. However like most consumer electronic gadgets, prices will drop when demand increases.

The migration period will cost quite a bit. Investments will need to be made for installation, transmitters and studio middleware to fully benefit from digital transmissions. There will also be extra costs during the simulcast period when both analogue and digital transmissions are operating. Investments will also be needed in the production or studio as well as in software and databases to make use of features like interactivity.

In order to handle the above hole punching issue, one method can be considered which is by adding the DVB-T transmitters at the same site/location as the mobile broadcast TV stations site wherever the hole punching occurs.

Another way of solving this 'hole punching' problem is to introduce a 'guard' channel, that is to skip one RF channel, between high power DTT and Mobile TV use (**Figure 5).** And for efficient use of the spectrum, that RF channel can be dedicated for the use of low power devices such as for Program Management Service Equipment (PMSE) for wireless microphone or for low power DTT transmission (in building coverage).

For cases between mobile TV operators or between DVB-T operators, sharing the same site/location is the best practice to avoid hole punching problem. SKMM will proceed on further detailed planning in the SRSP DTT working group using its Chirplus_BC planning tool with the industry players. This exercise is targeted to improve the overall planning requirements by confirming the assumptions used and gaining the exact estimate of bandwidth requirements by the industry players to ensure the success of the DTT rollout in Malaysia.

Minimalist set-up boxes

However it is money necessarily spent as digital migration is vital to better manage spectral resources and allow consumers to benefit from interactive content, HD content, both localized and nationwide. .my

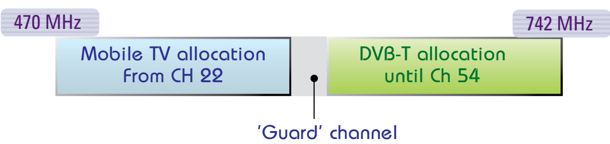

Figure 5: Possible DTT and service clustering

Ahmad Nasruddin Atiqullah Fakrullah is the Senior Spectrum Engineer with the Spectrum Research and Planning Department of SKMM. He can be contacted at ahmad.nasruddin@cmc.gov.my.