

Technical Standard for Digital Terrestrial Television Broadcasting

Statement of the Telecommunications Authority

4 June 2007

Introduction

Following two public consultations¹ on digital terrestrial broadcasting in 2000 and 2003, the Secretary for Commerce, Industry and Technology (SCIT) set out in his Statement² the implementation framework for digital terrestrial television (DTT) in July 2004 (the SCIT Statement). In the light of the implementation framework, the two incumbent terrestrial television broadcasters, namely Asia Television Limited (ATV) and Television Broadcasts Limited (TVB), are required to start simulcasting both analogue and digital terrestrial television services in 2007 at the latest using the multi-frequency network³ (MFN) which they will share. In addition, they are each assigned a single frequency network³ (SFN) multiplex to provide new high-definition broadcasting services.

2. SCIT also stated that the Government would adopt a market-led approach to the selection of DTT technical standard. ATV and TVB indicated that if Mainland China did not announce its national standard before the end of 2006, they would adopt the European Digital Video Broadcasting-Terrestrial (DVB-T) technical standard for digital

¹ The consultation paper entitled “Digital Terrestrial Broadcasting in Hong Kong” was issued on 1 December 2000 and another consultation paper entitled “Second Consultation on Digital Terrestrial Broadcasting in Hong Kong” was issued on 5 December 2003 (Please refer to http://www.citb.gov.hk/ctb/eng/paper/doc/DTT-c-paper-1Dec00_E.doc and http://www.citb.gov.hk/ctb/eng/paper/doc/DTT-c-paper-2_E.pdf respectively).

² The Statement of the Secretary for Commerce, Industry and Technology on the Implementation Framework for Digital Terrestrial Television Broadcasting dated 9 July 2004 refers (<http://www.digitaltv.gov.hk/pdf/DTT.pdf>).

³ A MFN multiplex uses more than one frequency channel at different locations to provide broadcasting service throughout the territory, while a SFN multiplex uses the same single frequency channel at different locations to provide broadcasting service throughout the territory.

broadcasting in order that they may launch the DTT services according to the schedule specified by SCIT.

3. In August 2006, the Standardization Administration of the People's Republic of China (國家標準化管理委員會) promulgated the national DTT standard entitled "GB20600-2006: framing structure, channel coding and modulation for digital television terrestrial broadcasting system" (數字電視地面廣播傳輸系統幀結構、信道編碼和調制) (referred to as the "National Standard" hereafter). The National Standard is mandatory and will be in force in Mainland China with effective from 1 August 2007. ATV and TVB were interested in the National Standard and conducted a field trial to explore its technical performance in the fourth quarter of 2006. In their proposals submitted to the Office of the Telecommunications Authority (OFTA), they suggested unanimously the deployment of DTT services based on the National Standard.

4. The transmission systems of the DTT services to be operated by the broadcasters are telecommunications systems licensed under carrier licences issued by the Telecommunications Authority (TA) under the Telecommunications Ordinance (TO). The receivers to receive the DTT services are customer equipment connected to the transmission systems. Under section 32D of the Telecommunications Ordinance, the TA may prescribe standards and specifications of telecommunications systems and customer equipment to ensure, among other things, interoperability of customer equipment with the telecommunications system to which it is connected. Under the special conditions in the carrier licences that the broadcasters have accepted, the licensees are required to comply with technical specifications which may be issued by the TA. Furthermore, pursuant to section 3 of the Broadcasting Ordinance (BO), for the purpose of providing practical guidance for licensees in respect of any requirements under the BO imposed on licensees or in respect of licence conditions, the Broadcasting Authority (BA) may issue codes of practice and guidelines in consultation with the TA if the codes relate to the

technical standards of a broadcasting service.

5. Having considered the proposals of ATV and TVB, the TA issues this Statement setting out his views and decisions on the transmission standard and receiver specification for DTT.

Transmission Standard

Criteria of Assessment

6. In selecting the DTT technical standard for Hong Kong, the TA has taken into consideration the following criteria referred to in the second consultation paper¹ (the Consultation Paper) issued by the Commerce, Industry and Technology Bureau:

- (a) the selected standard should facilitate the provision of sufficient channel transmission capacity (e.g., able to support SFN transmission) to meet new demand for broadcasting services during and after the simulcast period;
- (b) the selected standard should support mobile reception;
- (c) the channel bandwidth adopted by the selected standard should be compatible with the 8 MHz channel bandwidth that is currently used in Hong Kong for terrestrial television broadcasting;
- (d) the selected standard should preferably be widely adopted internationally. There should be a full range of consumer products such as set-top boxes⁴ and integrated television sets⁵ based on the selected standard in the market at competitive prices;

⁴ A set-top box for digital terrestrial television receives and decodes digital terrestrial television signals into a form suitable for display on analogue television sets or other display devices, e.g. computer monitors or projection screens. Analogue television sets currently in use cannot display digital transmissions on their screens without being connected to such a set-top box.

⁵ An integrated television set is a television set with built-in digital capabilities to receive and display digital terrestrial television signals. Integrated digital television sets are generally distinguished by wide screens, high quality audio capability and high quality displays. They do not require a set-top box to receive digital terrestrial television services.

and

- (e) it would be advantageous for the selected standard to be interoperable with other broadcasting services delivered by different transmission platforms such as satellite or cable. The commonality in the system design of the relevant broadcasting equipment and television receivers may lead to cost savings in both network rollout and network operation.

7. The TA is minded that the adoption of the DTT standard should not cause delay in launching the simulcast by end 2007 and achieving 75% digital coverage within 2008, as set out in the SCIT Statement.

8. In addition to bringing along improvement in television reception and spectrum efficiency, DTT service will also serve as a vehicle for new applications such as high definition television (HDTV) and other innovative services and features. Since ATV and TVB have committed in their investment plans to the BA on DTT that they would provide HDTV programmes using their SFN multiplexes, the TA has also assessed the proposed DTT standard in terms of its capability of conveying HDTV content.

Assessment on Technical Performance

9. The National Standard had been tested extensively in Mainland China before its promulgation in August 2006. ATV and TVB, in the presence of OFTA, conducted laboratory tests in October 2006 in Beijing. To verify the suitability of deploying the National Standard in the local environment, which is characterised by hilly terrain, high-rise buildings and tidal harbour with long waterfront, ATV and TVB, as facilitated by OFTA, conducted a field trial with the National Standard in Hong Kong in late 2006.

10. The field trial covered receptions under a variety of propagation conditions, such as line-of-sight, non-line-of-sight and tidal fading.

There were also indoor and mobile receptions on top of the tests on SFN / MFN multiplexes and in-building coaxial cable distribution systems (IBCCDS). The field trial demonstrated the superiority of the National Standard over analogue transmission (PAL-I⁶). In particular the picture and sound quality delivered by DTT signal was satisfactory under non-line-of-sight conditions using only one tenth of the transmitting power of its analogue counterpart. Satisfactory results were obtained for all the following test items:

- (a) Line-of-sight reception;
- (b) Reception in hill shadow;
- (c) Reception at roof level in building shadow;
- (d) Reception at ground level in building shadow;
- (e) Reception under tidal fading;
- (f) Indoor reception;
- (g) Standard definition television (SDTV)/ HDTV reception;
- (h) Mobile reception;
- (i) Tests on SFN / MFN; and
- (j) Test on IBCCDS.

11. As demonstrated in the field trial, the National Standard supports spectrum-efficient operations including SFN deployment, multi-channel programming (several programme channels carried in one frequency multiplex) and conveyance of HDTV content. As for mobile reception, a success rate of over 90% was recorded during the road measurement conducted with a reception van. Taking into account the difficult reception conditions for mobile stations within urban areas (such as the blockage of signals by high-rise buildings), such a success rate is considered to be satisfactory. Regarding the frequency characteristics, the 3 dB bandwidth of a frequency multiplex is 7.56 MHz, which fits well within the 8 MHz channel currently used for terrestrial television broadcasting. Based on the results of the laboratory test, field trial and OFTA's evaluation, the TA is satisfied that the National Standard meets

⁶ PAL, acronym for Phase Alternating Line, is a colour encoding system used in analogue terrestrial television. PAL-I, currently used in Hong Kong, is a variant of PAL.

the assessment criteria given in paragraphs 6(a) – (c) and 8. For public consumption, the technical test report covering the field trial and the laboratory test has been posted on OFTA's website (<http://www.ofta.gov.hk/en/broadcast/report20070604.pdf>).

12. Paragraph 6(e) specifies that it would be advantageous if the proposed DTT standard is interoperable with broadcasting services delivered by other transmission platforms, such as satellite and cable. Currently, pay television services including Hong Kong Cable Television, TVB Pay Vision, NOW TV and satellite television services in Hong Kong are based on DVB-C⁷, IP multicast and DVB-S⁷ respectively, with source coding of MPEG-2⁸. The TA notes that a pay TV licensee in Hong Kong is trying out HDTV services in H.264⁹. The TA considers that the adoption of the National Standard would not affect the interoperability as compared with adopting DVB-T, so long as Hong Kong adopts commonly-used video compression and coding standards, i.e. MPEG-2 and H.264. Receivers equipped with multiple tuners can decode commonly used source coding for reception of digital television broadcasting services from the pay television and satellite television service providers. Of course, it is up to the consumer electronics manufacturers to decide whether there is a market for such multi-standard receivers.

Assessment on Availability of Consumer Products

13. Paragraph 6(d) requires that there should be a full range of DTT

⁷ DVB-C and DVB-S stand for Digital Video Broadcasting-Cable and Digital Video Broadcasting-Satellite. They are the DVB European consortium standards for the broadcast transmission of digital television over cable and satellite respectively.

⁸ MPEG-2 is the second of several standards developed by the Motion Pictures Expert Group (MPEG). It is a standard for generic coding of moving pictures and associated audio information. It is an international standard which is widely used around the world to specify the format of the digital television signals that are broadcast by terrestrial, cable and direct broadcast satellite television systems.

⁹ H.264 is the next generation video compression technology, also known as MPEG-4 (Part 10). MPEG-4 can match the best possible MPEG-2 quality at up to half the data rate. Like MPEG-2, MPEG-4 is a standard developed by MPEG. Using MPEG-2, one multiplex can accommodate only one HDTV programme at a time. In contrast, the use of H.264 enables a multiplex to accommodate more than one HDTV programme or carry more datacasting and ancillary services when transmitting one HDTV programme.

set-top boxes and integrated television sets at affordable prices when the DTT service is commercially launched. Unlike the more popular standards such as DVB-T, ATSC¹⁰ and ISDB-T¹¹, the National Standard is relatively new. Hitherto, only the transmission aspect of the National Standard has been promulgated while the reception standard, which is necessary for the manufacture of DTT receivers, has yet to be issued. To meet the Government's DTT implementation schedule as specified in paragraph 7, the TA considers that it is necessary to set out a specification of DTT receivers for the local market as soon as possible.

14. Many broadcasters in Mainland China are migrating their existing DTT systems to ones in compliance with the National Standard. In the meantime, it is noteworthy that no consumer product officially conforming to the National Standard is available in the retail markets in Mainland China. With this in mind, OFTA recently conducted a survey with the relevant manufacturers with a view to assessing the availability and prices of consumer products of the National Standard. Based on the results of the survey, it is understood that a handful of manufacturers have developed prototypes for the National Standard and are ready for mass production when there is market demand. It is expected that consumer products supporting SDTV, HDTV or a combination of both, with MPEG-2 as the default source coding scheme, can be supplied in bulk quantity within three to six months from the date of issue of the receiver specification. The indicative prices of the set-top boxes and integrated television sets for the National Standard are comparable to those of the more popular DTT standards, such as DVB-T. In the light of the above market intelligence, the TA is satisfied that the National Standard meets the assessment criteria given in paragraphs 6(d) and 7.

Decision on Transmission Standard

¹⁰ The Advanced Television Systems Committee developed the ATSC digital television standard, which is currently for the United States, Canada, Mexico and South Korea.

¹¹ Integrated Services Digital Broadcasting-Terrestrial (ISDB-T) is the DTT standard developed by Japan.

15. Based on the proposals of ATV and TVB, the results of the field trial and the information garnered from the manufacturers, the TA is satisfied that the National Standard meets all the mandatory assessment criteria set out in paragraphs 6 to 8. In particular, the TA considers that it is technically feasible to deploy the National Standard, with the technical parameters used in the field trial, under various propagation situations in Hong Kong and there should be sufficient supply of DTT receivers and the associated consumer products in the market at the time of service launch, provided that the TA can set out the specification for DTT receivers for the local market in June 2007. The TA therefore decides that the National Standard should be adopted for the transmission of DTT in Hong Kong.

Receiver Specification

Broadcasters' Proposals on Source Coding

16. ATV and TVB submitted different proposals for source coding. ATV suggested using MPEG-2 as the source coding for both simulcast services (i.e. SDTV programmes) on the MFN multiplex and new digital services (i.e. both SDTV and HDTV programmes) on its SFN multiplex. This proposal is akin to the basic profile of the prototypes of the National Standard receivers developed by the manufacturers.

17. On the other hand, TVB suggested using MPEG-2 as the source coding for the simulcast services (i.e. SDTV programmes) on MFN but using H.264 for new digital services (i.e. both SDTV and HDTV programmes) on its SFN multiplex. If H.264 cannot be adopted at the outset, TVB is concerned with the inevitable hassle which requires the viewers to procure another set-top box when the broadcasters migrate their source coding standard from MPEG-2 to a more efficient scheme (e.g. H.264 or others) for all of its DTT service at a later stage. To support its proposal for using H.264, TVB also adduced evidence showing that a

number of set-top box manufacturers would provide products based on TVB's receiver profile within 2007.

Decision on Source Coding

18. It is noted that deployment of DTT service using H.264 has emerged in other countries. For instance, Estonia officially launched its DTT service based on DVB-T and H.264 compression standard in December 2006. France also announced in May 2005 that H.264 is to be used for HDTV services on any terrestrial channels and trials of HDTV services adopting H.264 format have been conducted since May 2006. HDTV trial based on DVB-T and H.264 has also been launched in Singapore since June 2006. The United Kingdom is also contemplating whether some existing free-to-air television channels using MPEG-2 should be terminated in order to unleash the frequency spectrum for pay television service based on DVB-T in conjunction with H.264. Based on the above observations, it appears that there are an increasing number of broadcasters opting for H.264, which is a more spectrum efficient coding scheme.

19. In the light of the market-led approach advocated by the Government, the TA has no intention to discourage broadcasters from deploying advanced source coding technologies which make more efficient use of the assigned radio spectrum and which may bring along more programme channels and interactive services to members of the public, so long as the DTT implementation timeframe is met and ample choice of suitable consumer equipment is available at affordable price in the market. To facilitate the supply of DTT receivers meeting versatile needs of consumers and different deployment plans of the two broadcasters, the TA is minded to set out a two-tier specification for DTT receivers to be used in the local market, namely, a basic-tier specification and a higher-tier specification.

20. The basic-tier specification will enable the reception of the four

existing television programme channels in digital format (i.e. SDTV format) on the MFN multiplex and all SDTV programmes on the SFN multiplex of ATV coded in MPEG-2 format. The TA understands that a DTT set-top box complying with such a specification should cost only a few hundred dollars.

21. Consumers equipped with basic-tier receivers will be able to benefit from improved reception quality of the existing four television programme channels in SDTV format on the MFN multiplex, and receiving new SDTV programme channels encoded in MPEG-2 format to be provided by ATV on its SFN multiplex. This will solve the reception problems in some areas currently suffering from ghosting and snowing of analogue television reception. It should be noted that the basic-tier specification will not require a receiver to have the capability of receiving HDTV programmes. Thus, consumers will not be able to receive HDTV programmes/channels with the basic-tier receivers. For reception of all SDTV and HDTV programmes on the MFN and SFN multiplexes of ATV and TVB coded in either MPEG-2 or H.264 format, a higher-tier receiver will be required. Consumers equipped with higher-tier receivers will be able to benefit from more programming choices and higher quality audio-visual effects, in addition to the benefits offered by the basic-tier receivers.

Broadcasters' Proposals on Middleware¹² and Return Path¹³

22. The SCIT Statement mentioned, among other things, that DTT broadcasting would usher in new applications such as datacasting and interactive services and the two broadcasters may make use of not more than 25% of the transmission capacity of the assigned frequency multiplexes for data services. To support these services, a middleware with or without a return path would be needed. The middleware will

¹² A middleware, which is a piece of software resident in DTT receiver, is required to enable proper running of new service applications, such as datacasting services, on different kinds of DTT receivers.

¹³ A return path is a telecommunication means for conveyance of instruction and data from television watchers to the concerned broadcaster.

also enable a unified look-and-feel of a common electronic programme guide which provides a user-friendly interface for viewers.

23. The two broadcasters do not have a unified view as to whether the middleware as well as the type of telecommunication means should be specified in the receiver specification. While TVB explicitly indicated its preference on middleware and return path, ATV does not specify any of these requirements in its receiver specification on the ground that they would better be treated as optional items and that consumers will make their own choice according to their consideration on price and functionality.

Decision on Middleware and Return Path

24. Overseas experience shows that datacasting and interactive services are being developed and there are various types of middleware and telecommunications means available on the market. Except in a few countries such as the United Kingdom, the inclusion of middleware in the receiver specification is not mandatory. Under such a circumstance, the TA is inclined to leave it to the market to decide and will not stipulate the relevant requirements in the receiver specification. Nonetheless, the TA will keep in view the matter. He will not preclude the inclusion of these requirements in the receiver specification in future having regard to the plans of the two broadcasters as well as the developments of the market and technology.

Promulgation of Receiver Specification

25. As indicated in paragraph 13, the early release of the receiver specifications for the local market will be vital for the relevant manufacturers to produce compatible consumer products in time for the launch of DTT service within 2007. To this end, OFTA has drafted the two-tier specification for DTT receivers and is seeking inputs from consumer electronics manufacturers and members of the DTT Reception

and Equipment Working Group. The TA is minded to issue such a specification before end June 2007.

Office of the Telecommunications Authority

4 June 2007

**Technical Parameters for the Field Trial of
GB 20600-2006 (National Standard) in Hong Kong**

The National Standard is composed of two discrete modes, that is, multi-carrier mode ($C=3780$) and single-carrier mode ($C=1$). To enable deployment under various situations, for example fixed or mobile reception, and SFN or MFN, the transmission can be optimized by setting different technical parameters of modulation, coding efficiency and time interleaving. A large variety of operation modes are available under the National Standard. As Hong Kong is characterised by hilly terrain, high-rise buildings and a tidal harbour with long waterfront, the following set of technical parameters have been selected for use during the field trial in Hong Kong:

1. Number of Carriers (C)

In the National Standard, C may take the value of either 1 (single-carrier mode) or 3780 (multi-carrier mode).

$C=3780$ was used in the field trial.

2. Symbol Constellation Mapping

The National Standard provides various types of mapping, namely, 4QAM¹⁴, 4QAM-NR¹⁵, 16QAM, 32QAM and 64QAM.

Symbol constellation mappings 4QAM, 16QAM and 64QAM were used in the field trial.

¹⁴ QAM, which stands for Quadrature Amplitude Modulation, is a digital modulation technique which conveys data by changing the amplitude of two carrier waves.

¹⁵ QAM-NR denotes QAM with Nordstrom-Robinson code.

3. Code Rate

Three types of code rates are given in the Chinese National Standard i.e. 0.4, 0.6 and 0.8.

Code rates of 0.4 and 0.6 were tested in the field trial.

4. Frame Header

Frame headers of 420 symbols, 595 symbols and 945 symbols are defined in the National Standard. They correspond to the guard interval of 55.6 μs , 78.7 μs and 125 μs respectively.

The frame header of 945 symbols was used in the field trial.
