UHDTV and other broadcast regulatory challenges

Because of the fragmented way TV standards are developed, standardising these remains a challenge, until the International Telecommunication Union (ITU) overcame this, most especially in the case of Ultra HDTV or UHDTV. ***Dr Ali R Ebadi****, member of ITU's Radio Regulations Board, and senior vice-president, Space Systems Development, Measat Satellite Systems, writes more ...*

Television has been around commercially since the 1930s and the development of TV standards has always been fragmented. In 1990, a major milestone was achieved in the standardisation of HDTV through the ITU-R Rec. BT.709. This recommendation represented the first single worldwide TV standard. Last year, ITU duplicated this feat by standardising the next generation of HDTV, known as Ultra HDTV (UHDTV), via ITU-R Rec. BT.2020.

UHDTV began its life in 2000 at the NHK Science & Technology Research Laboratories in Japan, where research started on a 4000-scan line display system. In 2002, NHK researchers successfully demonstrated the prototype system with a screen resolution of 7680x4320 pixels, which was s6ubsequently named Super Hi-Vision.

As the ITU began studies into UHDTV under the purview of Study Group 6C, NHK submitted its Super Hi-Vision system as a candidate standard. The ITU SG6C performed its studies while taking into consideration the ITU-R Rec. BT.1361, BT.1769 and BT.1201.

BT.1361 specifies unified colorimetric parameters for future TV systems with the aim of improving interoperability between TV systems and other imaging systems. BT.1769 concerns the specifications of Large Screen Digital Imagery (LSDI) beyond the highest resolution specified by BT.709.

BT.1769 states that a wider viewing angle afforded by larger displays and closer seating positions, relative to the display, results in a higher sensation of reality. To achieve this, BT.1769 studied the number of scan lines required in order to preserve the quality of image while increasing display size and decreasing seating distance from the display.

BT.1201 also specifies the general relationship between Extremely High Resolution Imagery (EHRI) with respect to the 1920x1080 image system specified in BT.709.

BT.1201 recommends that the usage of common technology and devices among TV systems should be facilitated and spatial resolution should be scalable from the 1920x1080 pixel resolution. BT.1201 also recommends that the reference colorimetry of BT.1361 be adopted with allowance for other colorimetry values to be applied, should it be required.

As a result, the UHDTV specifications of BT.2020 are backward-compatible with the HDTV content of BT.709.

BT.2020 contains two options for display resolution, both of which are 16:9 aspect ratios. The first option of 3840x2160 (8.3 megapixels) is commonly known as UHDTV/1, or 4k, due to the number of horizontal pixels, while the second option of 7680x4320 (33.2 megapixels) is commonly known as UHDTV/2, or 8k, and represents a staggering four and 16 times increase respectively over HDTV, in which the highest resolution is 1920x1080 (2.1 megapixels).

The increase in display resolution enables larger display sizes for an immersive viewing experience as specified in BT.1769. Display resolution is not the only improvement, as the BT.2020 also specifies a number of frame rates up to 120fps and dictates the use of progressive scanning only — which reduces flickering and edge-blurring of on-screen images. The UHDTV standard also specifies a wider colour space standard, according to BT.1361, which is able to reproduce colours beyond the capability of the HDTV standard.

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While the standards are now in place for UHDTV, there are technical and regulatory challenges to overcome in order for UHDTV to become mainstream.

UHDTV/1 compatible equipment has not fully matured yet, while UHDTV/2 compatible equipment is still in its infancy. Due to the huge data throughput demands of UHDTV, the supporting ecosystem of data storage, device interconnectivity and distribution media is still under development.

To help alleviate post-processing data throughput requirements, the ITU-T standardisation body has developed the High Efficiency Video Coding (HEVC), or H.265, which is twice as efficient, compared to the Advanced Video Coding (AVC), or H.264, widely used in HDTV content processing.

However, cost of migration to HEVC-capable set-top boxes (STBs) once they become available may be too prohibitive for pay-TV operators to aggressively pursue, especially as pay-TV operators have only recently upgraded from MPEG-2 to AVC capable STBs.

The broadcast platform of UHDTV presents a regulatory challenge, due to the amount of spectrum required to support the high data throughput of UHDTV distribution. In 2006, NHK successfully demonstrated an indoor test broadcast of the Super Hi-Vision at 60fps, compressed with MPEG-2 coding, using 300MHz of spectrum in the 21GHz frequency band.

Interest in UHDTV broadcasting appears to be strong and with limited spectrum available, there could be a battle on the regulatory front

Last year, NHK successfully demonstrated a test of UHDTV/2 broadcast over a distance of 4.2km at 120fps, using two 8MHz channels of UHF terrestrial broadcast channels, with a combination of several digital wireless technologies and a proprietary compression coding developed by NHK.

While NHK has demonstrated that it is possible to broadcast UHDTV/2 over two 8MHz channels in a test configuration, the US Federal Communications Commission (FCC) has mandated that all UHDTV broadcasts are required to comply to existing 6MHz broadcast channelling plan.

In support of this mandate, the FCC recently allowed trials of UHDTV/1 broadcast using European DVB-T2 technology, with the eventual goal to develop its own next-generation ATSC broadcast technology. In 2012, four major broadcasters in South Korea announced plans to conduct 4k broadcast trials in Seoul, and trials are currently on-going using DVB-T2 technology.

Interest in UHDTV broadcasting appears to be strong and with limited spectrum available, there could be a battle on the regulatory front between the proponents of UHDTV and other services. Digital dividend from the analogue switch-off could support the growth of UHDTV broadcasts. However this valuable piece of spectrum is also eyed closely by terrestrial wireless operators.

Availability of spectrum is not the only issue plaguing regulators. With the high data throughput requirements of UHDTV, broadcasters are expected to use more aggressive modulation codes and coding techniques to comply with strict channelling requirements, which would require higher-powered transmissions in order to achieve the desired Eb/N0, resulting in the significant increase in potential interference, which serves to further complicate cross-border frequency coordination with neighbouring countries.

On the satellite front, spectrum scarcity is not as critical compared to terrestrial systems, thanks to the steps taken by WRC-12 to facilitate the use of the 21.4-22GHz spectrums for broadcasting satellite services.

Among the major steps taken were to simplify the satellite coordination procedure by reducing the coordination arc from 16° to 12° and introducing a power flux density (pfd) mask as coordination triggers.

WRC-12 had also introduced a special procedure to allow developing countries, which file for national coverage area with homogeneous beam parameters, to jump the ITU satellite-filing queue and obtain a higher ITU filing priority date.

Major satellite operators, Eutelsat and SES, are leading the space-based UHDTV wave, with Eutelsat having already launched a dedicated UHDTV/1 50fps UHDTV demonstration channel. The UHDTV/1 content is compressed using AVC coding and broadcasted in quad HD streams, meaning it is split into four full-HD quadrants to be broadcasted and then recombined at the decoder.

In April this year, SES had performed a trial broadcast of UHDTV/1 using the newly adopted HEVC coding technology. The use of HEVC coding reduced the data rate required for transmission from 40Mbps using AVC coding to 20Mbps.

But even with HEVC, it still takes the equivalent of two HDTV channel broadcasts using AVC to broadcast a single UHDTV/1 channel with HEVC, leading to higher cost per UHDTV/1 channel compared to HDTV.

Therefore, growth of UHDTV broadcasting on satellite platforms would depend heavily on the development of coding techniques, which would minimise the amount of bandwidth required per channel.

On the roll-out point of view, UHDTV/1 display sets are being announced by major TV manufacturers and gradually appearing on the retail market, albeit at a slightly prohibitive cost.

NHK is still in the lead for terrestrial broadcasting with regards to roll-out timeline, with UHDTV/1 broadcast slated to begin next year, while UHDTV/2 broadcasting schedule has been brought forward to 2016 from the initial estimate of 2020.

On the satellite platform, pay-TV operators Sky UK (partnered with SES Astra) and DirecTV are putting their money on UHDTV. DirecTV plans to phase out SD content in favour of HDTV and UHDTV, and take advantage of the Ka-band spectrum for UHDTV by 2016.

Investment bank Credit Suisse forecasts five UHDTV channels to be launched this year and up to 135 channels by 2017. With these developments, the coming years will surely be exciting for the broadcast industry, with optimism that UHDTV would be a greater success than 3DTV.