Captain Ip

Ultra High Definition (Ultra HD) is a breakthrough in video technology and for the broadcast industry. It delivers more than four times the resolution of Full HD TV with more vibrant colours and higher frame rates, providing much better viewing quality especially in sporting events and action movies than ever. Delivering Ultra HD via satellite has become a hot topic in the community of broadcasters and industry partners. Table 1 shows the comparison between Full HD and Ultra HD.

	Full HD	**Ultra HD 1 (4K)**	**Ultra HD 2 (8K)**
Commercialization	2008	2015-2018	2020
Pixel count Horizontal × vertical	1920 x 1080	3840 x 2160	7680 x 4320
Scan mode	Interlace or progressive	progressive	progressive
Bit depth	8 bit, 10 bit	10 bit, 12 bit	10 bit, 12 bit
Frame frequency (Hz)	60, 50, 30, 25, 24	60, 50, 30, 25, 24	120, 100, 60, 50, 30, 25, 24
Colour Space	Rec. ITU-R BT.709	Rec. ITU-R BT.2020	Rec. ITU-R BT.2020
Optimal viewing distance	Three picture heights	1.5 picture heights	0.75 picture height

Table 1 - Comparison between Full HD and Ultra HD

Is satellite-delivered Ultra HD feasible?

Enormous data bandwidth (over 10Gbps for uncompressed material) is required to deliver Ultra HD video. It is a challenging task to transmit Ultra HD video via any traditional delivery infrastructures such as satellite links, over-the-air, cable channels and Blu-ray discs.

An indoor transmission of Ultra HD through a simulated satellite link was performed by NHK in May 2007 [1]. An Ultra HD TV signal (7680 x 4320 at 60 fps) was compressed into a 250Mbps MPEG-2 stream and transmitted through a 300MHz carrier using a wideband modulator in 21GHz. Although the transmission distance was only two meters, it was the first demonstration on the technical feasibility of delivering Ultra HD TV signal through a satellite transmission model. Figure 1 shows the experiment setup.

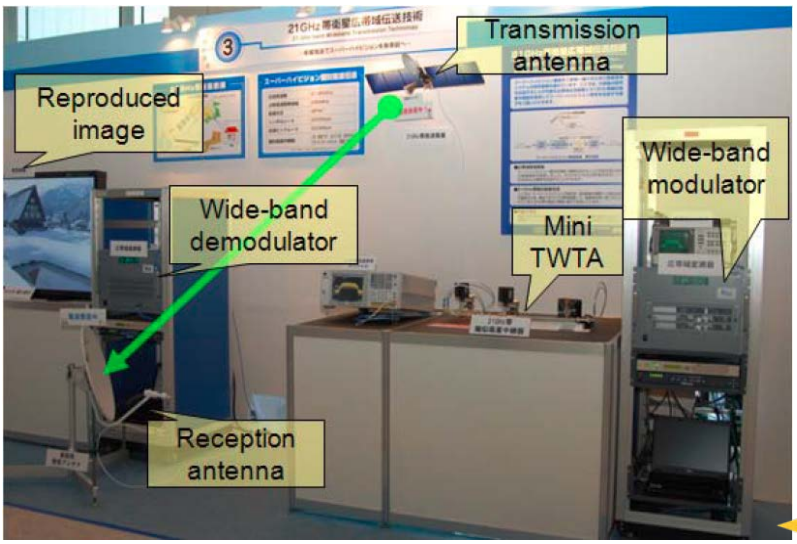

Figure 1: Setup of NHK indoor experiment

With evolutions in compression standard, Ultra HD and RF equipment, an Ultra HD channel (3840 x 2160) was first broadcasted on satellite in 2013. The video was split into four sections and compressed individually. MPEG-4 compression standard was used in such Ultra HD transmission, with a data rate of around 80-100Mbps and four HD professional IRDs were required at the receiving end (See Figure 2 for details). And a HD to UHD combiner was needed to reconstruct the Ultra HD video. Subsequently, this approach was used in many experimental or trial Ultra HD transmissions but not commercialized due to its high cost and inefficient use of equipment rack space. The cost barrier was lowered with the launch of High Efficiency Video Coding (HEVC) video compression solution which can fully support the Ultra HD resolution instead of combining four MPEG-4 encoded HD videos.

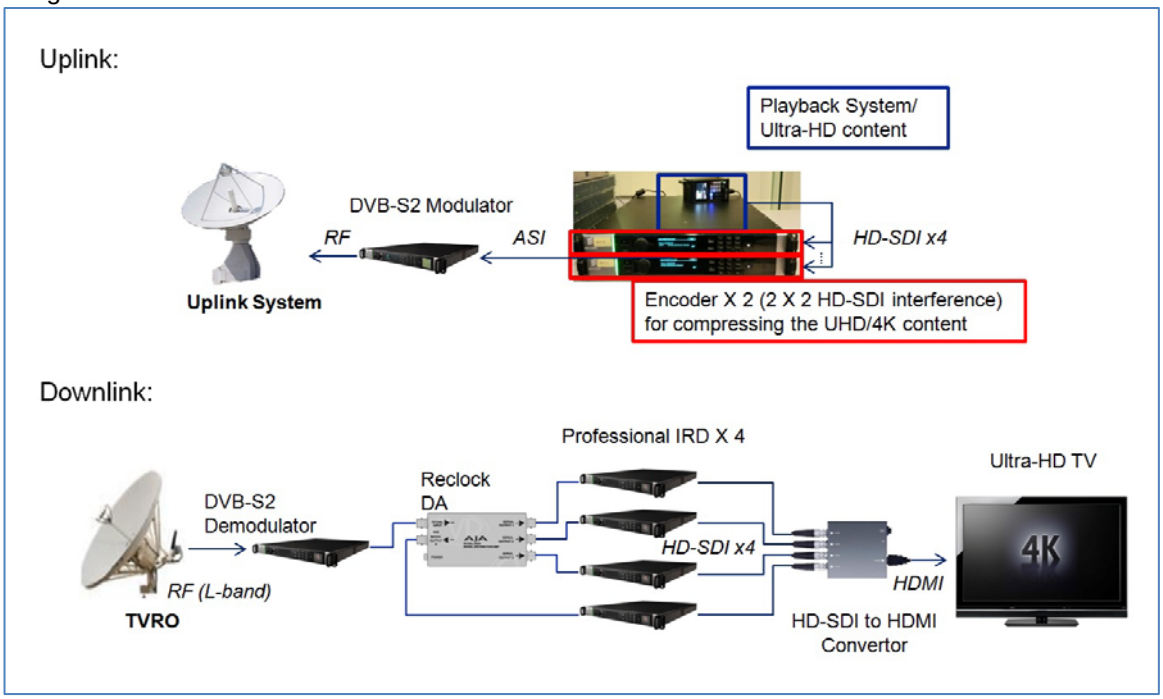

Figure 2: MPEG-4 approach for Ultra HD transmission

HEVC, new standard for video compression

High Efficiency Video Coding (HEVC), the latest generation video compression standard, was debuted in 2013. Compared to H.264/MPEG-4 AVC, HEVC at least doubles the compression efficiency while maintaining the subjective quality of the video. It can also support the higher Ultra HD (8K) resolutions up to 8192×4320. HEVC is still under development. The latest version was published in early 2015. This version supports format range extensions, scalable coding extensions, multi-view extensions [2] and 3D-HEVC extensions [3]. Further screen content coding (SCC) extensions is still in the development stage and is expected to complete in early 2016. It will improve compression capability for video containing rendered graphics, text, or animation as well as (or in place of) camera-captured video scenes [4].

By using HEVC, the bandwidth requirement of an Ultra HD channel can be reduced to around 20Mbps per channel, a mere quarter bandwidth of employing MPEG-4 in the aforesaid case. With the well developed satellite digital transmission technology DVB-S2, it is feasible to broadcast 3 – 4 Ultra HD channels over a 36MHz C-band transponder. In addition, limited selection of HEVC decoder embedded Ultra HD TV and Ultra HD set-top-box (STB) are gaining momentum in developed countries. Figure 3 shows the block diagram of a HEVC solution.

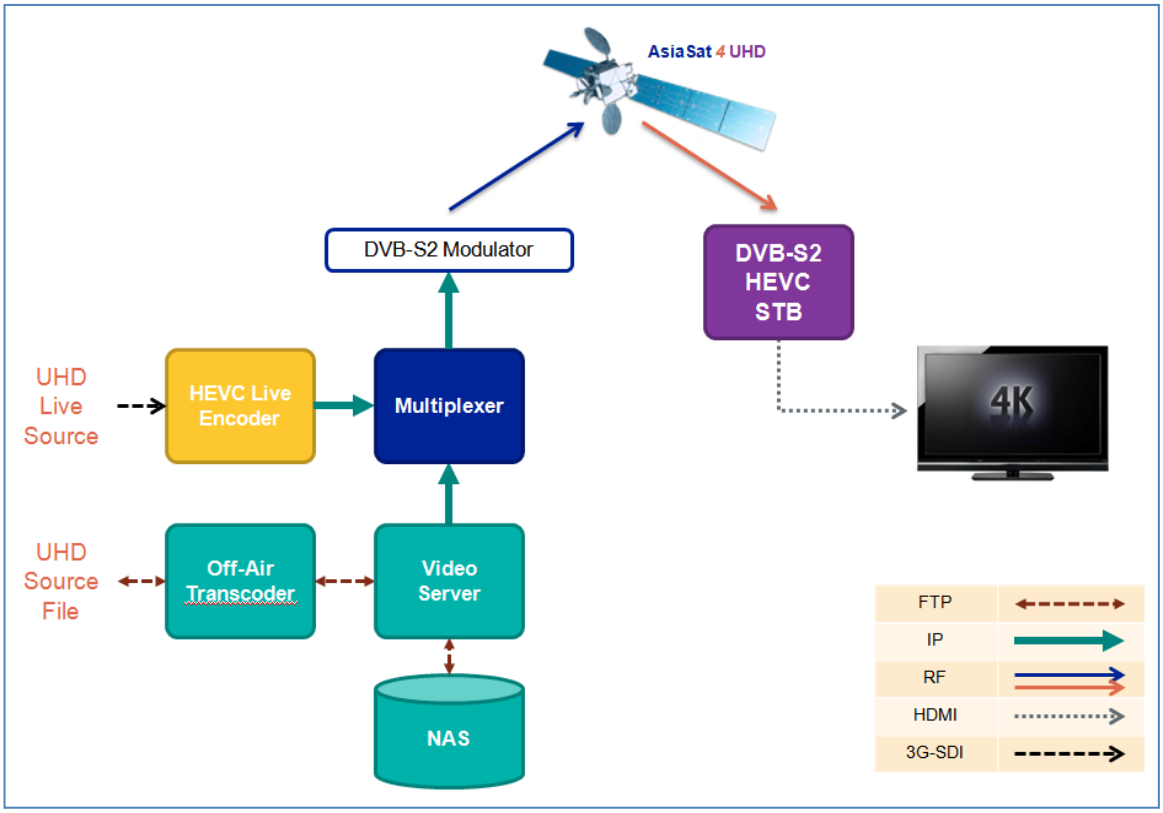

Figure 3: HEVC solution for Ultra HD transmission

Ultra HD HEVC transcoder, set-top-box are ready in the market

Many Ultra HD file transcoders (support up to 2160p, 60fps) are available in the market but most of them are software based non-real time, off-line encoders. Professional grade servers with tens of processers are required to minimize the prolonged processing time. In addition to off-line transcoder, more and more vendors, e.g. ATEME, Ericsson, Harmonic, NEC, Rohde & Schwarz, etc., are starting to provide real-time Ultra HD broadcast solutions.

Ultra HD satellite STB is another key element required to realize 4K video distribution through satellites. Though in Europe, handful of models of Ultra HD TV with built-in HEVC full framerate decoder and satellite tuner are available in the consumer market, currently most commercial HEVC satellite STBs are aiming at the half framerate video. Until at least 60 fps commercial STB has become more common in the market, the full quality of Ultra HD cannot be realized. Fortunately, semiconductor vendors such as Broadcom [5] and ViXS [6] are starting to offer a range of HEVC products including entry-level satellite system-on-a-chip STBs which support 60 fps. It is expected the penetration of Ultra HD into homes will ramp up when Ultra HD STB featuring HEVC and 60 fps becomes affordable to the consumer market.

What is AsiaSat doing on Ultra HD?

AsiaSat has taken great effort since 2014 to promote knowledge and awareness of Ultra HD in Asia. In January 2014, AsiaSat cooperated with Hong Kong Cyberport Management Company Limited to demo a live Ultra HD broadcast through AsiaSat 3S. AsiaSat satellites also supported Ultra HD broadcast of international sporting events, for example, the first-ever live telecast of the 2014 FIFA World Cup matches held on 28 June (Round of 16), 4 July (Quarter-Final) and the Final on 13 July 2014 in Brazil.

Furthermore, AsiaSat believes an in-depth knowledge on the actual performance of equipment and thorough understanding of different compression technologies will be highly beneficial for our customers to identify the best possible solution and the support they need. With that, AsiaSat established an Ultra HD research laboratory in 2014 and joined hands with various partners in promoting and accelerating the reception of Ultra HD content in Asia.

The laboratory is tasked to evaluate end-to-end Ultra HD solutions including playout, compression technologies, compatibility of satellite transmission and reception, as well as different types of content through on-air satellite transmissions. A series of tests were successfully conducted using different HEVC encoding equipment, including off-line and real time solutions, in order to determine the optimum configuration and to understand the limitations of the existing systems.

Figure 4: Ultra HD demo room in AsiaSat's Tai Po Earth Station in Hong Kong

These tests enabled AsiaSat to optimize the data rate required and understand how to provide the most effective solution to our customers. Furthermore, AsiaSat evaluated the user interfaces of different Ultra HD equipment such as file transcoder, playout, etc. to assess user friendliness of the equipment. AsiaSat will continue to test and evaluate new Ultra HD equipment in the AsiaSat research laboratory as they develop and provide update to the market.

To promote the reception of Ultra HD and to allow broadcasters to validate the economic feasibility of satellite-delivered Ultra HD broadcasting in Asia, AsiaSat is setting up a Free-to-Air Ultra HD platform based on DVB-S2 and HEVC solutions on AsiaSat 4 at 122°E. It will be able to deliver 2-5 full time Ultra HD channels, available for reception by terrestrial TV stations, pay TV platforms and home viewers across Asia using C-band antenna as small as 2.4m to 3m in size.

AsiaSat is ready to broadcast Ultra HD content to the Asia-Pacific region and welcomes our customers and partners to join in this exciting development of Ultra HD, do not hesitate to contact our team of industry experts.

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