ERICSSON

HEVC and DVB-S2X

A Compressed Benefit?

1/28701-FGD101140 Rev D

1 Introduction

The use of satellite communication links has for many years played an important role in moving live video content. Because of its reputation for reliability and global reach, satellite is likely to stay as an important content delivery platform - alongside the growth in fibre delivery. However, satellite communication has limitations of bandwidth constraints and a cost profile that takes into account launching technology into earth orbit. Cost per unit bandwidth has, and will always be under scrutiny.

With satellite cost and the constant drive to do more for less, the broadcast industry is looking for technologies that can deliver efficiency gains. Reacting to this demand, two technologies have recently come to the forefront, that, when combined, enable operators to enhance their financial models and react more rapidly to commercial needs.

2 The Technologies

2.1 DVB-S2X

Building on the tools successfully deployed in the DVB-S2 satellite transmission system, the technology has been further extended with additional enhancements and released as the new DVB-S2X (extensions) standard. The conservative headline figure associated with DVB-S2X is up to a 20% transmission efficiency gain for Carrier to Noise ratios commonly associated with video transmission - although for larger C/N ratios the gains can be far higher.

There is no one key piece of technology that has led to the DVB-S2X efficiency gains. Instead a suite of improvements has been combined to yield the useful improvements.

In order to create better bandwidth efficiency DVB-S2X makes use of tighter rolloffs – the measure of how efficiently the modulated spectrum can fill the bandwidth slot allocated to the transmission. The more the modulated spectrum can fill the allocated bandwidth the more Mbit can be carried. DVB-S2X allows the rolloff to be increased from the previous limit of 20% to a new maximum of 5%.

DVB-S2 introduced a new Forward Error Correction (FEC) scheme of Low Density Parity Check codes. DVB-S2X now allows a far greater range of FECs than was previously available. This greater choice within DVB-S2X means a greater likelihood of having an FEC that fits the bandwidth, bit rate, C/N requirements of the transmitted data and link restrictions.

Additionally, DVB-S2X has new constellations. These constellations, particularly for 16APSK and upwards have been optimized with choices tailored specifically for linear (multi-carrier) and non-linear (single carrier per transponder) operation. These tools along with other minor improvements such as adaptive filtering in the demodulator combine to give significant efficiency gains over DVB-S2.

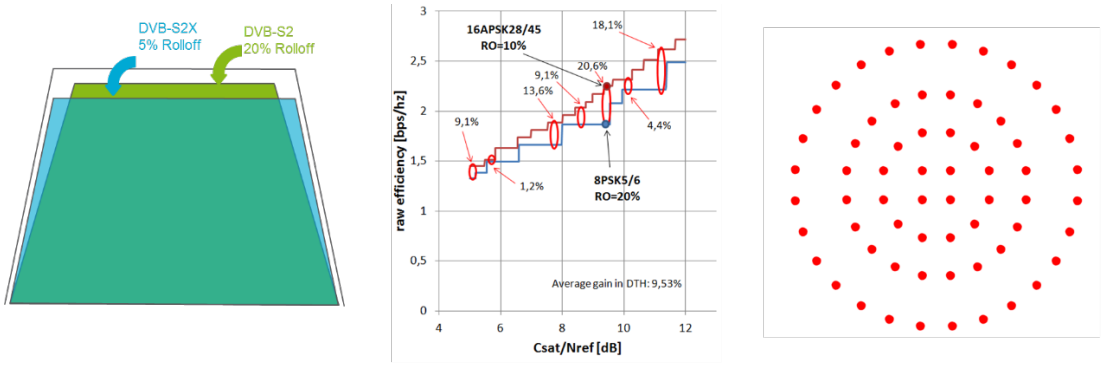

FIGURE 1 – NEW DVB-S2X TOOLS TO IMPROVE TRANSMISSION EFFICIENCY

2.2 High Efficiency Video Coding (HEVC)

HEVC builds on the suite of compression tools that were developed as part of the MPEG-4 AVC specification. HEVC adds further improvements to video compression - primarily through the greater flexibility in the transforms used. It makes use of a larger hierarchy of transforms that can be introduced across different sections of the video image, allowing the video to be more efficiently coded.

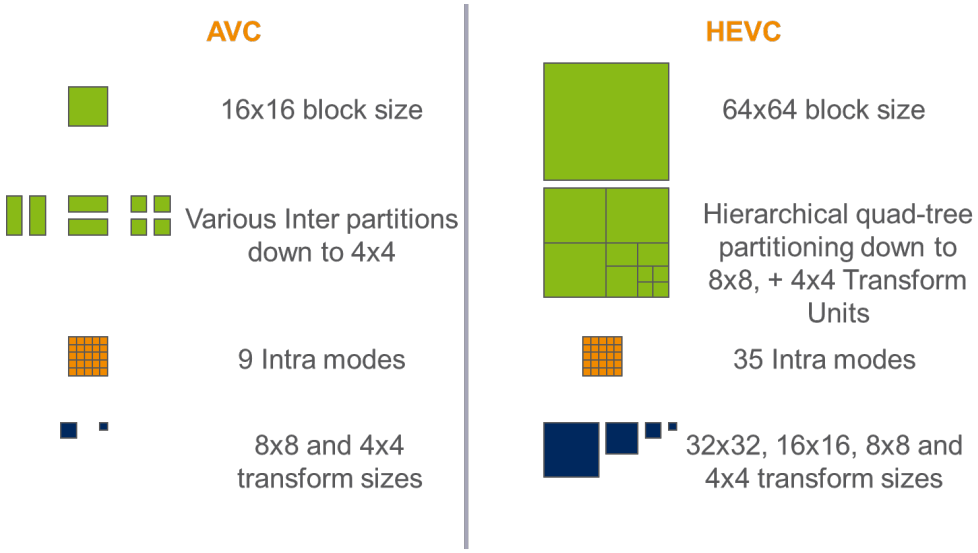

FIGURE 2- COMPARING MPEG-4 AVC AND HEVC TRANSFORM MODES

The headline efficiency improvement of HEVC has been suggested to be up to 50%. It is likely that this headline figure is achievable for highly compressed consumer video services and should certainly be possible over time as the HEVC toolset use is optimized over generations of encoder products. For higher video quality Contribution and Distribution services, however, the current HEVC efficiency gain over MPEG-4 AVC is up to approximately 30%.

3 Applications for DVB-S2X and HEVC

The combination of DVB-S2X satellite modulation and HEVC video compression is particularly well suited to satellite Contribution and Primary Distribution applications. In these applications, the efficiency gains from the new technologies can yield valuable benefits. The efficiency savings can lead to lower transmission costs, better quality pictures or more services within a leased bandwidth leading to more revenue generation for the operator. The combined efficiency savings resulting from such system updates have the potential to be up to 50% compared to the performance of an existing deployed MPEG-4 AVC system - which is remarkable.

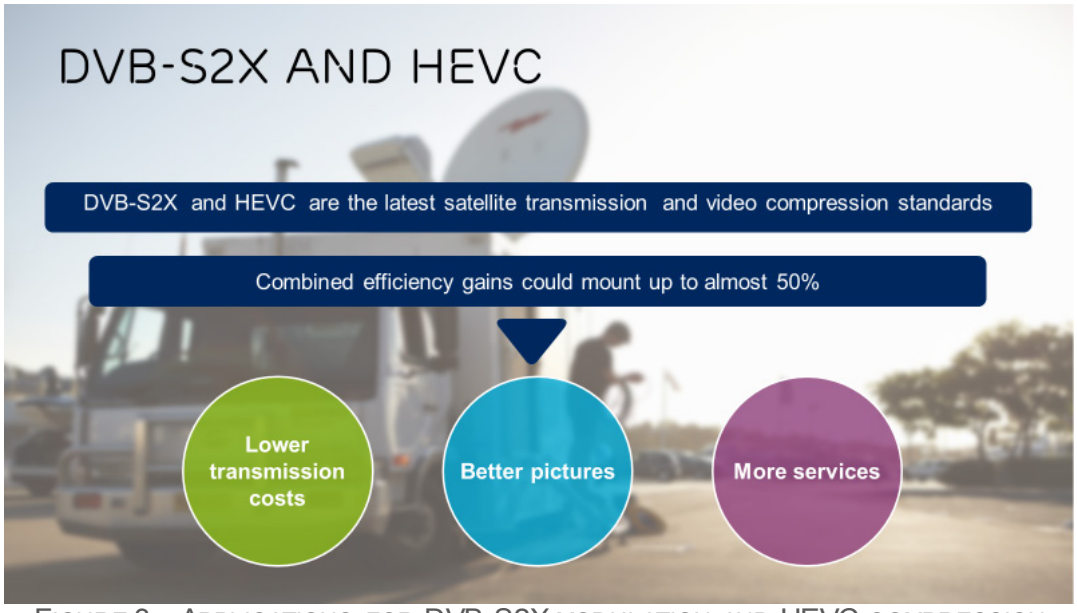

FIGURE 3 – APPLICATIONS FOR DVB-S2X MODULATION AND HEVC COMPRESSION

The conversion from DVB-S2 satellite parameters and MPEG-4 bit rates to DVB-S2X and HEVC parameters can be directed towards different goals – Lower leased bandwidth for reduced operational costs or better quality picture for a premium service or more revenue generating services in a given bandwidth.

3.1 Contribution

In satellite Contribution applications, the commercial pressures are often targeted at maintaining the video quality alongside reducing transmission costs, rather than to increase the number of services per event covered. The use of DVB-S2X and HEVC can assist in driving towards a leased satellite bandwidth reduction and lower Opex.

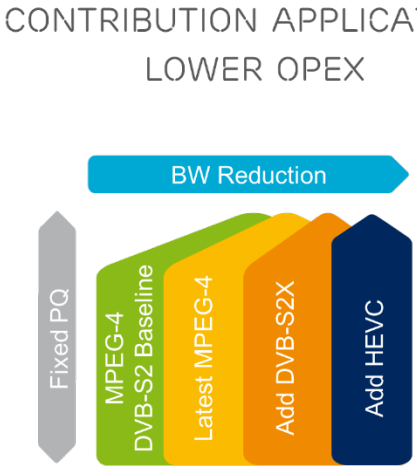

FIGURE 4 – HOW DVB-S2X AND HEVC CAN COMBINE TO DRIVE SATELLITE BANDWIDTH/COST REDUCTION

3.1.1 Example - How DVB-S2 and HEVC can lead to Opex reduction in a Contribution Scenario

As an example of how DVB-S2X and HEVC can be practically deployed to lead to a reduction in satellite leasing costs Ericsson has analyzed the following scenario for a high quality video Contribution feed comparing the use of DVB-S2 modulation on a 12MHz satellite bandwidth and a current best-in-class MPEG-4 AVC encoder against an equivalent DVB-S2X and HEVC transmission, both offering equivalent downlink margin into a typical receive 2m antenna.

	MPEG-4, DVB-S2 Transmission	**HEVC, DVB-S2X Transmission**
Video compression standard	MPEG-4 AVC	HEVC
Video format	HD 1080i	HD 1080i
Service bit rate (Video + Audio)	20.9 Mbit/s	17.6 Mbit/s
Modulation standard	DVB-S2	DVB-S2X
Modulation mode	8PSK	16APSK
FEC	3/4	23/36
Rolloff	25%	5%
Downlink antenna size	2m	2m
Symbol rate	9.6 Msym/s	7.1 Msym/s
Leased satellite bandwidth	***12MHz***	***7.5MHz***

FIGURE 5 – EXAMPLE OF USING DVB-S2X AND HEVC TO REDUCE LEASED SATELLITE BANDWIDTH FOR CONTRIBUTION APPLICATIONS

Using this example and comparing the combined gains from DVB-S2X and HEVC against an existing DVB-S2 modulation with a best-in-class MPEG-4 AVC encoder leads to a conservative 37.5% reduction in leased satellite bandwidth. In recognition that many existing systems may be using a less efficient MPEG-4 AVC encoder purchased some years previously, an efficiency gain in excess of 37.5% could be expected.
Satellite costs vary across geographic regions and many other commercial factors but a yearly leasing cost in the region of $1.4m for the DVB-S2/MPEG-4 case would not be atypical. The same price per MHz cost would allow the yearly satellite leasing cost to drop to $0.9m per year. This $0.5m saving per year would lead to payback on the DVB-S2X/HEVC equipment refresh in a matter of months.

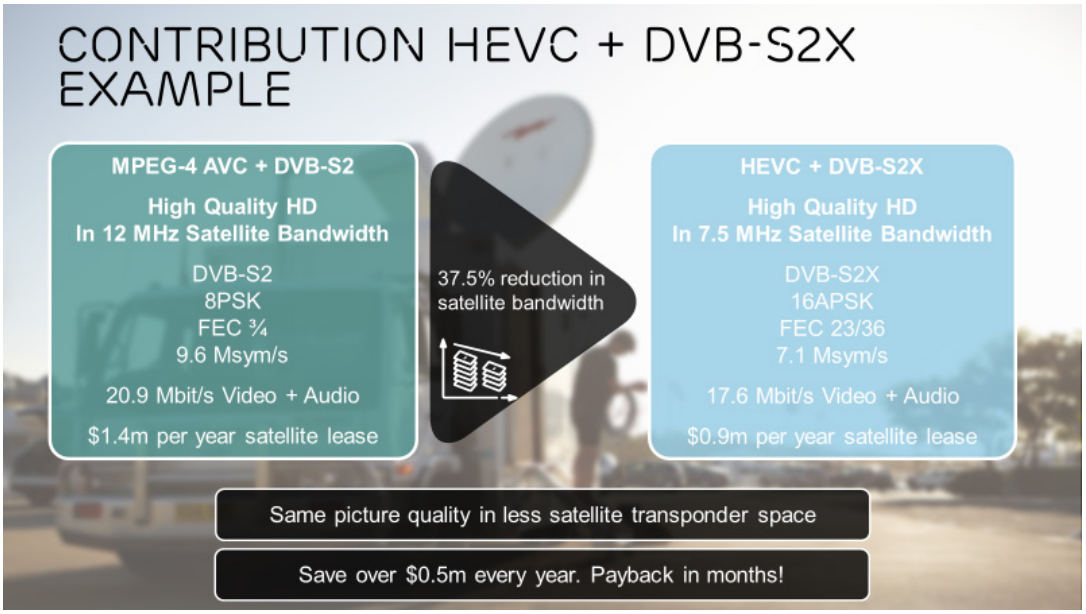

FIGURE 6 – SUMMARY OF LIKELY EFFICIENCY AND MONETARY GAINS IN CONVERTING FROM BEST-IN-CLASS DVB-S2/MPEG-4 AVC TO DVB-S2X AND HEVC IN A CONTRIBUTION SCENARIO

3.2 Primary Distribution

Primary Satellite Distribution content often has different values to Contribution applications. In the Distribution case, it is frequently the case that a transmission contains a bouquet of channels being supplied as a point to multi-point service. And whilst the need for high quality video is paramount the quality requirement is prioritized differently to that of a Contribution feed. Within the Distribution business model, operators are frequently looking to offer the ability to carry, and enable a business model for carrying, more services without increasing the cost base with the net effect of a revenue gain to their business. Alternatively, the operator can look to make Opex cost savings by reconfiguring the transponder leasing to continue to deliver the same number of services in a reduced bandwidth.

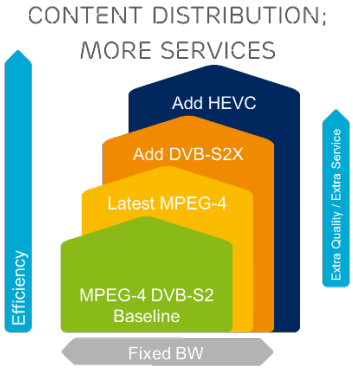

FIGURE 7 – HOW DVB-S2X AND HEVC CAN COMBINE TO ALLOW MORE REVENUE GENERATING SERVICES WITHIN AN EXISTING BANDWIDTH/OPEX IN THE DISTRIBUTION MARKET

3.2.1 Example - How DVB-S2X and HEVC can lead to launching more revenue generating services within an existing bandwidth/OPEX in a Distribution Scenario

To illustrate how DVB-S2X and HEVC can combine to allow *more services to be transmitted* within an existing satellite bandwidth – without increasing operating costs, Ericsson has analyzed the below typical scenario for a system carrying 12 high quality video services over 3x 36Mhz transponders.

	MPEG-4, DVB-S2 Transmission	**HEVC, DVB-S2X Transmission**
Video compression standard	MPEG-4 AVC	HEVC
Video format	HD 1080i	HD 1080i
Service bit rate (Video + Audio)	15 Mbit/s per video service	11.8 Mbit/s per video service
Leased satellite bandwidth	36MHz	36MHz
Modulation standard	DVB-S2	DVB-S2X
Modulation mode	8PSK	8PSK
FEC	3/4	13/18
Rolloff	25%	10%
Symbol rate	28 Msym/s	34 Msym/s
Downlink antenna size	2m	2m
Number of services per transponder	4	6
Number of leased transponders	3	3
Total number of services carried	***12***	***18***

FIGURE 8 – EXAMPLE OF USING DVB-S2X AND HEVC TO ALLOW TRANSMISSION OF MORE REVENUE GENERATING SERVICES FOR PRIMARY DISTRIBUTION APPLICATIONS

In this scenario, the number of HD services that can be accommodated within the existing satellite bandwidth has been increased from 12 to 18 - without affecting picture quality or down-link reliability. The carriage of these additional services can allow the Distribution platform provider to gain more revenue from content owners. Given typical charges for running a distribution service these extra 6 services could enable an additional $2m revenue a year for the Distribution platform provider. Such a system change would require a level of network refresh - to upgrade encode and decode equipment to HEVC and DVB-S2X. The additional revenue generated from the new services could lead to an investment payback period of less than 2 years for a typical platform consisting of many hundreds of down-link locations.

3.2.2 Example - How DVB-S2X and HEVC can lead to reduce Opex costs for an Operator in a Distribution Scenario

As an example of how DVB-S2X and HEVC can be practically deployed to maintain the existing number of services within a *reduced bandwidth leasing, leading to lower Opex costs* to the business, Ericsson has analyzed the following scenario of a high-quality video Distribution operation running 12 video services over 3x 36Mhz transponders into a typical receive 2m antenna - comparing DVB-S2 and latest best-in-class MPEG-4 AVC encoders with a DVB-S2X and HEVC transmission whilst maintaining existing down-link margin and video quality.

	MPEG-4, DVB-S2 Transmission	**HEVC, DVB-S2X Transmission**
Video compression standard	MPEG-4 AVC	HEVC
Video format	HD 1080i	HD 1080i
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Modulation mode	8PSK	8PSK
FEC	3/4	13/18
Rolloff	25%	10%
Symbol rate	28 Msym/s	34 Msym/s
Total number of services carried	12	12
Number of services per transponder	4	6
Number of leased transponders	***3***	***2***

FIGURE 9 – EXAMPLE OF DISTRIBUTION TRANSMISSION PARAMETERS MODIFIED FOR DVB-S2X AND HEVC TO GIVE A BANDWIDTH AND LEASED SATELLITE COST REDUCTION

This example allows a Distribution platform operator to maintain their current 12-channel playout whilst reducing the satellite leasing from 3 transponders down to 2 transponders – A 33% reduction in bandwidth leasing. In systems where the existing MPEG-4 AVC encoders are older and less efficient than the best-in-class MPEG-4 AVC benchmark used in this example the efficiency gain through a switch to HEVC compression would be greater still.
In terms of a financial incentive to enhance the existing network the 1-transponder reduction in satellite leasing occupancy could save the operator approximately $1m year-on-year (depending on the pricing plan agreed with the satellite owner). Not all equipment in the existing, deployed video compression infrastructure – Encoders, satellite modulators, IRDs may currently be HEVC/S2X enabled or capable so an element of system refresh would be expected. The Capital expenditure needed to fulfil such an upgrade would, in a typical 12-channel encode, 500 to 800 unit IRD point to multi-point system, have a payback period of just 2 – 3 years.

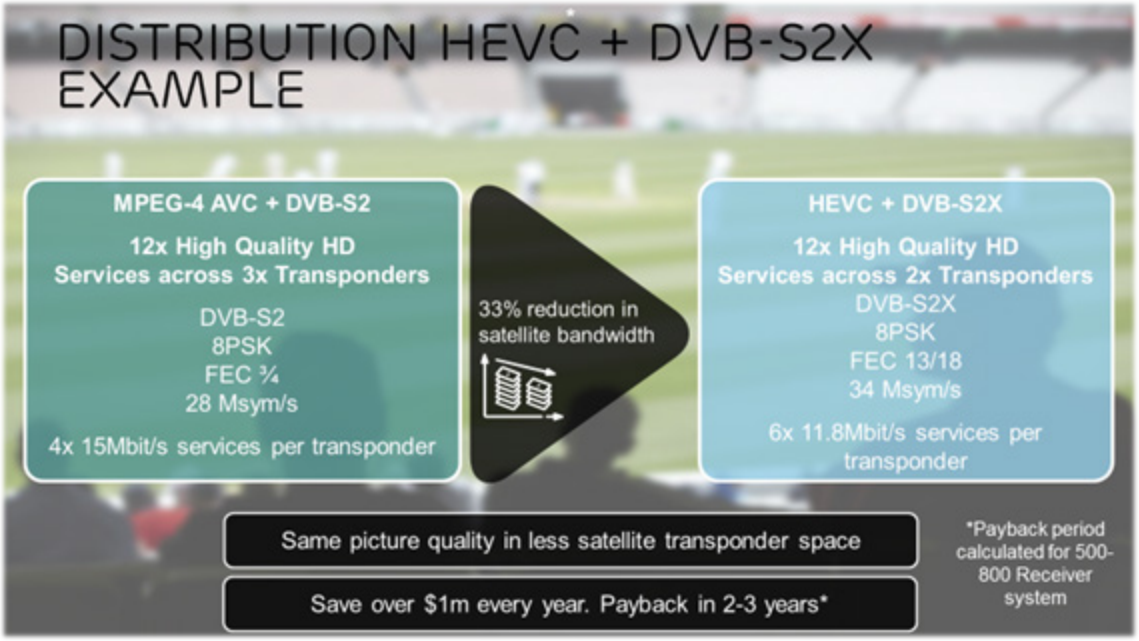

FIGURE 10 – SUMMARY OF LIKELY EFFICIENCY AND MONETARY GAINS IN CONVERTING FROM BEST-IN-CLASS DVB-S2/MPEG-4 AVC TO DVB-S2X AND HEVC IN A DISTRIBUTION SCENARIO

4 Summary

Whilst the cost of transponder space remains such a significant part of operator's costs then compression and transmission efficiency will remain central in any broadcaster's or satellite operator's future plans. With the market still heavily relying on a combination of older MPEG-4 AVC compression and DVB-S2 modulation technology there is a real opportunity to increase efficiency by between 25% and 50% using proven technology when compared to systems using older technology and compression techniques. Making the upgrade has the power to bring significant financial benefits for any operator processing content from Contribution to Primary Distribution.

5 About Ericsson's DVB-S2X and HEVC portfolio

Ericsson has a range of DVB-S2X and HEVC capable equipment and solutions available that enable these technology driven cost savings today including:

AVP 2000 Contribution Encoder

AVP 3000 Voyager Satellite Newsgathering Encoder

AVP 4000 System encoder

M6100 Satellite Modulator

RX8200 Advanced Modular Receiver

For more information on these products and how to upgrade to a more cost-efficient media processing solution please browse to http://crmweb.ericsson.net/cn/ar0ma/simpleupgrade