Extensions to DVB-S2

- new enhancements allow for higher data rates
- more rectangular transponder spectrums provide more space for additional transponders
- reducing sidelobs gives more space for more transponders
- wide-band transponders add to efficiency
- new modulation with 6 bits
What’s coming next after DVB-S2?
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The DVB-S2 standard was first published in 2005. While the performance it offers may still impress us nowadays, the advances in technology and growing demand for higher and higher data rates make the satellite industry search for even more efficient ways to transfer huge amounts of data most notably the high demands generated by Ultra High Definition TV (UHDTV) and high speed IP services over satellite.

Recently in TELE-audiovision 07-08/2013 we have published a feature articles about the new UHDTV standard and the video compression standard HEVC, also known as H.265 – a successor of MPEG-4 (H.264). These new solutions require new hardware and software. It makes a good moment to improve also the modulation, coding and error correction standard as defined by the DVB-S2 standard.

As the proposed improvements have not yet been blessed by the DVB organization we will call them the proposed extensions to DVB-S2. However, real hardware devices have been built and various test have been performed to prove these new concepts. These new DVB-S2 extensions are labelled as DVB-S2EBI, DVB-Sx or even DVB-S3 although such a standard does not yet officially exist in this moment.

The proposed extensions can give a 20% increase in data rate compared to DVB-S2 in DTH (Direct-To-Home) broadcasts. For professional services, like VSAT communication, the gain can be as high as 64%.

So, what exactly are these extensions? Here is our list:
- reduction of the roll-off factors and the side lobes of digitally modulated carriers
- use of wide bandwidth transponders
- additional modulation: 64 APSK
- more modulation and coding (MODCOM) schemes and forward error correction (FEC) Choices and non-linear MODCOMs

Not all of the extensions are easy to comprehend but in this features article we try to help you to get a general idea on most of them.

The roll-off factor describes the shape of the transponder spectrum as seen on a spectrum analyzer. Its value tells you how close to an ideal rectangular spectrum is. The smaller it is the more steep are the slopes of a transponder spectrum. DVB-S requires a roll-off of 35%, DVB-S2 of 20% and 25% while the the proposed S2 extensions aim at 15%, 10% and 5%. It is easy to understand that with smaller roll-offs one can position transponders closer to one another in the frequency domain and gain a free space for additional ones in the same Ku-Band or C-Band.

However, not only (relatively) big roll-offs prevent closer location of the DVB-S2 transponders. So called side lobes are normally present on both sides of the useful signal. These are unwanted artifacts after modulation. With today’s technology it is possible to practically get rid of them thanks to improved filtering. Once they are removed, the center frequencies of the neighboring transponders can be set closer to one another.

If you take a look at Figure 1, you can come to the conclusion that even after removing side lobes and improving roll-offs, there is still some spectrum wasted between the transponders. And that’s why wideband transponders are the next trick in improving efficiency. Their throughput is increased to 72 Ms/sec. When compared with the most popular 27.5 Ms/sec transponders, the wideband ones are three times wider in spectral view.

Every new DVB standard introduces a new modulation schemes. DVB-S2 end up with 32 APSK. The proposed extensions call for 64 APSK. In this modulation, every symbol is made up of 6 bits. Of course, the higher the order of modulation, the smaller the differences in amplitude and phase between similar symbols. We can send more data in the same bandwidth but the signal is more sensitive to interference and noise. 64 APSK will be used in professional setups with large antennas rather than in DTH transmissions.

Probably the same goes true for the last extension mentioned in the beginning of this article: more MODCOM and FEC values. These parameters generally describe how big overhead is introduced in the data stream to the useful payload. The overhead in bit rate is needed for error correction. Once we have more possibilities here, we can almost smoothly change the proportion between useful and corrective bits in order to find a minimum overhead still ensuring faultless processing. Such thing is possible when we have a point-to-point two-way communication. In case of a reception problem, the system automatically adjusts MODCOM/FEC.

Also the wideband transponders described above require the reception system to be of a higher performance because the carrier-to-noise ratio degrades proportionally with the bandwidth increase. The best way to maintain a good C/I is to use a bigger dish. Therefore, it is not certain if wideband transponders will be used for DTH broadcasts. After all, not too many end users will be eager to replace their 60-90 cm dishes with larger ones. That’s why the experts assume that in DTH transmissions only about 20% increase in the efficiency is realistic while in professional links even 64% would be possible. Anyway, we can not say today which particular extension proposals will be included in the eventual settlement of the DVB-S3 standard. Maybe only some of the above, maybe all of them. We will not be surprised though if brand new concepts are worked out in meantime and included in the new standard.

One thing is for sure: the improvements will enable higher useful data rates in the existing satellite communication channels and this will be a very important factor enabling UHDTV and other wideband services.