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Cropping Rectangle

Introduction

Cropping refers to removing unwanted areas from digital pictures or video streams. This feature can be very useful to isolate the portion of the original image which carries the most significant information or has the best visual effect. In fact, the cropping method allows changing from one aspect ratio to another. So, by applying the cropping window it is possible to focus on a specific area of the picture and discarding the rest.

The "Cropping Rectangle" (CR) is one of the parameters conveyed in the H.264 Sequence Parameter Set. Specifically, the cropping rectangle has been adopted in 3D video broadcasting applications. The purpose is to ensure the backwards compatibility with existing 2D video appar tus, especially during the current transitional phase of TV service. In other words, the CR is a method to transform a frame compatible 3D picture into a 2D service compatible picture.

Technology description – Frame compatible format and Cropping Rectangle

Stereoscopic 3D coding using the frame-packing arrangement SEI (Supplemental Enhancement Information) is the key technology that is being adopted in the first generation of 3DTV broadcasting services.

Squeezing the Left and Right images in a single High Definition frame (the so called "frame compatible format") allows service providers to reuse part of the existing production infrastructure and the entire existing distribution infrastructure. This is becoming even more relevant since the possibility for a second digital dividend (UHF 700 MHz band) already anticipated at ITU WRC-12 after 2015 is making RF spectrum resources extremely precious.

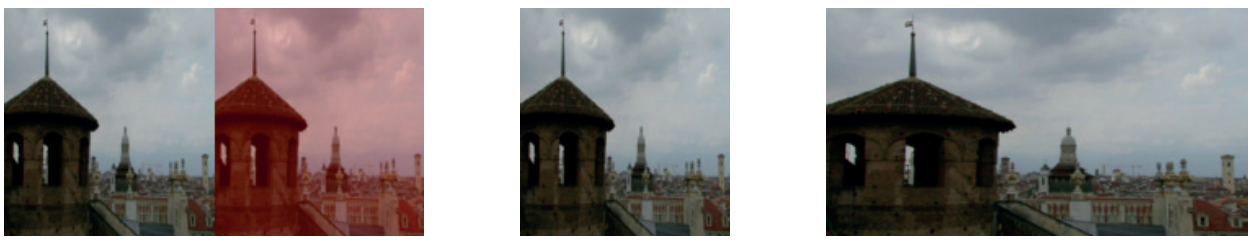
Unfortunately, due to the geometric layout of the composite frame that contains both left (L) and right (R) views, the resulting HD video (in which L and R are stitched together) will not be "service compatible", meaning backwards or 2D compatible.

Practically, in this specific condition, 2D HD decoders will be able to decompress the composite video, eventually displaying the whole composite picture without discarding, as it would be desirable, one of the two composing images.

The H.264/AVC provides the technology for solving this problem: the cropping rectangle parameter.

Whenever a composite frame is used for the distribution of 3D stereoscopic videos (Side by Side or Top and Bottom Frame Compatible modes), the CR can be used to delimit the frame portion containing one of the two 2D views.

During this procedure, illustrated in the figure below, 2D receivers decode the video and output only the view enclosed in the CR area.



Decoded output (with cropping rectangle in red) **Cropped output** **Scaled output**

Therefore the output video, properly scaled, provides a 2D-compatible video format.

In case of 3DTV decoding, receivers are required to ignore the cropping rectangle parameter when SEI messages (a sort of frame packing arrangement signaling) indicate that a frame compatible format is being decoded. That is because the system has to use the part of the decoded picture outside the cropping rectangle bounds. Consequently, decoding and displaying of both Left and Right views will be correctly performed.

Situation within standardization bodies

Since this feature is deemed to be a powerful tool, regional standardization bodies such as HD Forum Italia, have already decided that support for this specification for AVC receivers designed for the Italian market is mandatory. In fact, newly compliant products are already arriving on the shelves of CE stores.

Further information about Set-Top-Box and TV sets implementing the CR can be found at the following URL www.dgtvi.it/bollino.php. In particular, the listed TVs and the STBs have obtained the “Gold” label in 2012.

Moreover, DVB has adopted this technology in the 3DTV specification document TS 101 547 v1.1.1 DVB Frame Compatible Plano-Stereoscopic 3DTV (DVB-3DTV).

Advantages for TV broadcasters

Evidently, the CR brings significant advantages to TV service operators that already deploy the HD broadcasting architecture. One has to understand that frame compatible formats in use today do not allow for addressing 2D and 3D users at the same time.

In fact, if broadcasters intend to simultaneously reach 2D and 3D users, they have no other choice than to simulcast the two versions of the same program.

As a consequence, a separate channel is needed to broadcast 3D content even though it would be more desirable to insert 3D content in a HDTV channel. This fact is further reinforced by the restricted number of 3D contents actually available to fill up a dedicated channel.

Some complications can occur where the RF spectrum is a limited and expensive resource, e.g. in terrestrial TV broadcasting.

In summary, there are two principal reasons for public broadcasters adopting the Cropping technology; first, the possibility of saving bandwidth of a dedicated 3D channel, and secondly, it provides for the seamless introduction of 3DTV services in the existing HD infrastructure.

Adopters among TV broadcasters Currently, in Italy there are quite a few terrestrial broadcasters running 3D trials using DVB-T. All of these are 2D service compatibility transmissions within 3DTV, having been

launched within the past few years. Namely:

- Quartarete is transmitting in the Piedmont region
- 50Canale is transmitting in the Tuscany region
- Several regional broadcasters (under negotiation) are interested in joining the partnership which is offering nationwide 3D services based on 2D-compatible technologies over a DVB-T platform

Situation within standardization bodies

In addition, it should be mentioned that a 3D trial service is being transmitted from SES satellite (19.2°).

At the same time, RAI and TeleDiffusion de France (TDF) are setting up regional trials via DVB-T2.

Also, the national Vietnamese broadcaster (VTV) will start to transmit 3DTV services via DVB-T2 based on backward compatible formats.

Last, but not least, negotiations with US broadcasters interested in using the CR for 3DTV broadcasting are presently taking place.

Presence of compliant products in the market

Supporters and Adopters

In general, all HD Forum Italia members support the CR as a service compatible technology:

Aeranti-Corallo • Eutelsat • Fastweb • Fondazione Ugo Bordoni • Fracarro • IDS Multimedia Mediaset • Panasonic • Philips • RAI • Samsung • SES Astra • Sisvel Technology • Sky Italia Sony • STMicroelectronics • Telecom Italia • Telecom Italia Media • Telsey

Professional broadcasting equipment manufacturers: **Utah Scientific, Motorola, Hitachi, BLT**

Receiving apparatus producers: **Vestek, ANTIK Technology, SIM2 Multimedia**

Other broadcasters and service operators: **TDF, VTV, DigiKoalice, Quartarete, 50Canale**

Universities and R&D centers: **CSP, University of Turin, Polytechnic of Turin, IRT**

Compliant products available

- Sony KDL-40EX720, KDL-46EX720, KDL-46CX520
- Samsung UE46ES8000QXZT, UE46ES5500PXZT
- TP Vision – Philips 40pfl8606M, 40pfl5007H
- Motorola H.264 AVC encoder SE6600
- SIM2 3DHome DVB-T, DVB-S set-top-box
- Giada 3DHome DVB-T set-top-box
- SIM2 Teleweb DVB-T, IPTV set-top-box
- Antik Technology Juice 3D Extreme
- Vestel 3DTV P710, 42VHLYR947UD
- SIM2 Lumis 3D-S projector
- GammaRED Video Server