

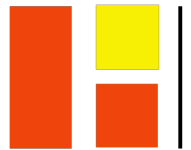


High Definition Television: Addressing the Key Challenges

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In order to Address the Key Challenges ...

We need to know:

What HD is, and;
What it is not

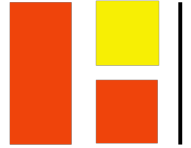
HDTV:



is **16:9** aspect ratio
not 4:3

can have **5.1 sound**
not only stereo

is a **rising star**
not mainstream



How would you fit 16:9 into a 4:3 world?

You could ask 10 people and get 20 opinions ...



Why is aspect ratio a Key Challenge?

Let's think about it for a moment.

How would you present ?:

- a. HD content on an SD channel (service)
- b. SD content on a HD channel

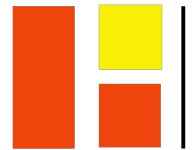
How would you differentiate ?:

- a. Up-converted SD content
- b. Native 16:9 HD content



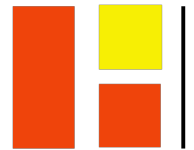
The first part of the Aspect Ratio
challenge is:
Presenting content with differing
aspect ratios

16:9 into 4:3 and vice-versa



- Don't do it – keep them separate
 - Maintain the proper aspect ratio with letter and pillar boxes
- Stretch/Squish or Zoom/Crop – the LCD / Plasma TV problem
 - Rugby-shaped soccer balls: Linear stretch
 - Broad shoulders: Non-linear stretch
 - Missing Logo/Bug: Zoom cropped
- 14:9 – compromise
 - 16:9, 14:9, 12:9 (== 4:3)

Maintain Proper Aspect Ratio



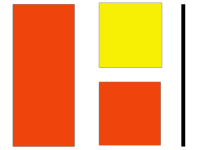
Pro

- Circles remain truly circular.
- Artistically the right thing to do.
- We can fill those black bars with (interactive) Ads!

Con

- Those really irritating black bars!
- Viewers know which content is SD!
- Google is way ahead of broadcasters in this game.

Stretch/Zoom/Crop



Pro

- Pan & Scan maintains correct aspect ratio!
- Center Zoom/Crop is a good compromise.
- Stretch/Squish preserves info.
- Non-linear stretch sort-of natural.

Con

- Intelligent Pan & Scan == Human Operator.
- Lose information / resolution
- Rugby-shaped soccer balls.
- Non-linear stretch sort-of natural.

14:9 Compromise



Pro

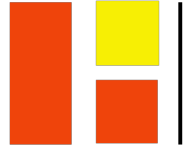
- Thinner bars.
- Zoom / Crop less.
- More natural non-linear stretch

Con

- Bars still there.
- Data is still lost.
- Less un-natural non-linear stretch.



How do we address this aspect-ratio presentation challenge?



We (Broadcast Engineers)
should not address it ...

It is a question for the
Programming Policy folks

But now we know how to brief those folks so that they can set policy...



However there is a second part to the Aspect Ratio Challenge:

How would you differentiate ?:

- a. Up-converted SD content
- b. Native 16:9 HD content

Do I hear that we already have a solution ...



We should **tag** content with the correct aspect ratio information

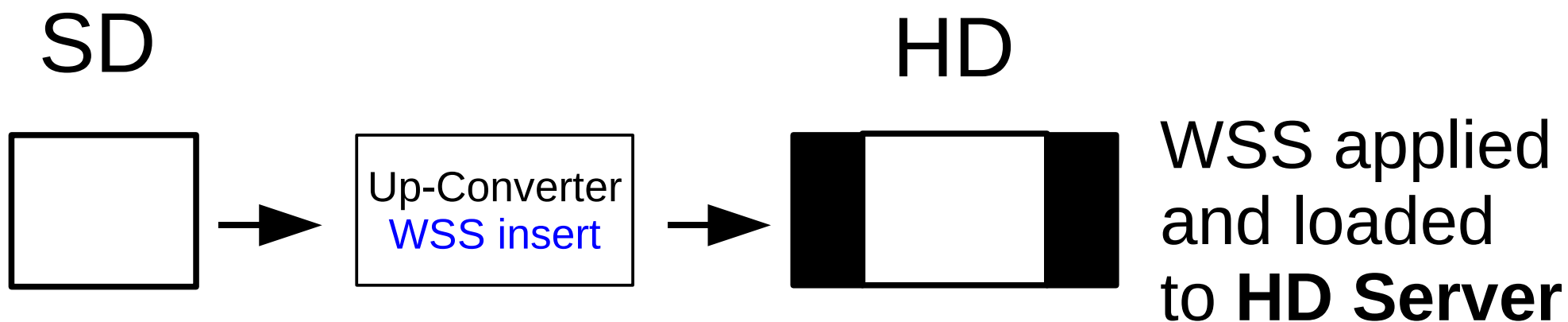


Suppose we tag / attach a
Wide Screen Signal (WSS)
ala **PAL Plus**
for 16:9 aspect pictures

Umm... ahh... yes, but consider this...



HD Service



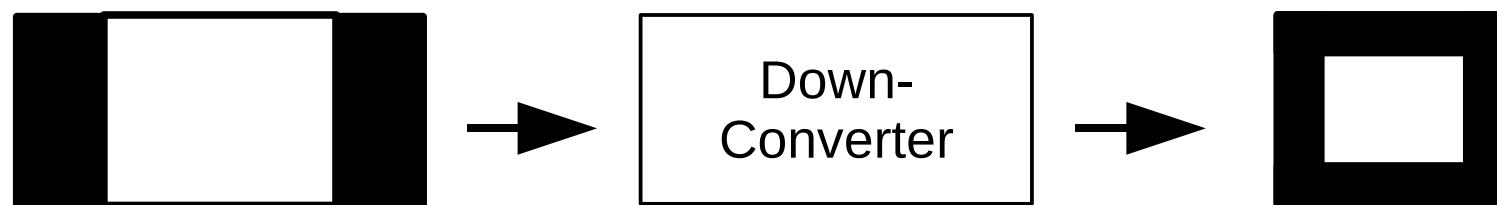
Problem solved !
... for the HD service



However we have a problem
with the SD (mainstream)
service !

“HD” Content

SD

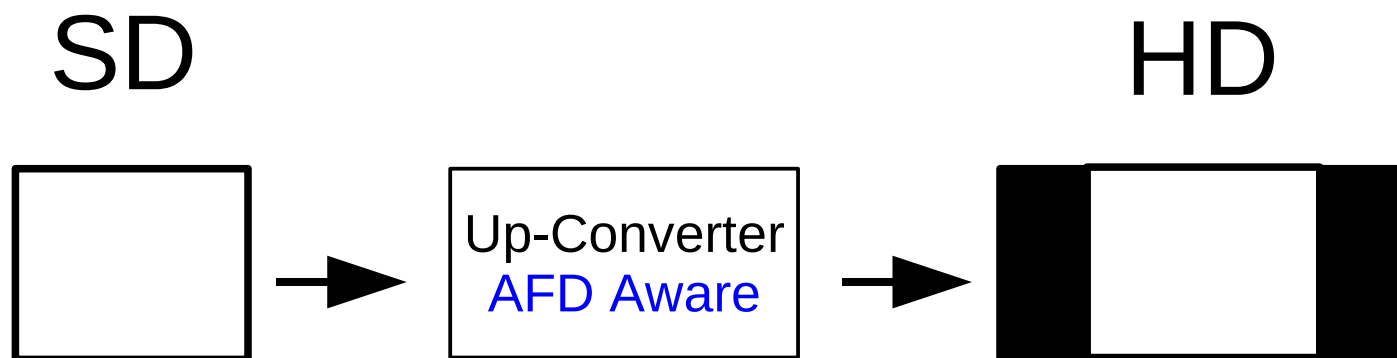


Must letter-box for SD channel !



Fortunately there is a newer
standard to the rescue !

AFD – Active Format Description



AFD:
Native 4:3

AFD:
4:3 in 16:9

So far so good ...
... for the HD Service



SD Service

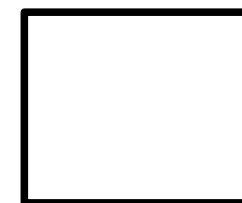
“HD” Content



AFD:
4:3 in 16:9



SD



AFD:
Native 4:3

AFD-aware Down-converter checks the incoming AFD and does the right thing!

Complete list of AFD codes

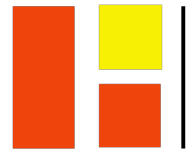
[\[edit\]](#)

Values from ETSI TS 101 154 V1.7.1 Annex B, ATSC A/53 Part 4 and SMPTE 2016-1-2007

0	ESTI: reserved; ATSC: undefined
1	reserved
2	ETSI: 16:9 active picture (top aligned); ATSC: "not recommended"
3	ETSI: 14:9 active picture (top aligned); ATSC: "not recommended"
4	ETSI: box > 16:9 (center): wider than 16:9 active picture. The aspect ratio of the source area is not given, and the size of the top/bottom bars is not indicated. ATSC: bar data (indicating the extent of top, bottom, left, and right bars) should be transmitted when using this code.
5–7	reserved
8	Full Frame image, same as the frame (4:3 or 16:9).
9	4:3 Image: Full Frame in 4:3 frame, Pillarbox in 16:9 frame.
10	16:9 Image: Letterbox in 4:3 frame, Full Frame in 16:9 frame.
11	14:9 Pillarbox/Letterbox image.
12	unused
13	4:3 with shoot and protect 14:9 centre. The term "shoot and protect" is not explained in the standard, but means that the areas above and below the central 14:9 region of the 4:3 active picture can be trimmed without losing important detail.
14	16:9 with shoot and protect 14:9 centre. Here, the areas to the right and left of the central 14:9 region of the 16:9 active picture can be trimmed without losing important detail.
15	16:9 with shoot and protect 4:3 centre. Here, the areas to the right and left of the central 4:3 region of the 16:9 active picture can be trimmed without losing important detail.

Data from Wikipedia

Summary – thus far ...



Aspect Ratio Challenges

- Presentation: Maintain, Stretch/Zoom/Crop or 14:9 compromise
 - Programming Policy Question
- Aspect ratio tagging / signaling
 - Broadcast Engineer's Responsibility
 - Simple WSS “on/off switch” not adequate
 - Fortunately AFD aware equipment is coming on stream.
 - AFD: Active Format Description



How would you fit 5.1 sound into a stereo world?



Why is 5.1 sound (multi-channel audio) a Key Challenge?



Sound also has challenges
relating to:

- **Presentation**
- **Sound Format Tagging** (stereo or 5.1)

Presentation: Obvious Reasons & Solutions



- 5.1 sound = 6 audio tracks !
 - Issue: Multiple audio tracks
 - Solutions:
 - Use SDI embedded audio: Capacity 16 tracks
 - Use Dolby E encode/decode: Fits 8 audio tracks into one AES channel (= 1 stereo pair)

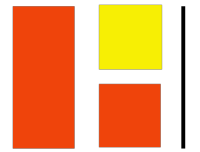
Presentation: Obvious Reasons & Solutions



- Switching between Stereo (advertisement) and 5.1 sound (movie)
 - Issue: Sound from 2 speakers then later from 6 speakers.
 - Solution: Refer to the Programming Policy Folks – just as in the Aspect Ratio question

How would you – the Broadcast Engineer - brief the Programming People on this issue?

Presentation: Switching between Stereo and 5.1 sound



- Keep them separate:
 - Stereo should be heard only on 2 speakers
 - 5.1 sound on 6 speakers
- Synthesize 5.1 sound from stereo
 - 5.1 sound all-the-time, heard always on 6 speakers
 - “Non-linear stretch” for sound.

Again, this is for the program policy folks!



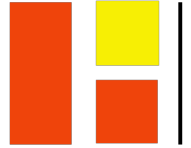
The de-facto (industry) standard for
“AFD for audio” is Dolby Metadata ...

... a complex and very powerful
system

Dolby Metadata



- Defines whether a piece of audio is:
 - Stereo or;
 - 5.1 (or 6.1 / 7.1)
- Is set by an operator, ideally during the production of the audio
- Has other entries relating to other parameters such as:
 - Loudness levels (Dialog Normalization or DialNorm)



... but tagging alone does not
address the
Key Audio Challenge



The key challenge facing Audio
for HD :

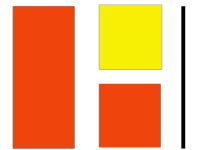
LIP-SYNC



The Key Challenge: Lip-Sync

- 5.1 sound is typically encoded with a Dolby Digital (AC-3) encoder.
- AC-3 encoder has a typical processing delay of about 0.2 seconds (200 ms)
 - 5 video frames (at PAL rate)
- Lip-Sync problems detectable at 2 video frames
 - 80 ms
- Switching between stereo (0ms delay) and 5.1 sound (200 ms delay) results in temporal discontinuities (time jumps)

Solution 1: Don't Switch



- Feed Stereo into Lt, Rt and silence for the other channels.
- 5.1 mode “on” continuously -- all-the-time
 - Now we have a fixed 200ms audio processing delay
 - Add a 200ms *video* delay to compensate

How about TV receivers without 5.1 sound
– stereo or mono only sets?

Solution 1a: Add Stereo Channels

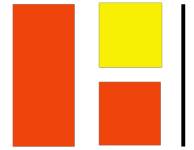


- With 200ms *video* delay added;
- Plain-old-stereo audio is now 200ms *ahead* of video
- Fix with 200ms delay for stereo channels

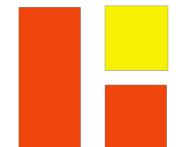
However 5.1 mode is “on” all-the-time.
What if we want it only for movies and
not during commercial breaks?

Solution 2:

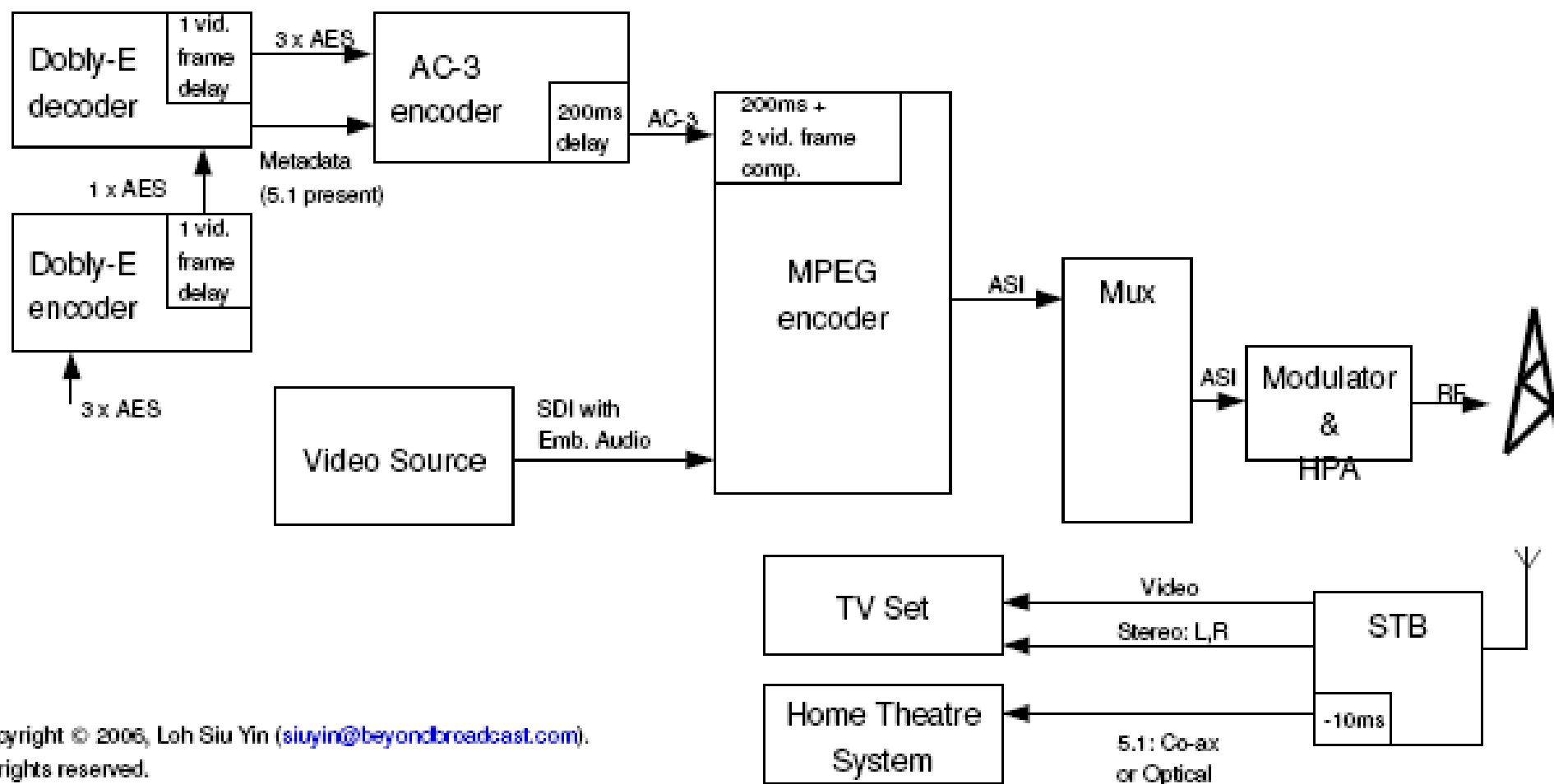
Add 5.1 mode signaling



- In non-5.1 mode, stereo audio is passed directly to the Lt and Rt speakers.
- This routing is handled by the Dolby Digital (AC-3) *decoder* at the TV Set / Home Theatre System.
- The Decoder knows when to switch modes in accordance to received Dolby Metadata
- Solution: ensure Dolby Metadata is present and correct



One solution for Dolby Digital Transmission

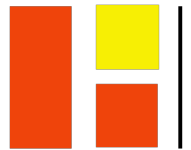


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Summary: Audio Challenges



- Compensating for Dolby Digital (AC-3) processing delay is complex
 - Video delay is required
 - Without delay compensation a 5 video-frame lip-sync problem will surface
- Dolby Metadata signals the Set-Top-Box or TV Set to switch between 5.1 and Stereo
 - Metadata must be present and reflect the correct mode.
 - Must be associated / attached to each piece of audio.

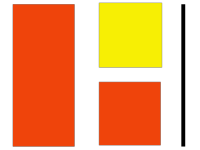


Key Challenge #3

HD is a rising star ...
not *yet* mainstream

What is the implication of the above statement?

HD: Rising Star



- Rising Star: new / fresh, lots of potential, not yet mature / mainstream
- **Lots of Potential:** We're going to have to implement it
- **Not Mainstream:** We probably have to Simulcast both HD and SD services

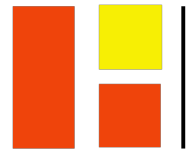


Simulcasting is a Key Challenge to be addressed

...

why?

HD / SD Simulcasting:



One playback path or two ... ?

– Single Path

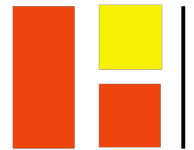
- All content stored and processed in one resolution (pref. HD)
- Converted to other resolution (pref. SD) at the end of the chain

– Dual Paths

- HD and SD have completely independent playback paths

– Hybrid – a combination of the above

Single Playback Path



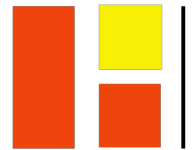
Pro

- Only one set of equipment

Con

- Failure affects both SD and HD services
- Branding: 16:9 safe area \neq 4:3 safe
- Wastes Space: SD stored as HD
- AFD needed

Dual Playback Paths



Pro

- Dual independent paths: sure to work
- Can have different programming on each path
- No need for fancy techniques like AFD

Con

- Costly: two full systems
 - Capital Costs
 - Operating Costs

Hybrid / Combination:



- Key Considerations
 - Where do you split the path?
 - Channel Branding
 - Video Server
 - Do the split paths rejoin?
 - Eg. SD_cont. -> Up-Conv->HD_sys.
HD_cont.->HD_sys.
 - What processing is needed?
 - Eg. AFD-aware up/down converters

Summary



- 3 Key Challenges Highlighted:
 - Aspect ratio handling
 - Multi-channel audio processing delay (200ms)
 - HD / SD Simulcast system design
- FAQs
 - Can you propose an AFD implementation / system design for my TV station?
 - How can we modify / extend our system for HD?





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