

AMIA 2023

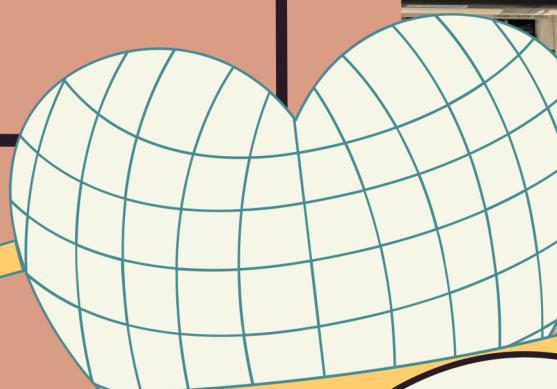
# S-VHS & S-VIDEO

SUPER, OR  
SUPERCILIOUS?

Presentation By:  
Morgan Oscar Morel  
Video Lab Supervisor  
Library of Congress

**LIBRARY**  
LIBRARY  
OF CONGRESS

# MORGAN MOREL



**Video Lab Supervisor at Library of Congress  
National Audiovisual Conservation Center**

# TOPICS COVERED

1

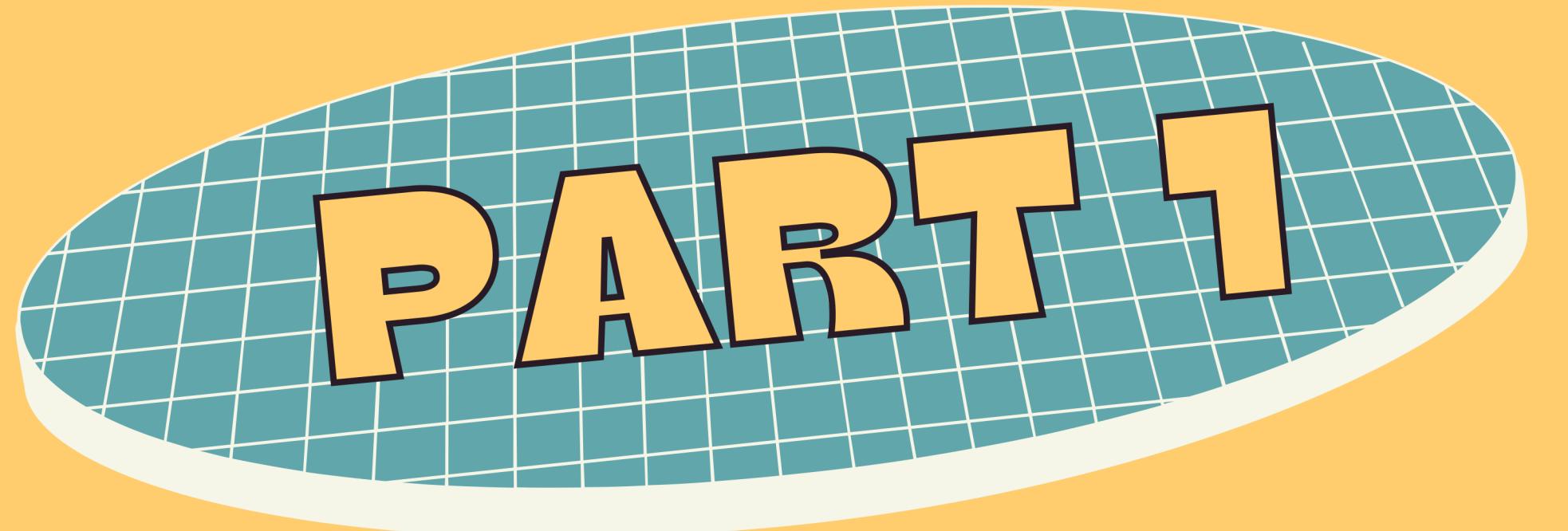
**DEFINITION OF S-VHS, S-VIDEO,  
AND RELATED CONCEPTS**

2

**PERFORMING TESTS TO DETERMINE  
QUALITY DIFFERENCES**

3

**APPLYING THIS INFORMATION IN AN  
ARCHIVAL PRESERVATION CONTEXT**



# DEFINITIONS

(WHAT IS THIS STUFF?)

# DEFINITIONS

## SVHS

A videotape **recording format**

Stands for **Super VHS**

Improved version of VHS Format

**Increased resolution** from increased luminance bandwidth.  
Color is not improved

Cassette shells are nearly identical to VHS, with a detection hole punched in the bottom

## S-Video

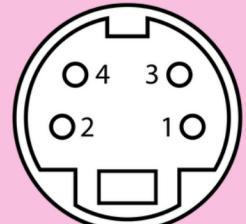
A video signal **transmission format**

Stands for **Separate** Video (not super!)

Improves artifacts inherent to composite video by allowing for the processing of Luma and Chroma separately

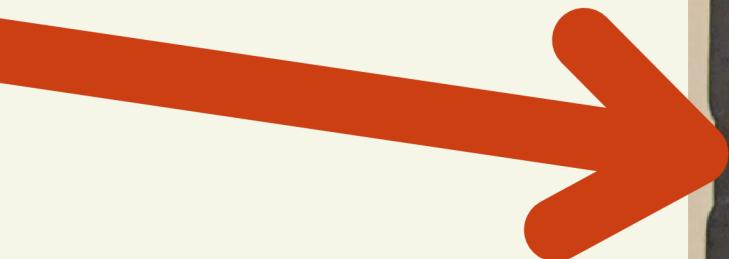
Can use the 4 pin DIN connector

Or two BNC cables



# S-VHS & VHS

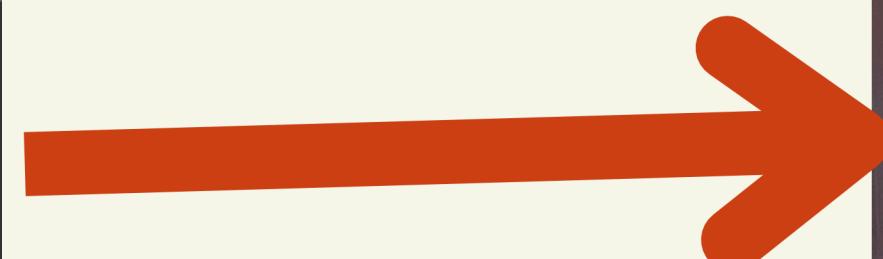
VHS



S  
VHS



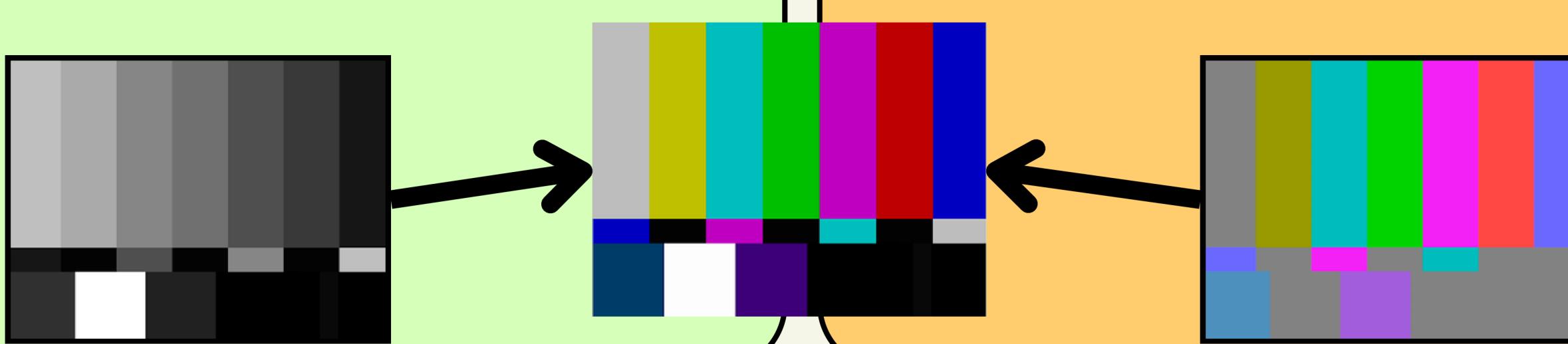
# S-VHS & VHS



# DEFINITIONS

## Luminance (Luma)

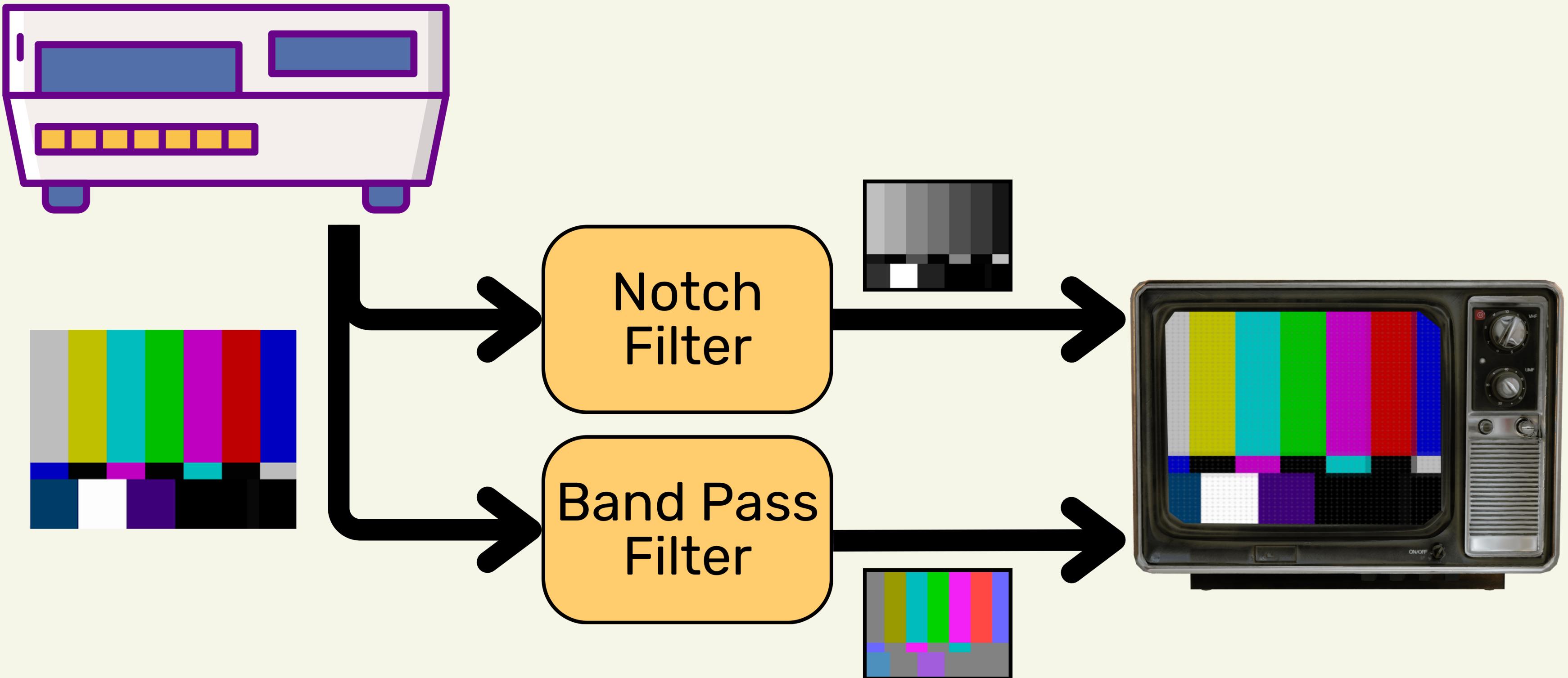
- The brightness or brilliance of the video signal
- Edges and details of an image depend on properly resolved luma
- Most of the bandwidth of a video signal is devoted to the luma



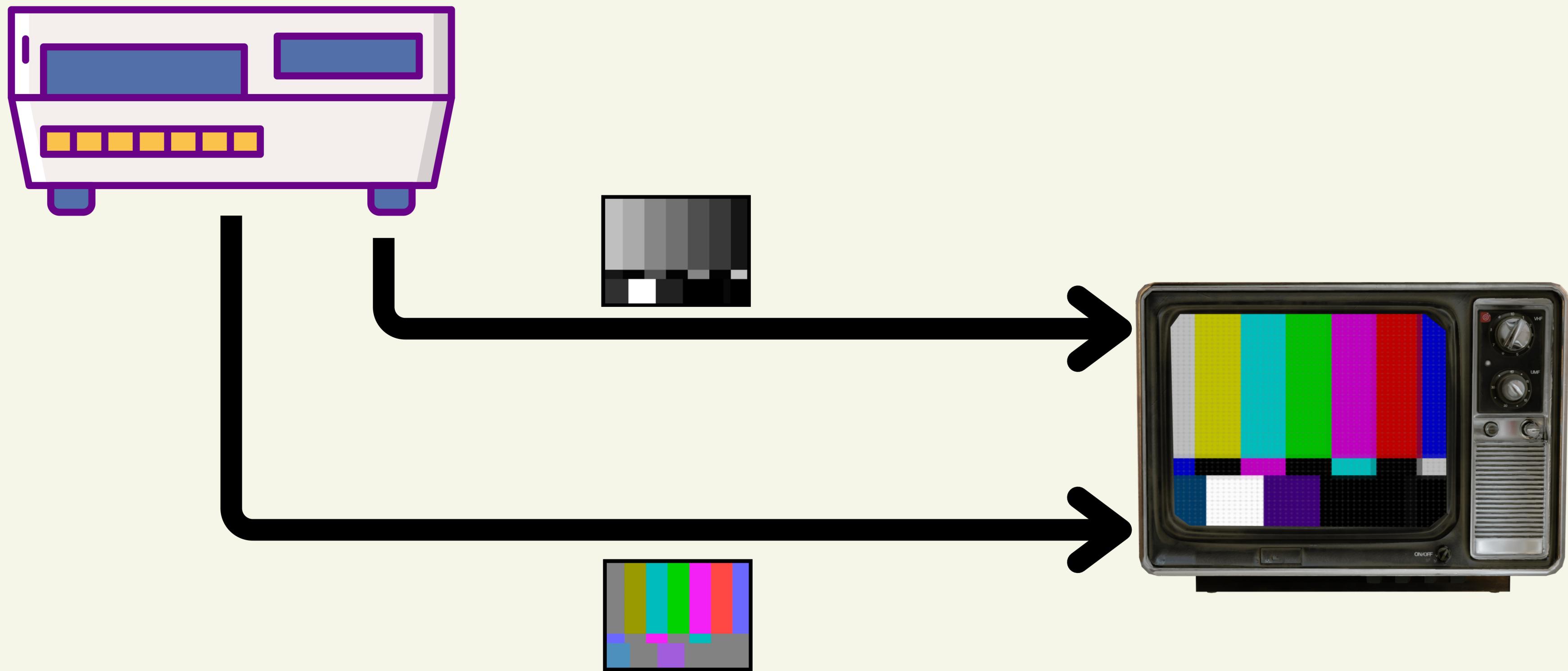
## Chrominance (Chroma)

- The color information of a picture
- The color information is often downconverted (heterodyned) to a much smaller bandwidth than luma

# COMPOSITE TRANSMISSION



# S-VIDEO TRANSMISSION



# COMPOSITE ARTIFACTS

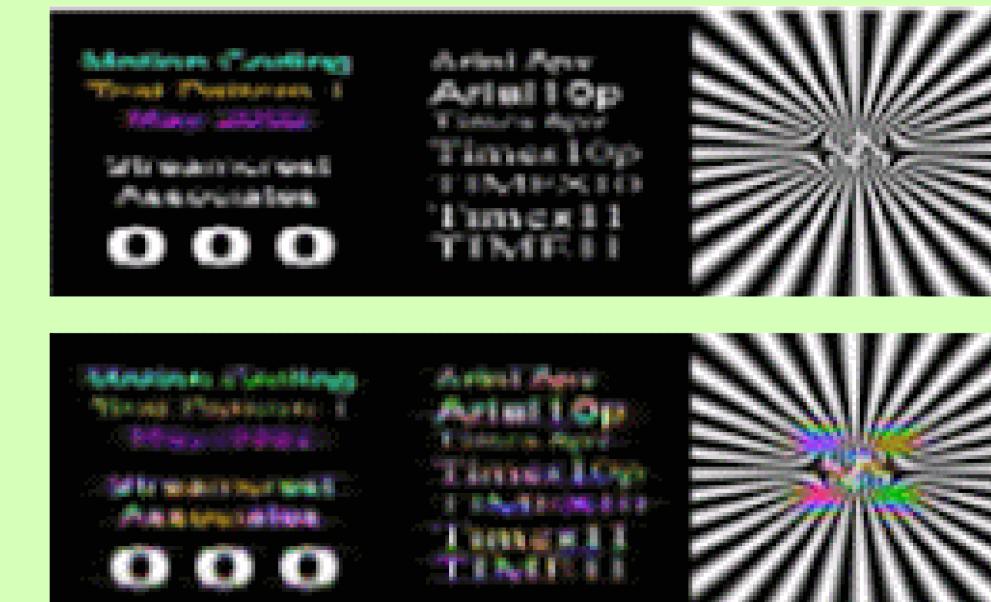
## Dot Crawl Cross Luma



*Occurs at sharp transition between saturated colors*

Chroma information bleeds into luma frequencies

## Rainbow Effect Cross Color



*Occurs near sharp black or white edges and text.*

High frequency luma freqs bleed into chroma freqs

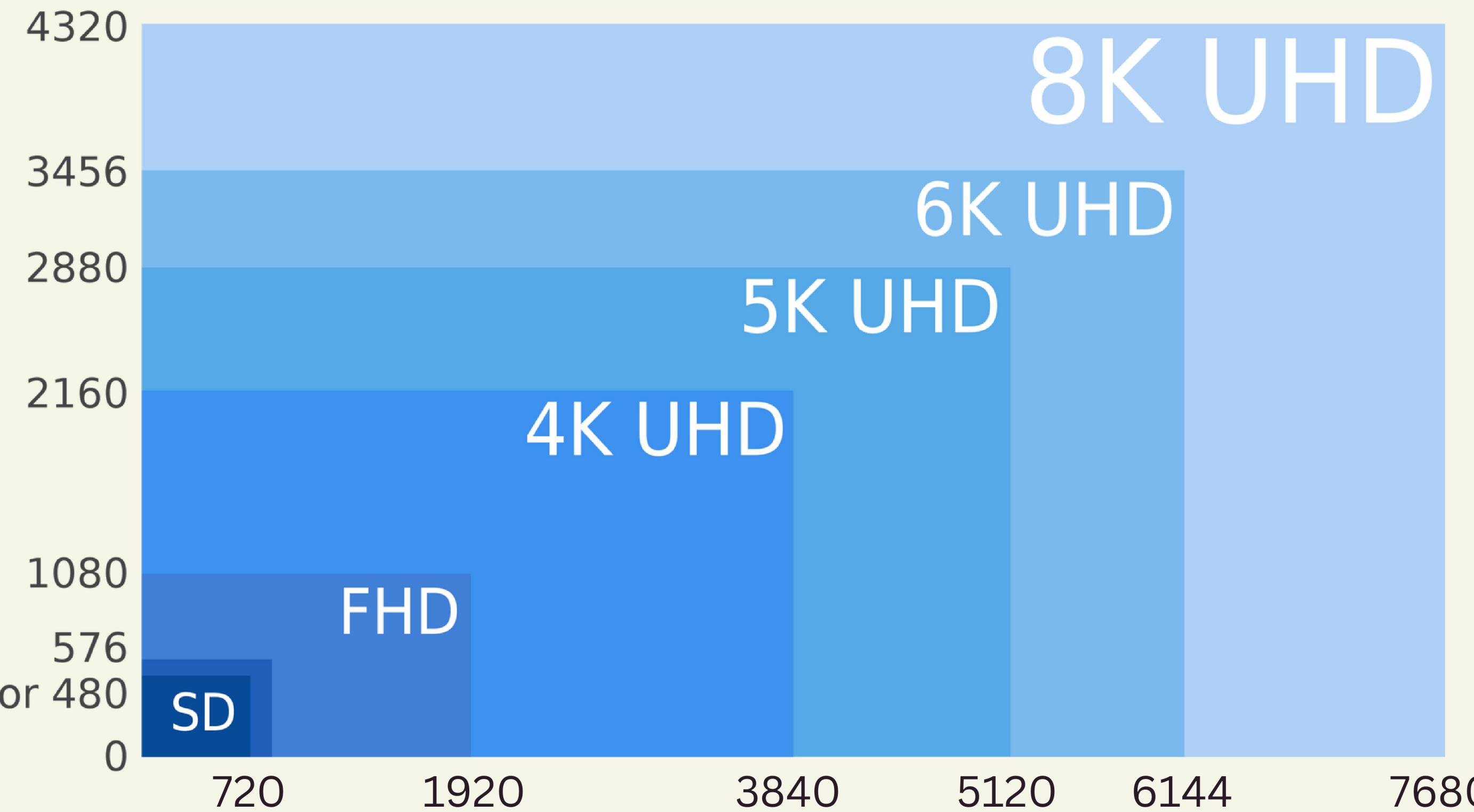
# RESOLUTION

Digital resolution is measured in **Pixels**

Analog resolution is measured in  
**Total Vertical Lines (TVL)**

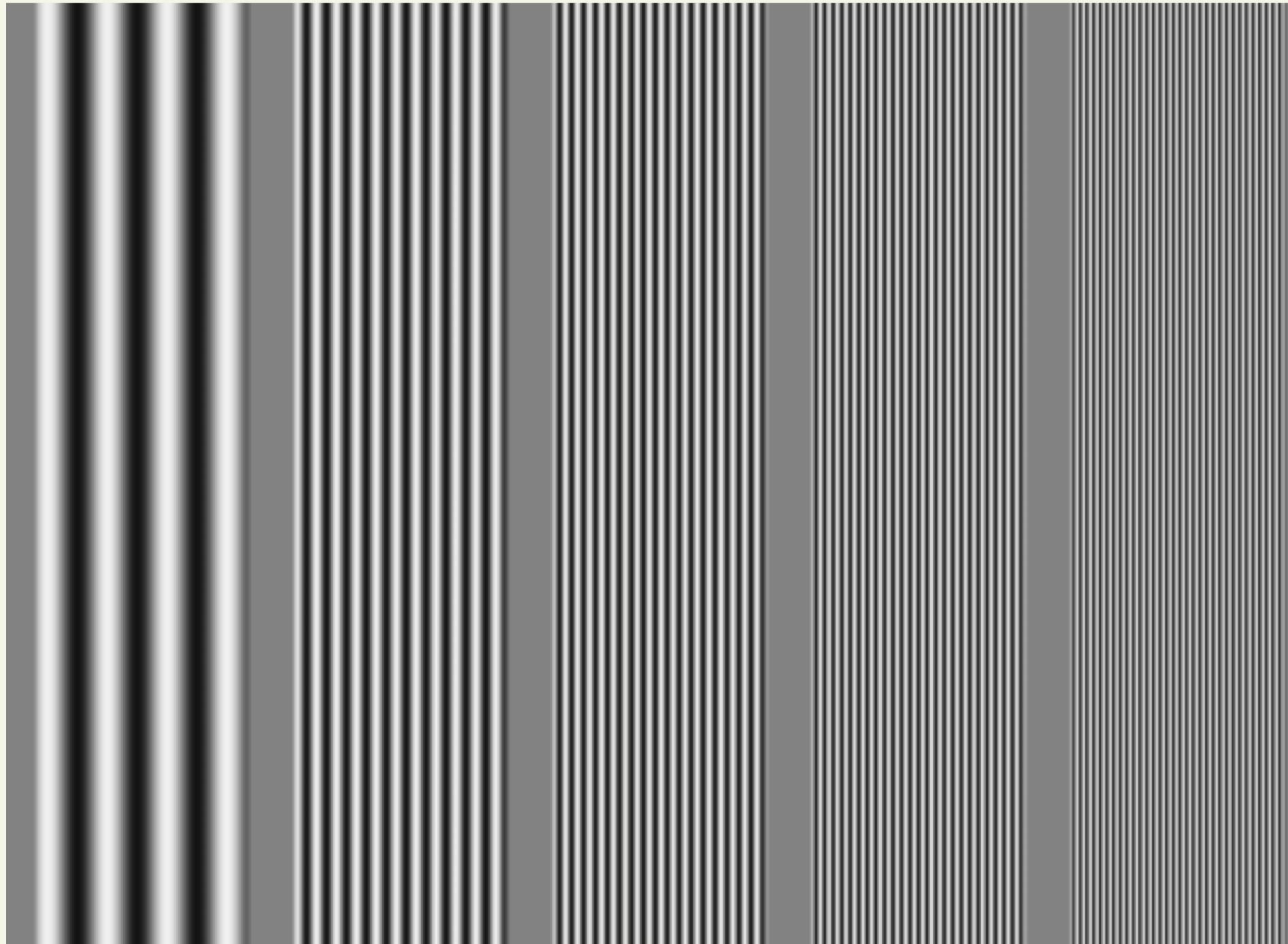
References to the “**number of lines**” a format can reproduce refers to TVL, not to pixel height, or scan lines

# RESOLUTION



Digital  
resolution  
measured  
in **Pixels**

# RESOLUTION



40 TVL

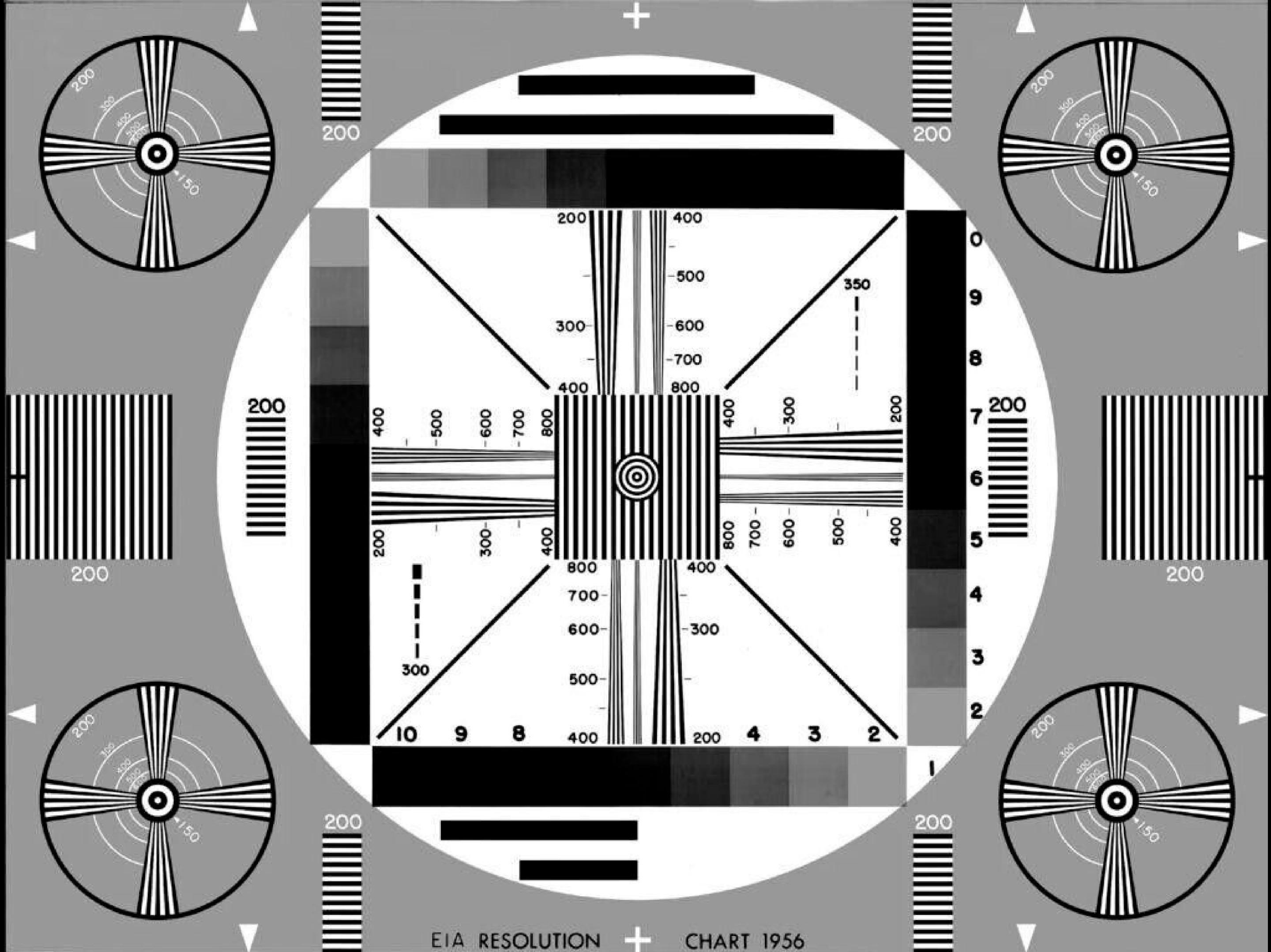
120 TVL

160 TVL

240 TVL

288TVL

Analog  
resolution  
measured by  
how many Total  
Vertical Lines  
can be  
represented



EIA RESOLUTION + CHART 1956

VHS  
(maximum resolution)

NTSC or PAL-M  
(maximum resolution)

# RESOLUTION

$$TVL = \frac{(LP \times tHA \times BWs)}{AR}$$

tHA =  $52 + (59/90)$  microseconds  
BWs = Signal bandwidth (in MHz)  
AR = Aspect Ratio = 4:3 = 1.33  
LP = Line pairs per cycle = 2

$$TVL = \frac{(2 \times 52.644 \times 1)}{1.33}$$

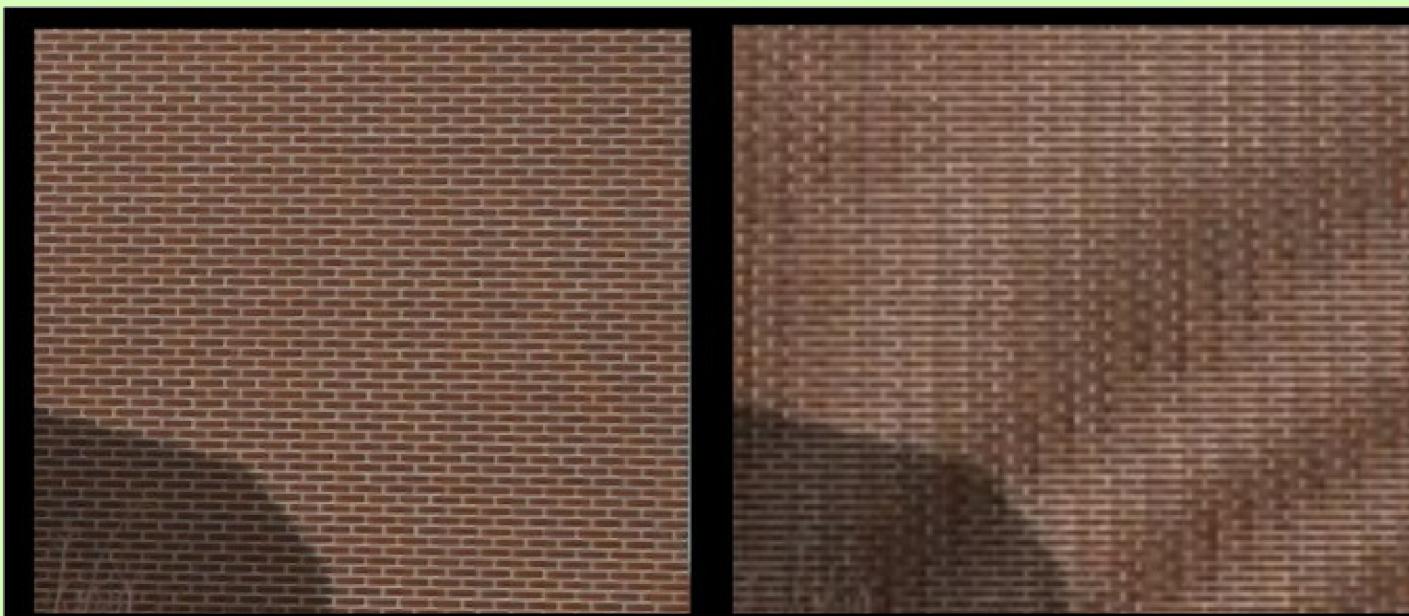
**78.983 TVL per 1  
MHz of bandwidth**

# RESOLUTION

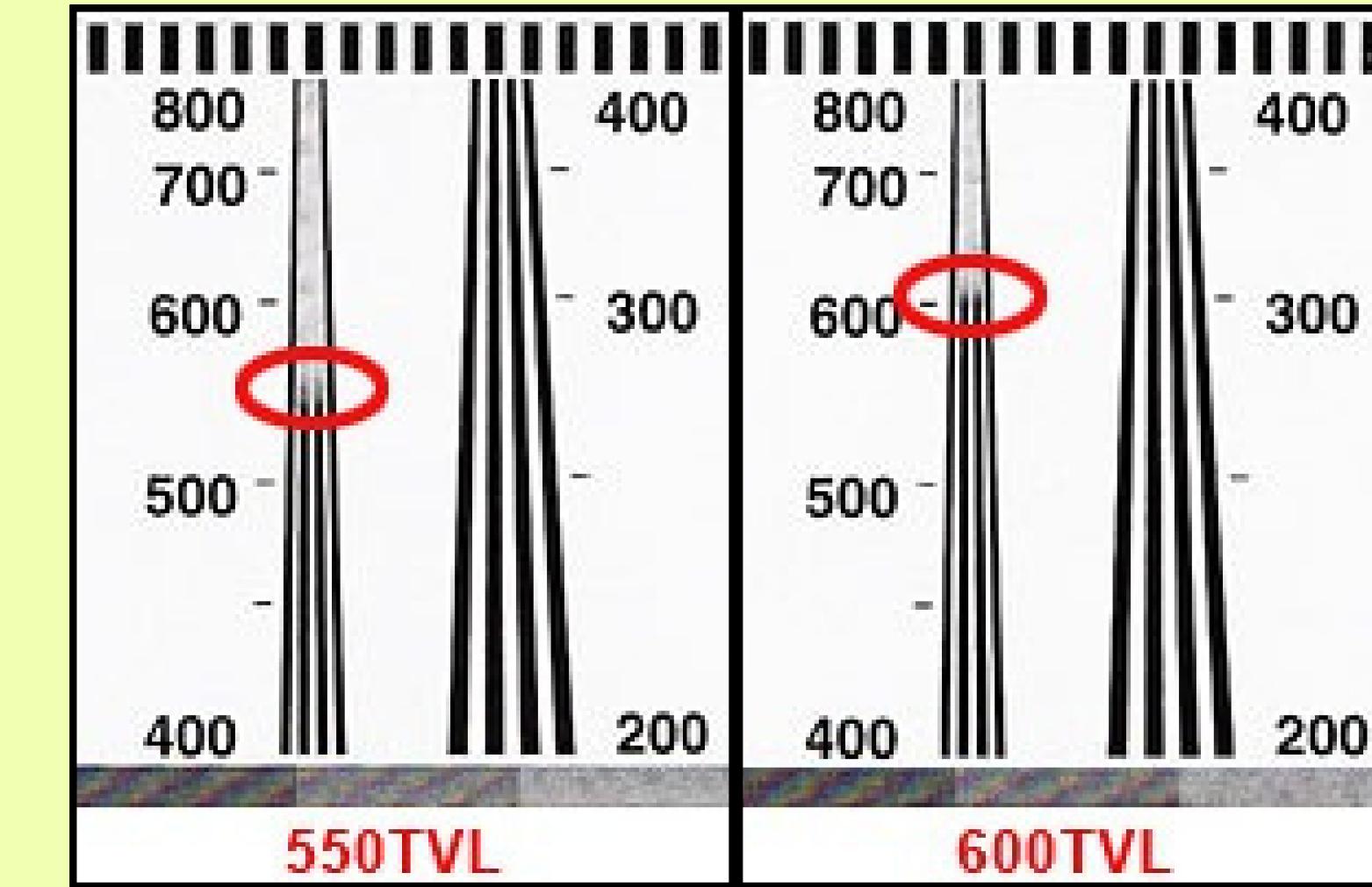
FORMAT	<i>Broadcast NTSC</i>	VHS	SVHS	<i>U-matic</i>	<i>U-matic SP</i>
<b>TOTAL VERTICAL LINES</b>	336	240	420	250	330
<b>TOTAL PICTURE HEIGHT</b>	448	320	560	333	440
<b>LUMA CARRIER FREQUENCY</b>	4.25 MHz	3.04 MHz	5.03 MHz	3.58 MHz	4.2 MHz

# RESOLUTION ARTIFACTS

Moiré



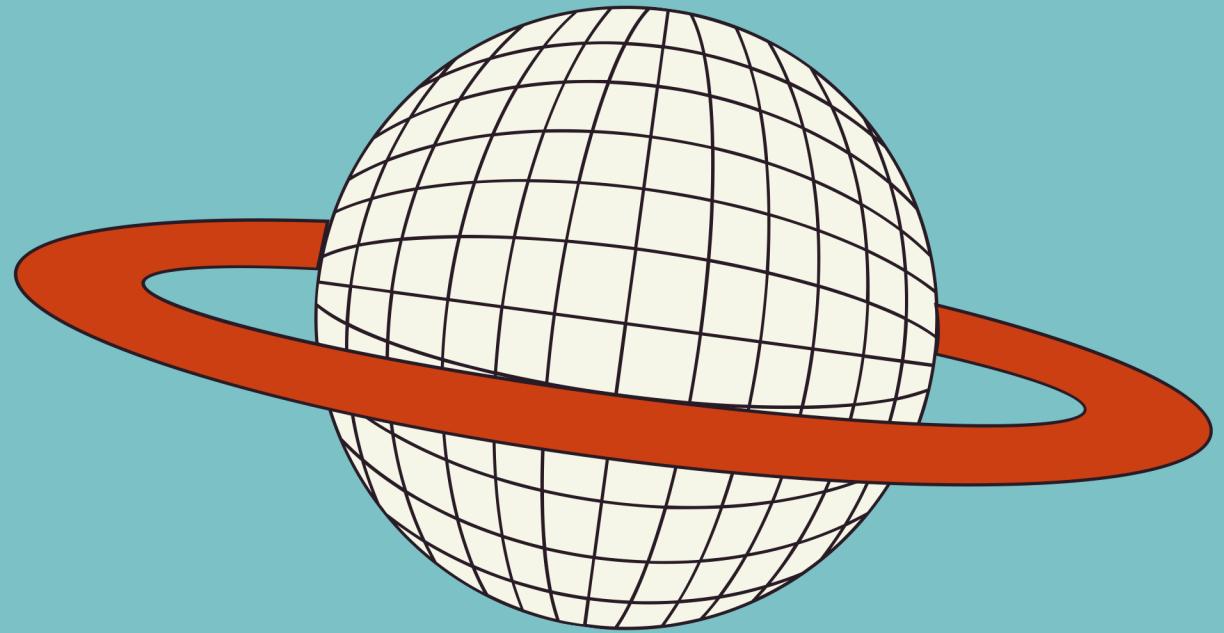
Lost Detail



# RECAP

**S-VHS** Improves analog.resolution, but maintains same color quality as VHS

**S-Video** reduces cross luma and cross chroma errors by allowing transmitting luma and chroma separately.



PART 2

QUALITY  
ANALYSIS

# EXPERIMENT

I wanted to **compare the quality differences** between different permutations of **S-VHS** and **VHS** recordings, along with using **S-Video** and **Composite** transmission

# METHODOLOGY

## COMPARING RESULTS

- **Visual comparison:** Compose videos in DaVinci Resolve to easily compare their resolution and any artifacts
- **Data Comparison:** Look at the resulting file in QCTools. Analyze saturation and compression rates

# METHODOLOGY USING QCTOOLS DATA

- **SAT MAX**

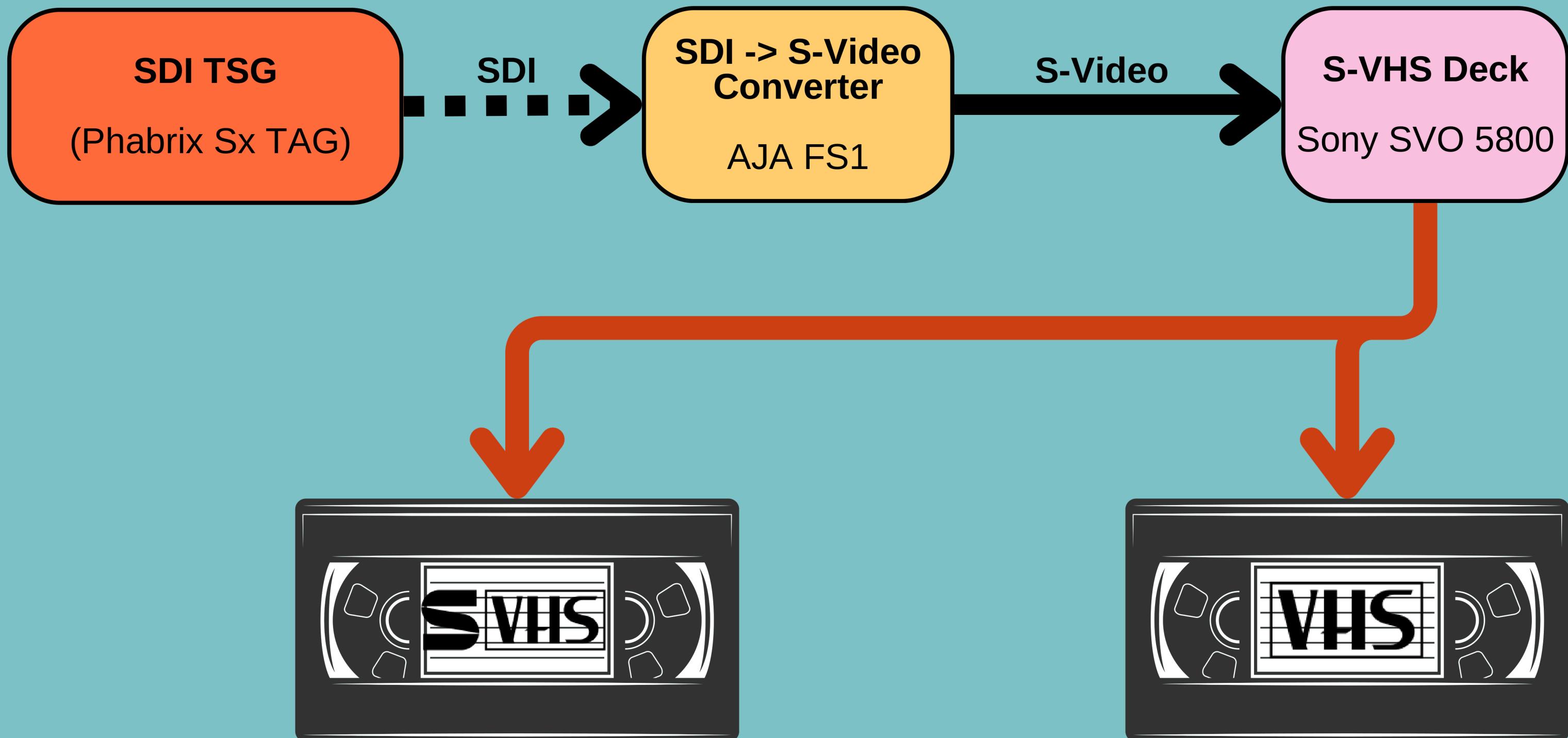
- The highest saturation value in the frame
- *High saturation values in black and white content are indicative of cross-color errors*

- **PACKET SIZE:**

- The size in bytes of the frame, which is variable for compressed formats
- *Larger packet sizes indicate more complex visual content, either due to detail or errors*

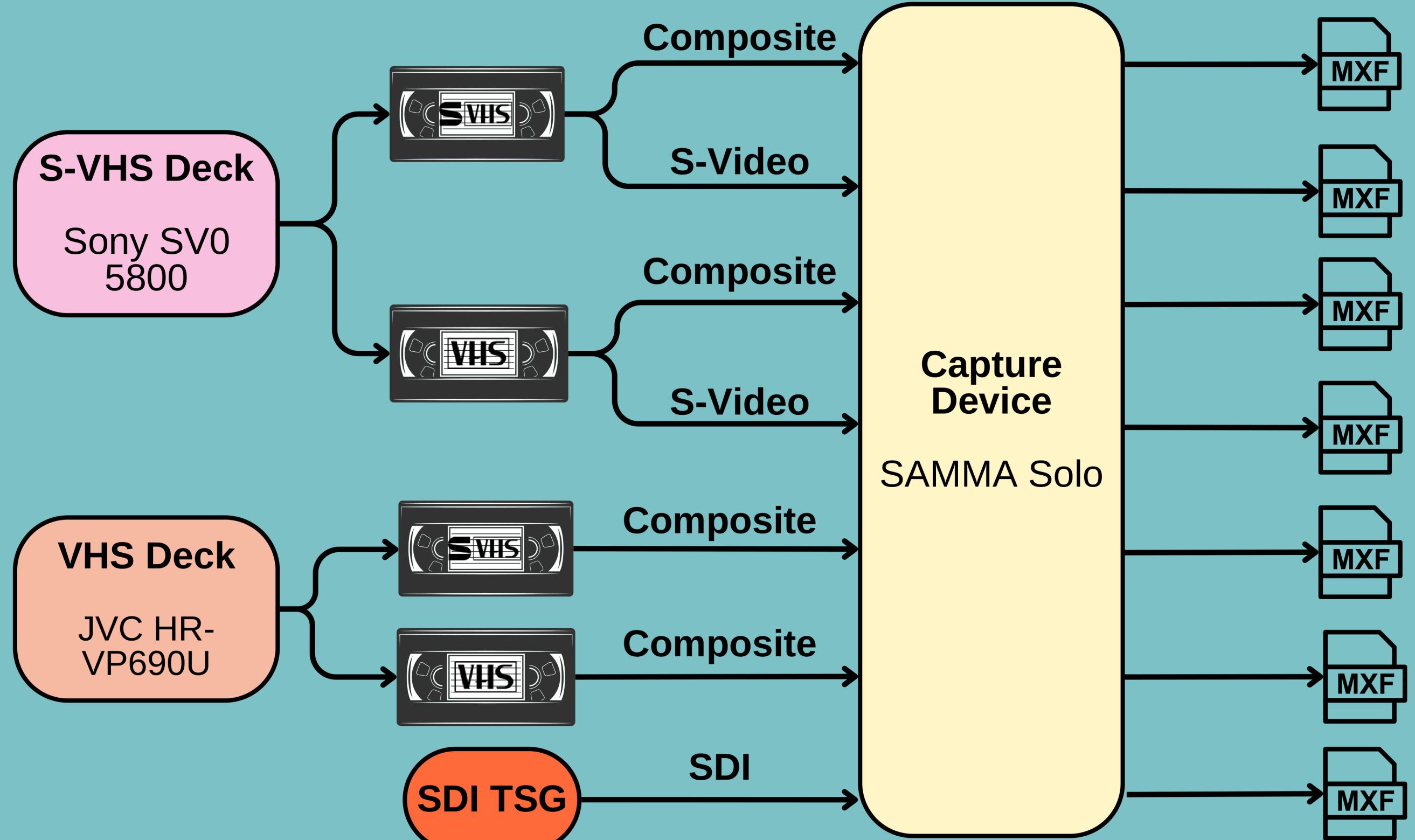
# METHODOLOGY

## SIGNAL CHAIN



# METHODOLOGY

## SIGNAL CHAIN



# METHODOLOGY

## TEST SIGNALS

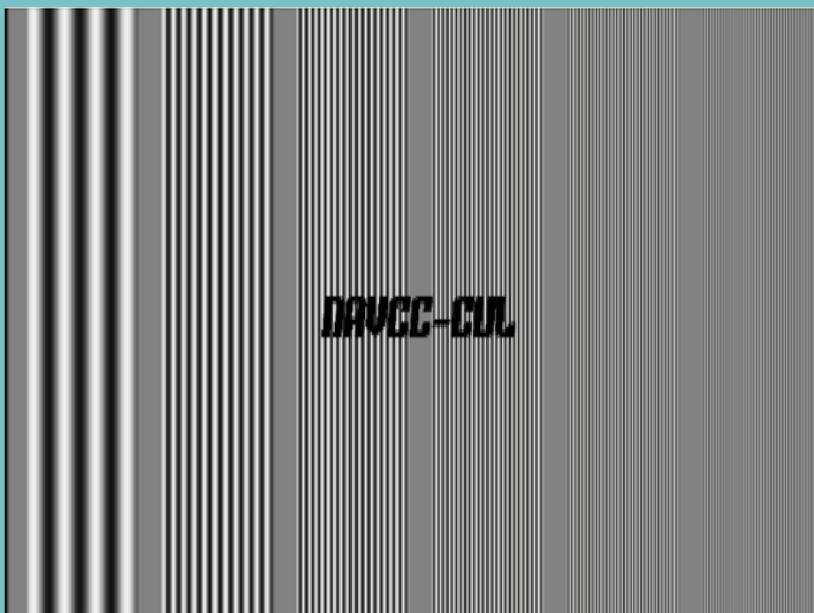
SMPTE Bars



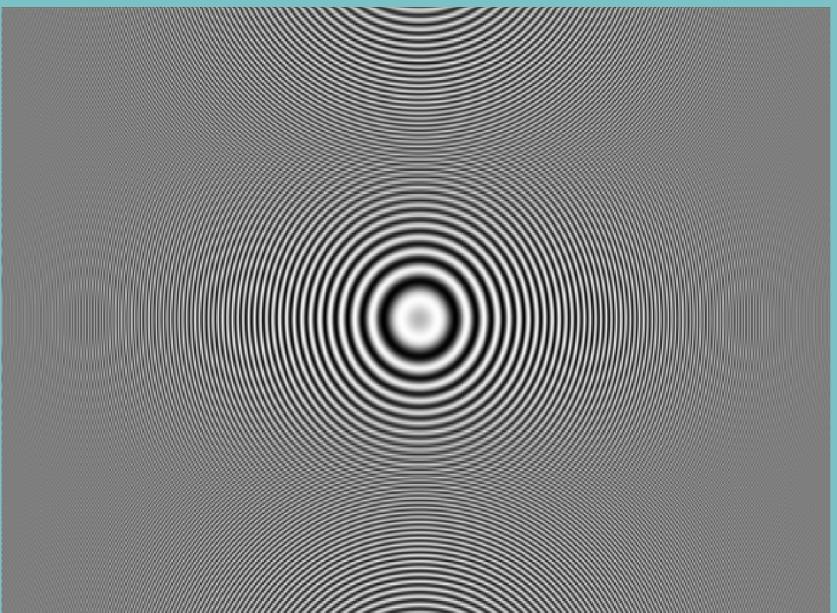
Tartan Bars



Multiburst



Zone Plate

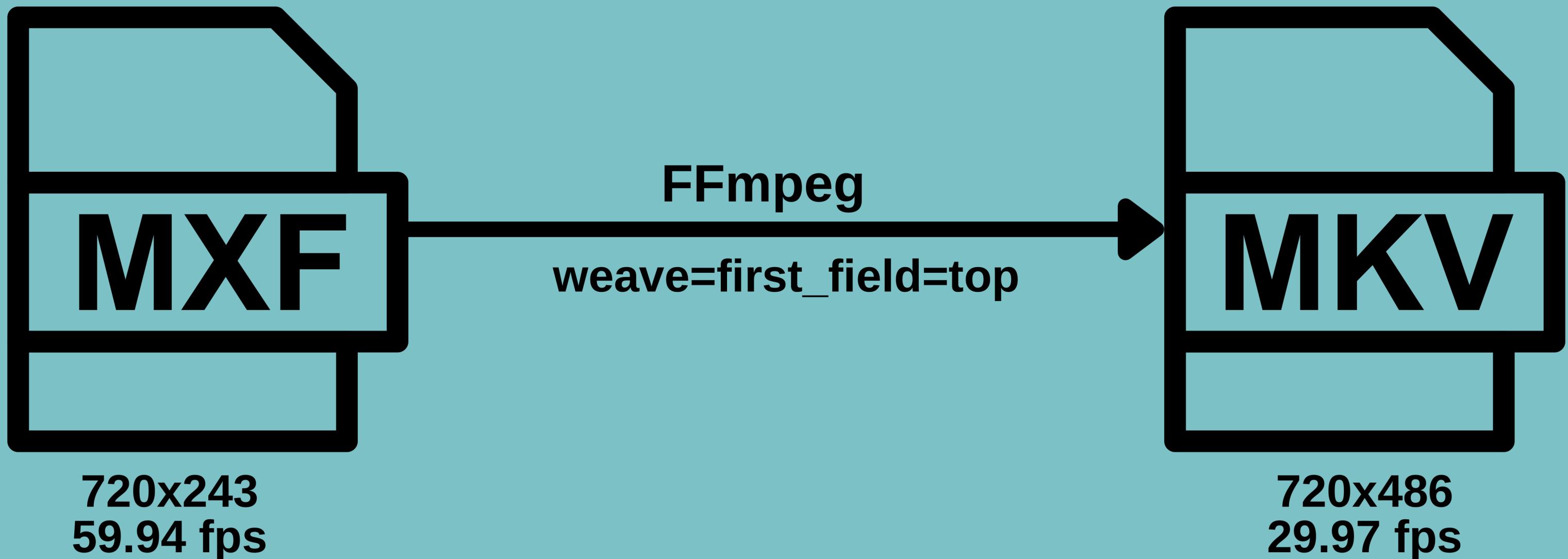


Content



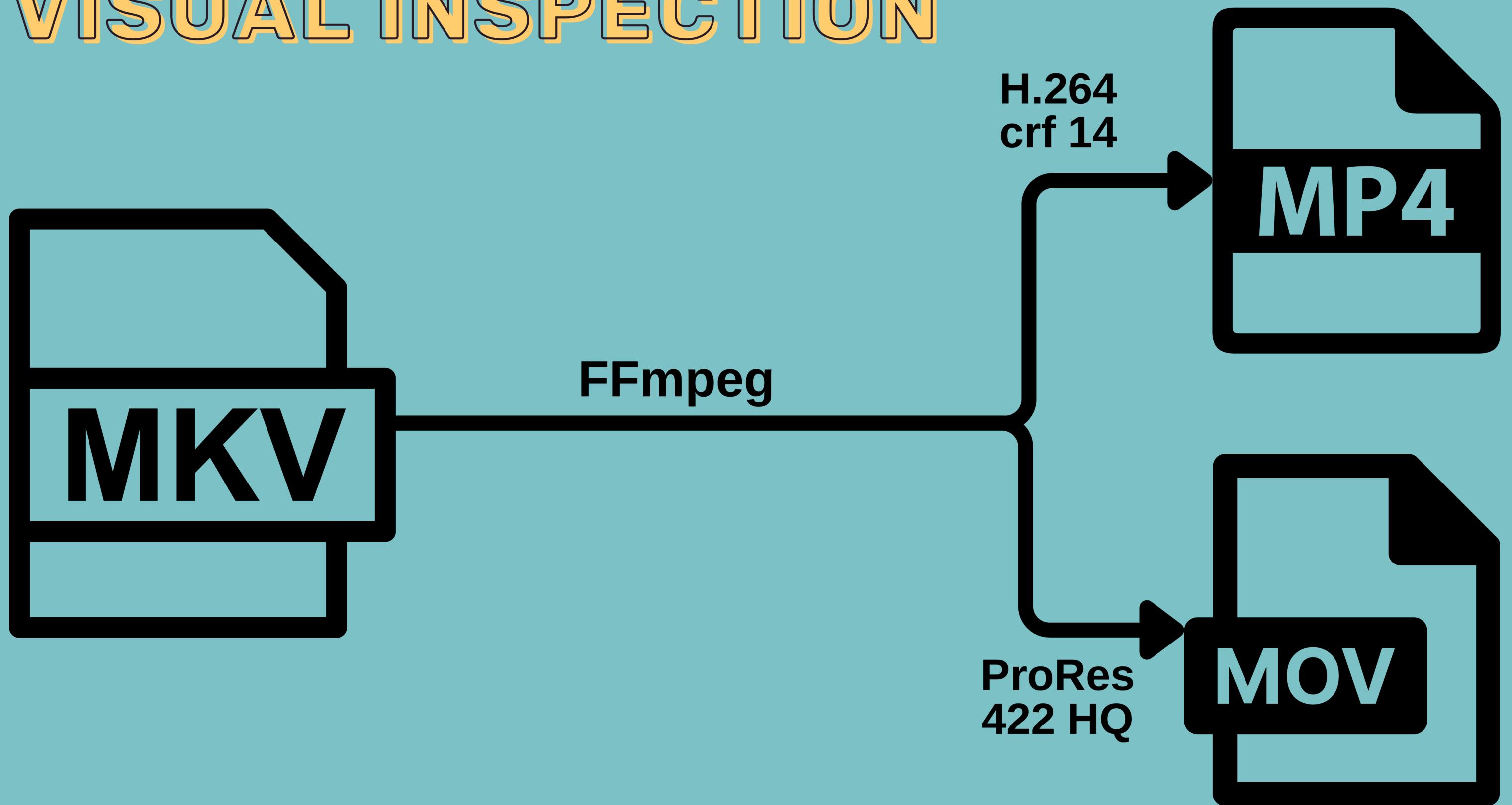
# METHODOLOGY

## VISUAL INSPECTION



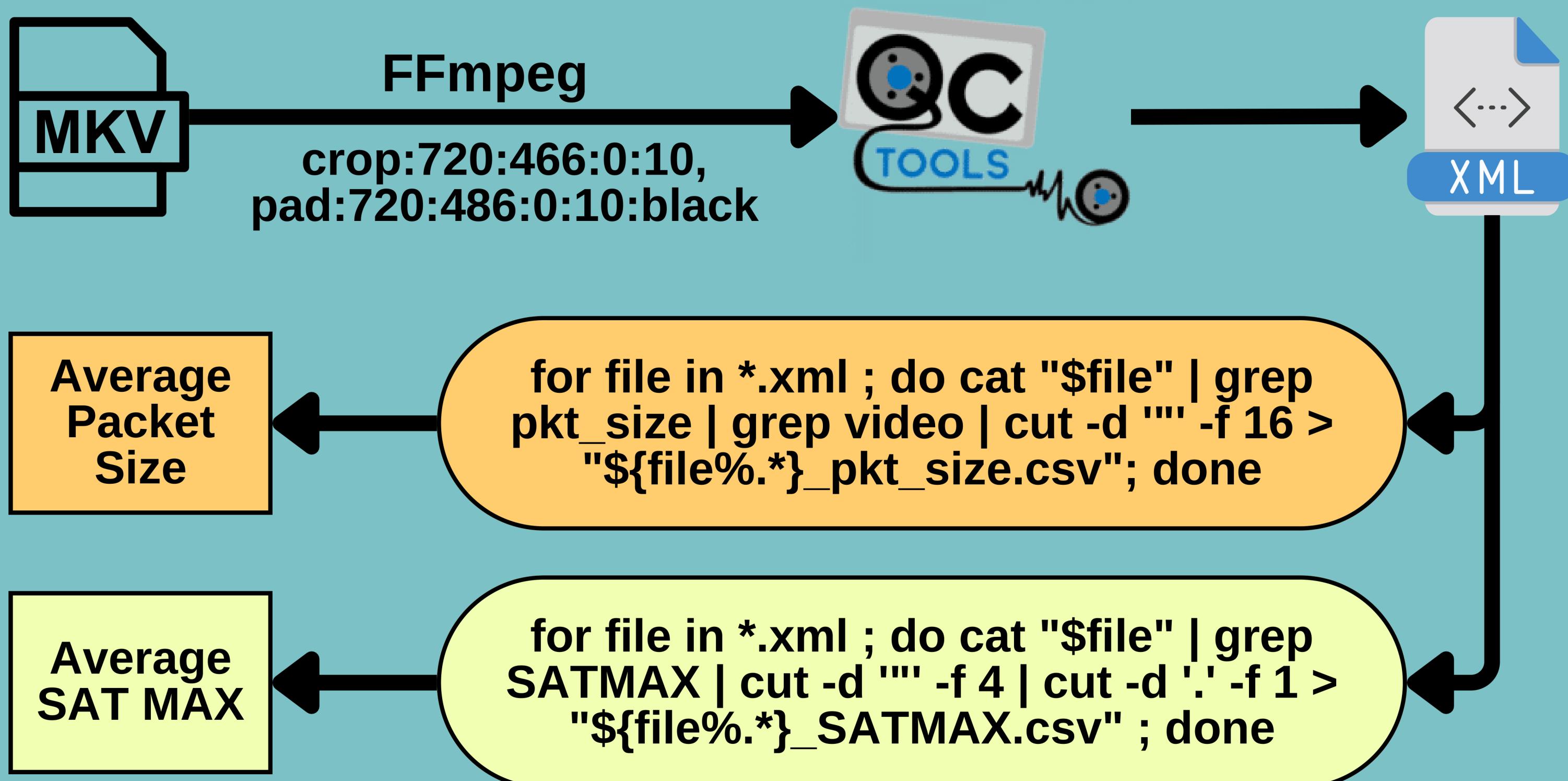
# METHODOLOGY

## VISUAL INSPECTION

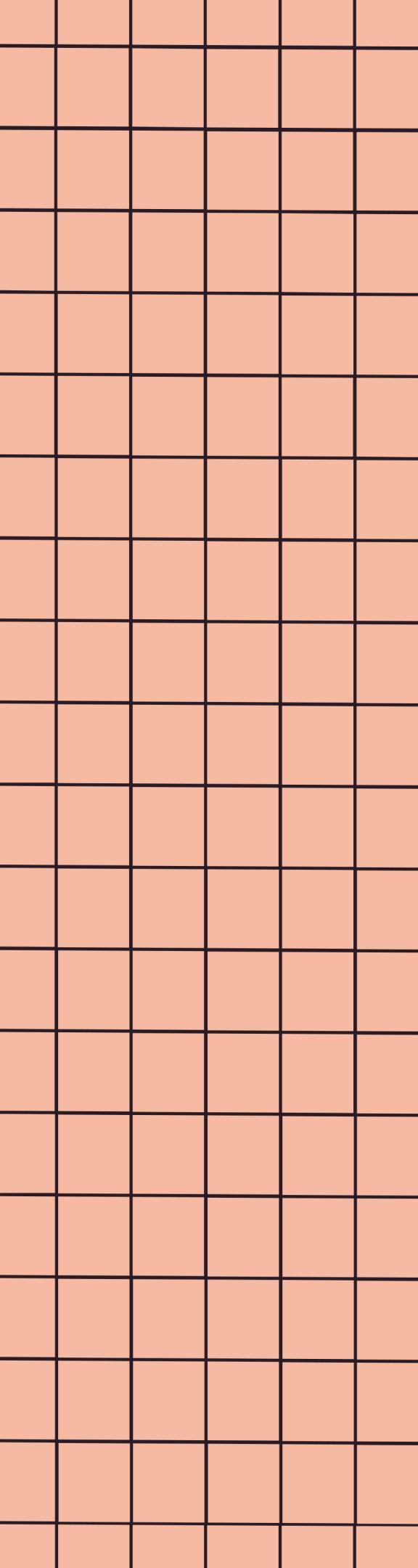
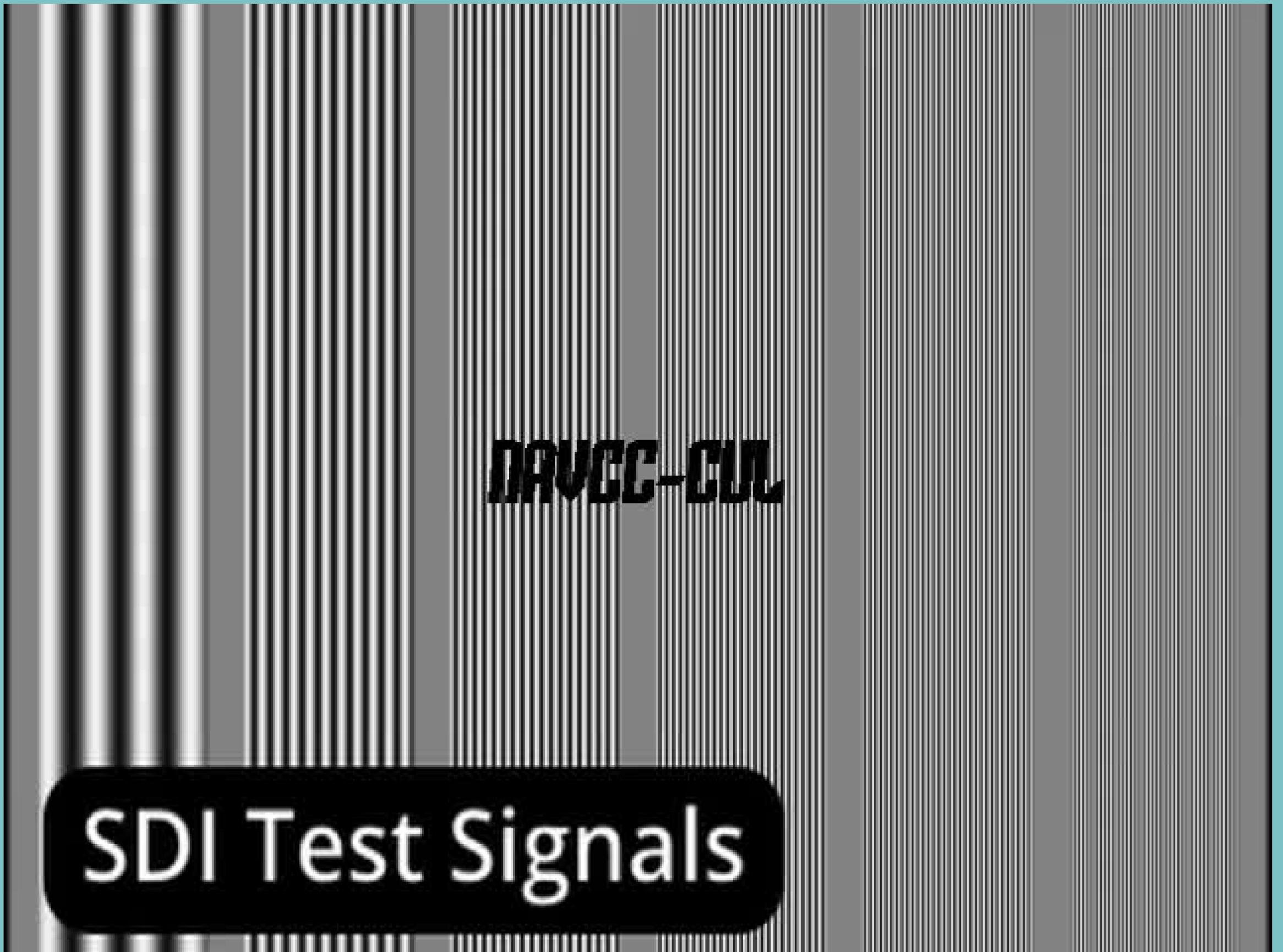


# METHODOLOGY

## DATA INSPECTION



# RESULTS: MULTIBURST



# RESULTS: MULTIBURST



Details lost  
entirely on VHS  
tape

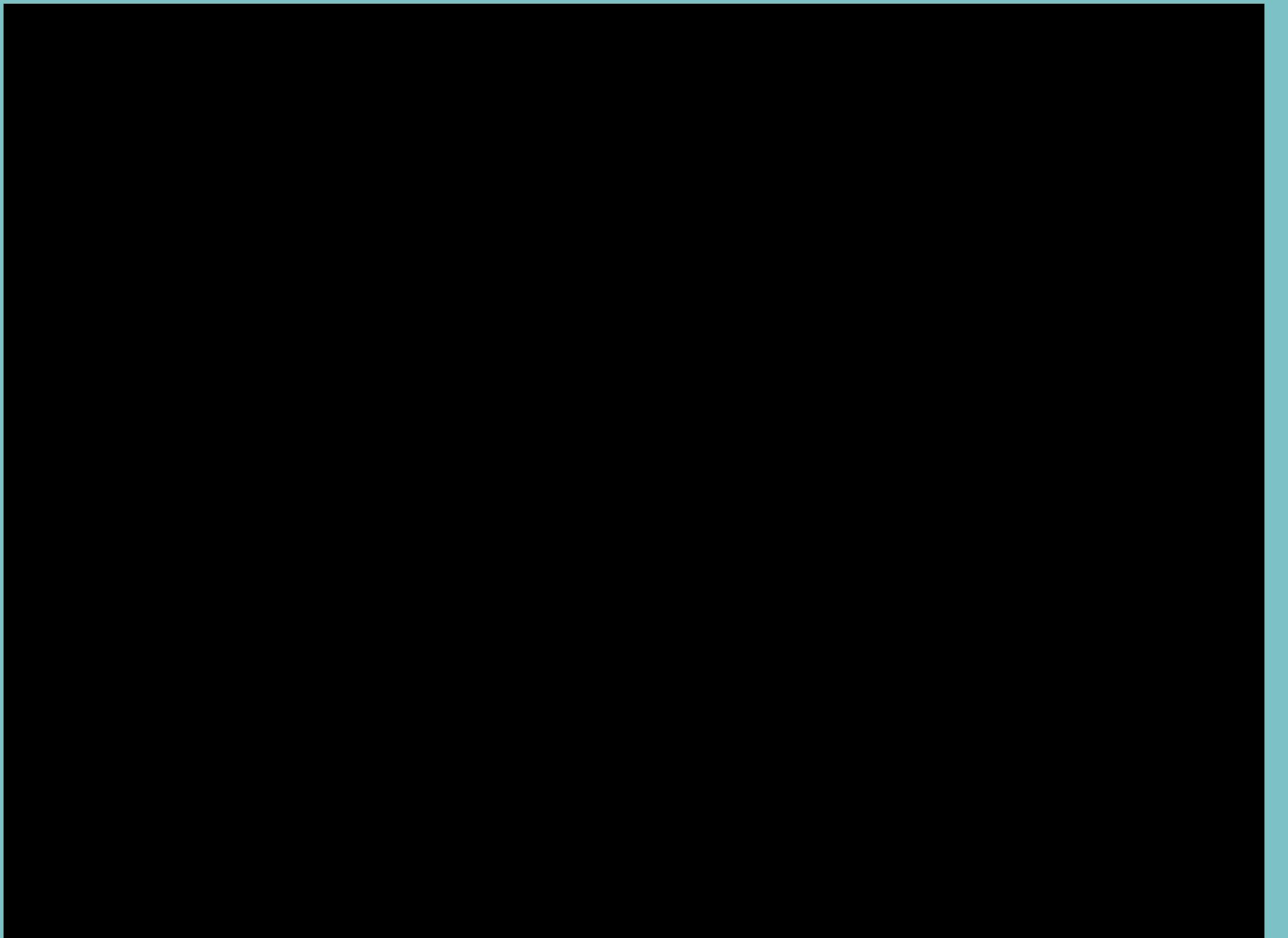
VHS deck able to get  
some extra details  
from an SVHS tape

**WARNING**

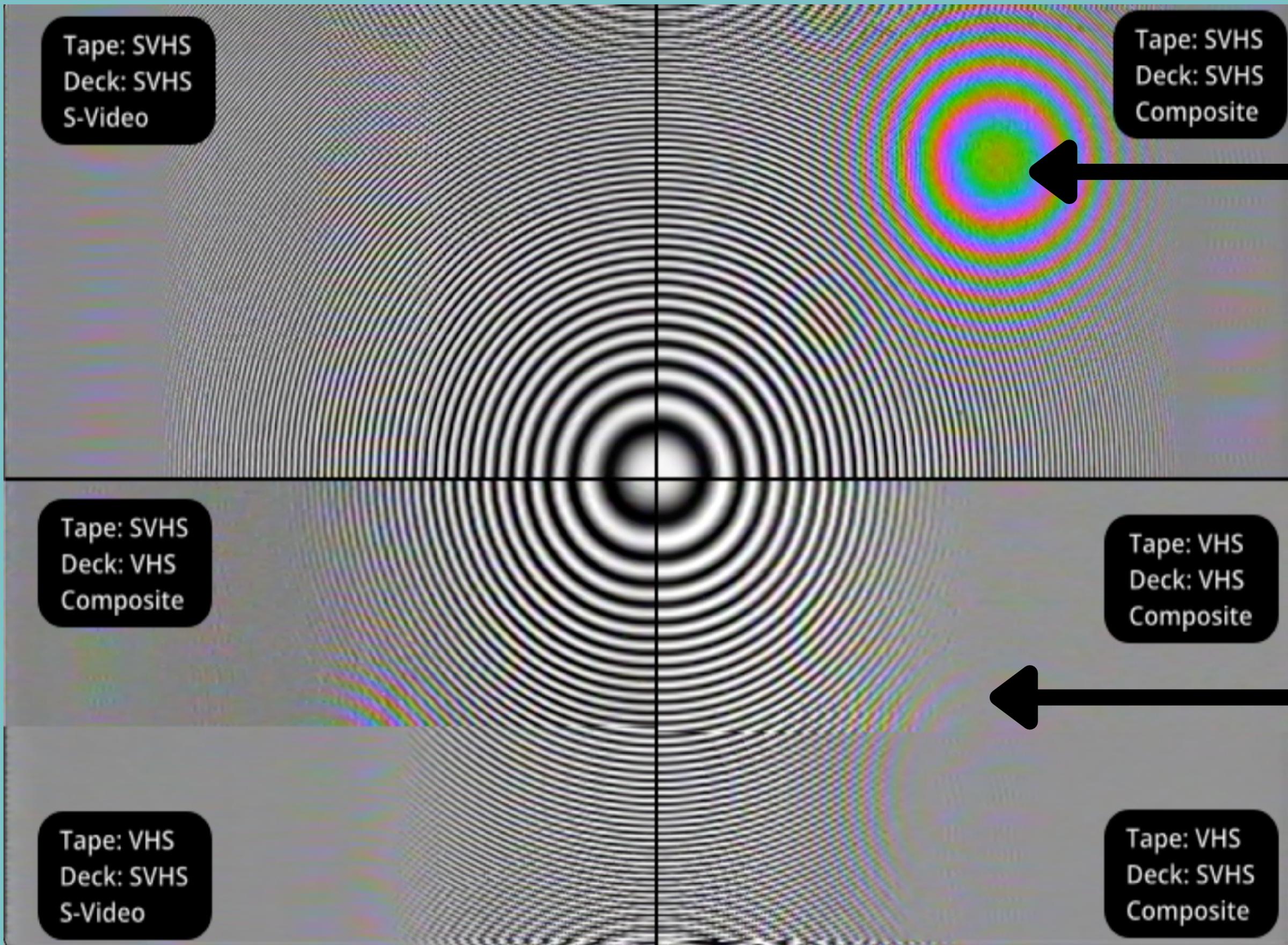
THIS VIDEO HAS BEEN IDENTIFIED  
BY EPILEPSY ACTION TO POTENTIALLY  
TRIGGER SEIZURES FOR PEOPLE WITH  
PHOTORESITIVE EPILEPSY.

VIEWER DISCRETION IS ADVISED.

# RESULTS: ZONE PLATE



# RESULTS: ZONE PLATE

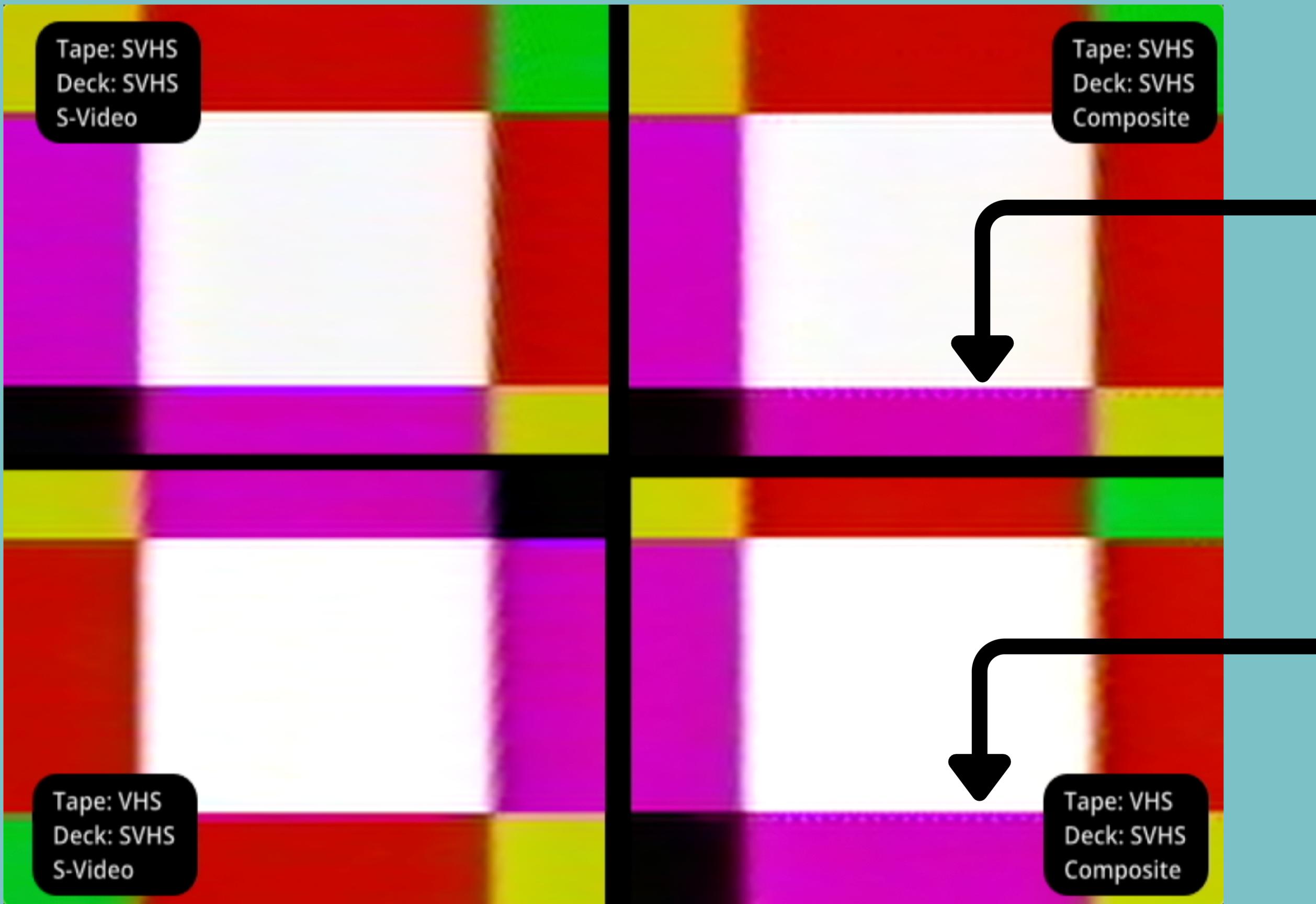


Significant Cross  
color errors when  
using composite

# RESULTS: TARTAN BARS



# RESULTS: TARTAN BARS



Dot-crawl visible  
in composite  
transmission of  
both VHS and  
SVHS

# RESULTS: CONTENT



SVHS: S-Video  
vs  
SVHS: Composite

Cross Color in  
tight details

# RESULTS: CONTENT



SVHS: S-Video  
vs  
VHS: Composite

Lost detail, image  
is blurry

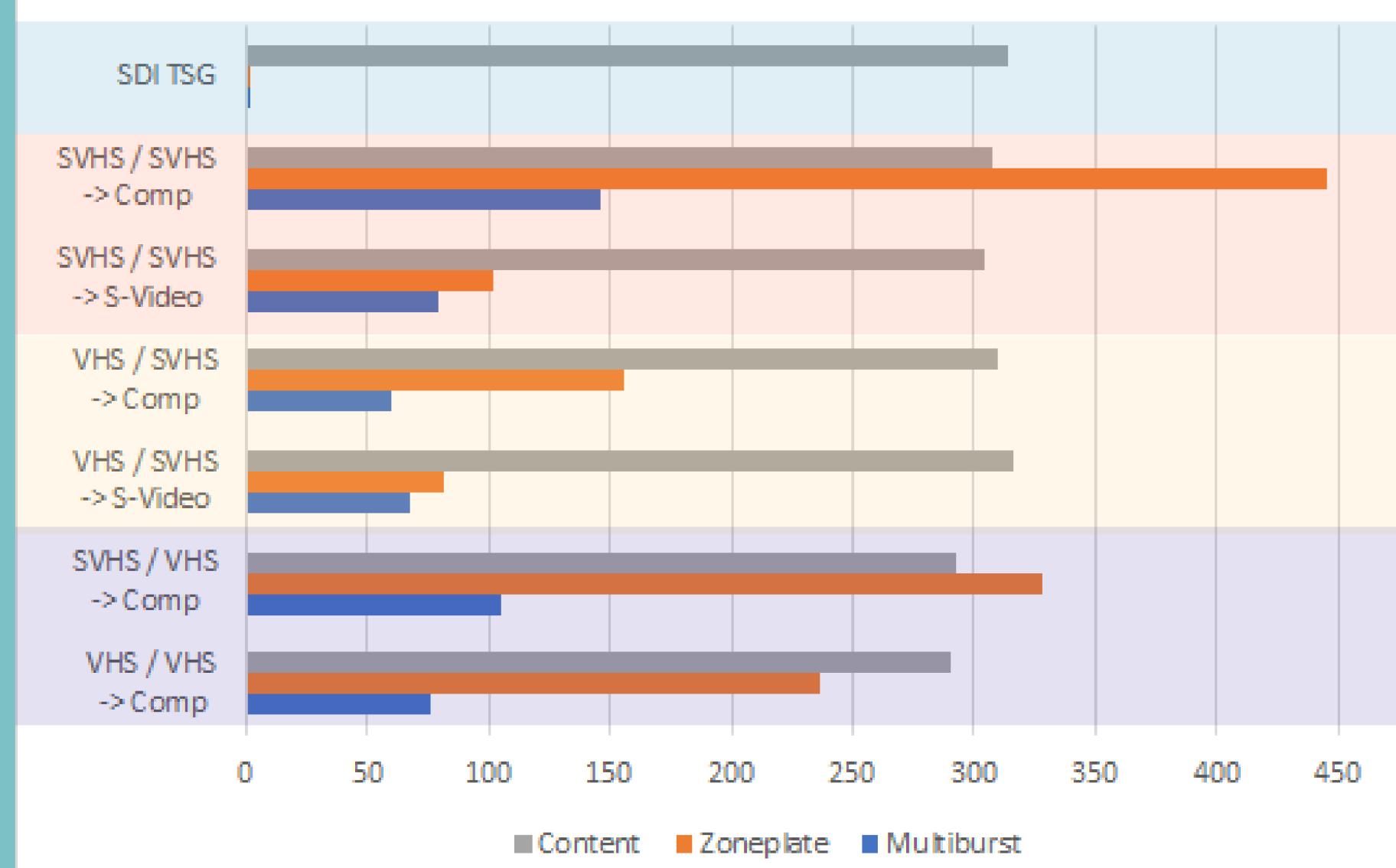
No cross color in  
superimposed  
text

# RESULTS: DATA

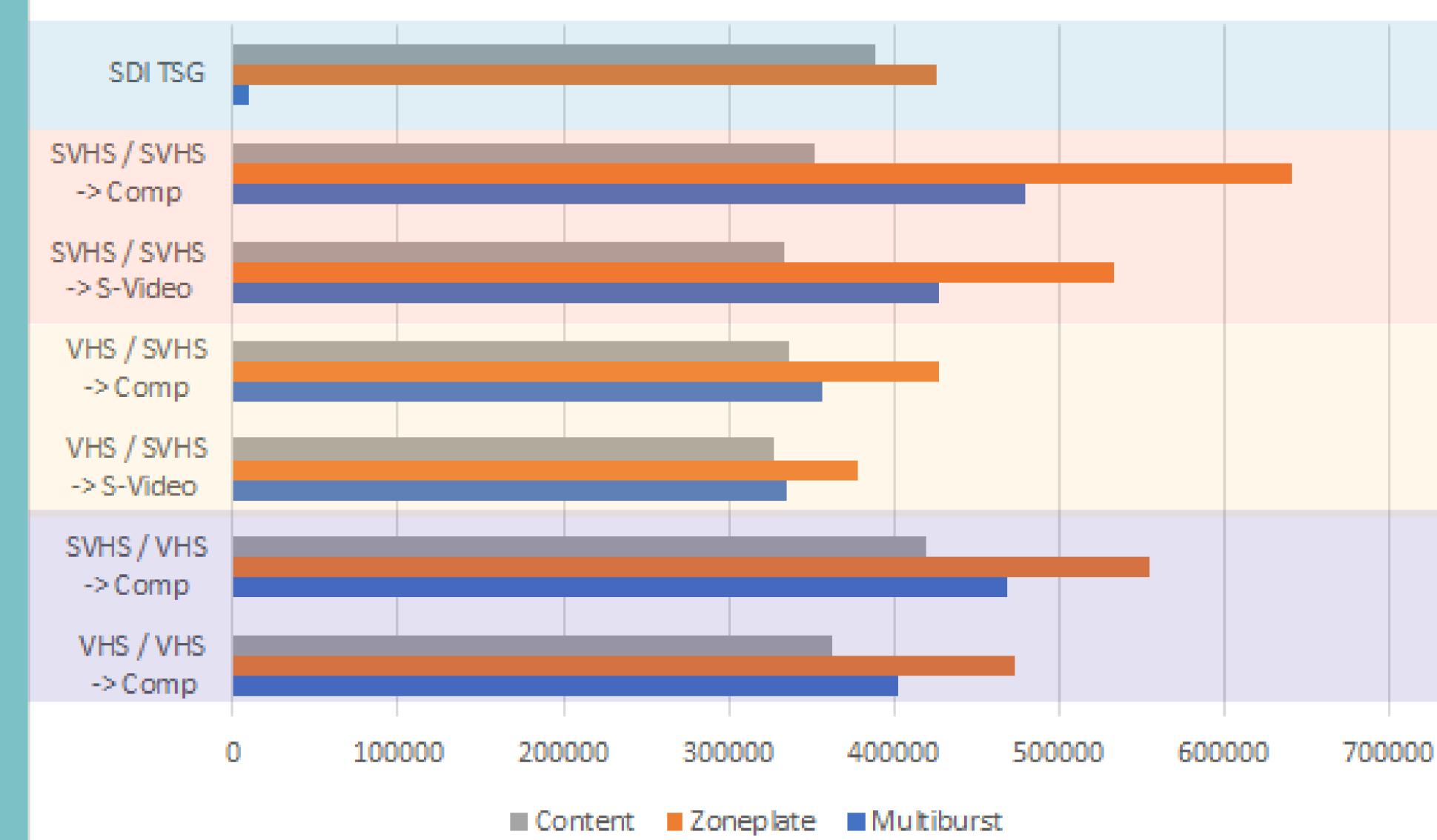
RECORDING	<b>SDI</b>	<b>SVHS</b>	<b>SVHS</b>	<b>VHS</b>	<b>VHS</b>	<b>SVHS</b>	<b>VHS</b>
PLAYBACK	<b>N/A</b>	<b>SHVS</b>	<b>SVHS</b>	<b>SVHS</b>	<b>SVHS</b>	<b>VHS</b>	<b>VHS</b>
TRANSMISSION	<b>SDI</b>	<b>Comp</b>	<b>S-Video</b>	<b>Comp</b>	<b>S-Video</b>	<b>Comp</b>	<b>Comp</b>
<b>MULTIBURST SAT MAX</b>	2	146	80	60	68	105	76.7
<b>ZONEPLATE SAT MAX</b>	2	445	102	156	82	328	237
<b>CONTENT SAT MAX</b>	314	308	304	310	316	293	290
<b>MB PACKET SIZE</b>	9969	480234	427413	356887	335185	468598	403388
<b>ZP PACKET SIZE</b>	426591	641312	533859	428285	378757	555583	473971
<b>CONTENT PKT SIZE</b>	392853	352949	334004	337335	328166	419224	363676

# RESULTS: DATA

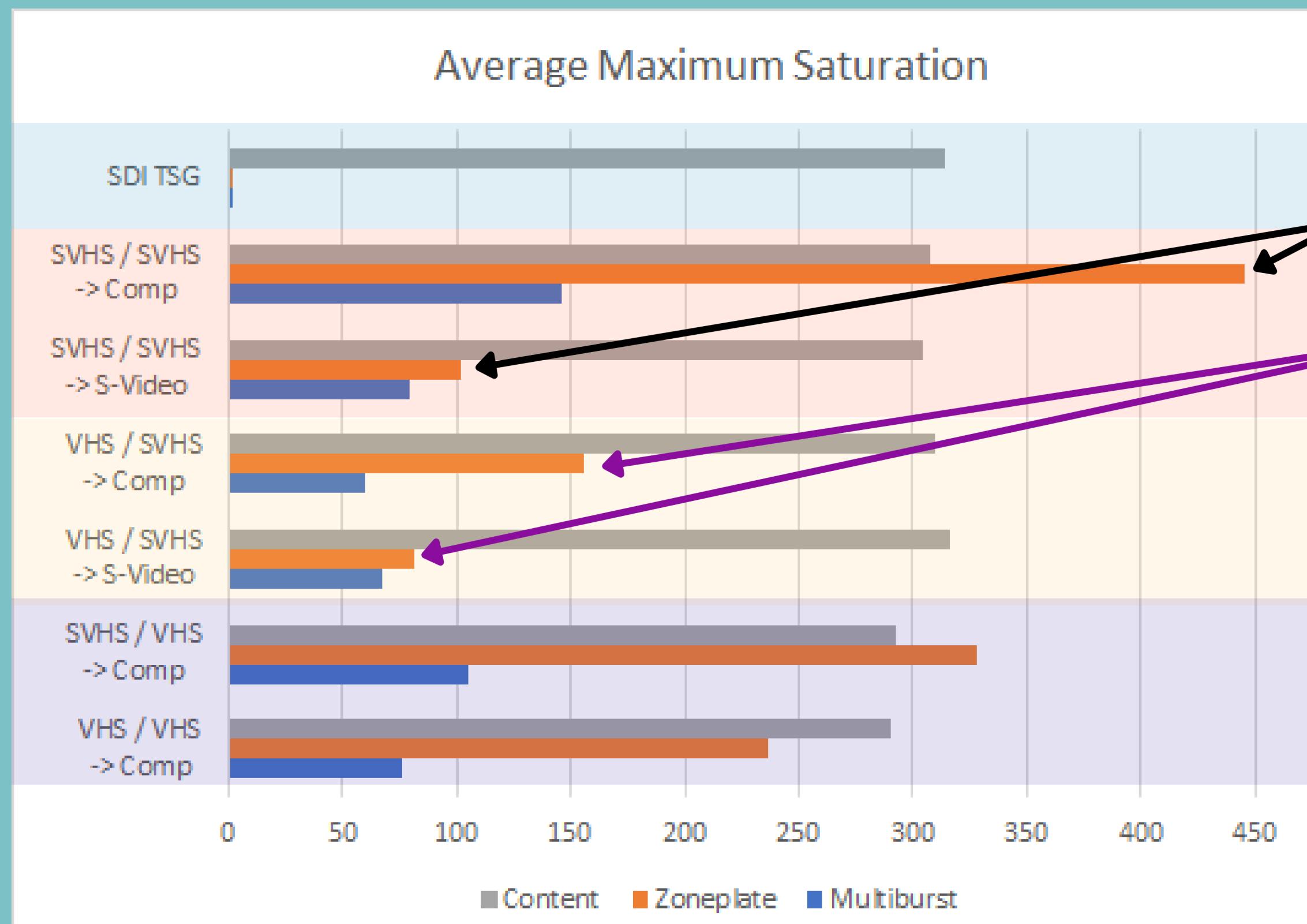
Average Maximum Saturation



Average Packet Size

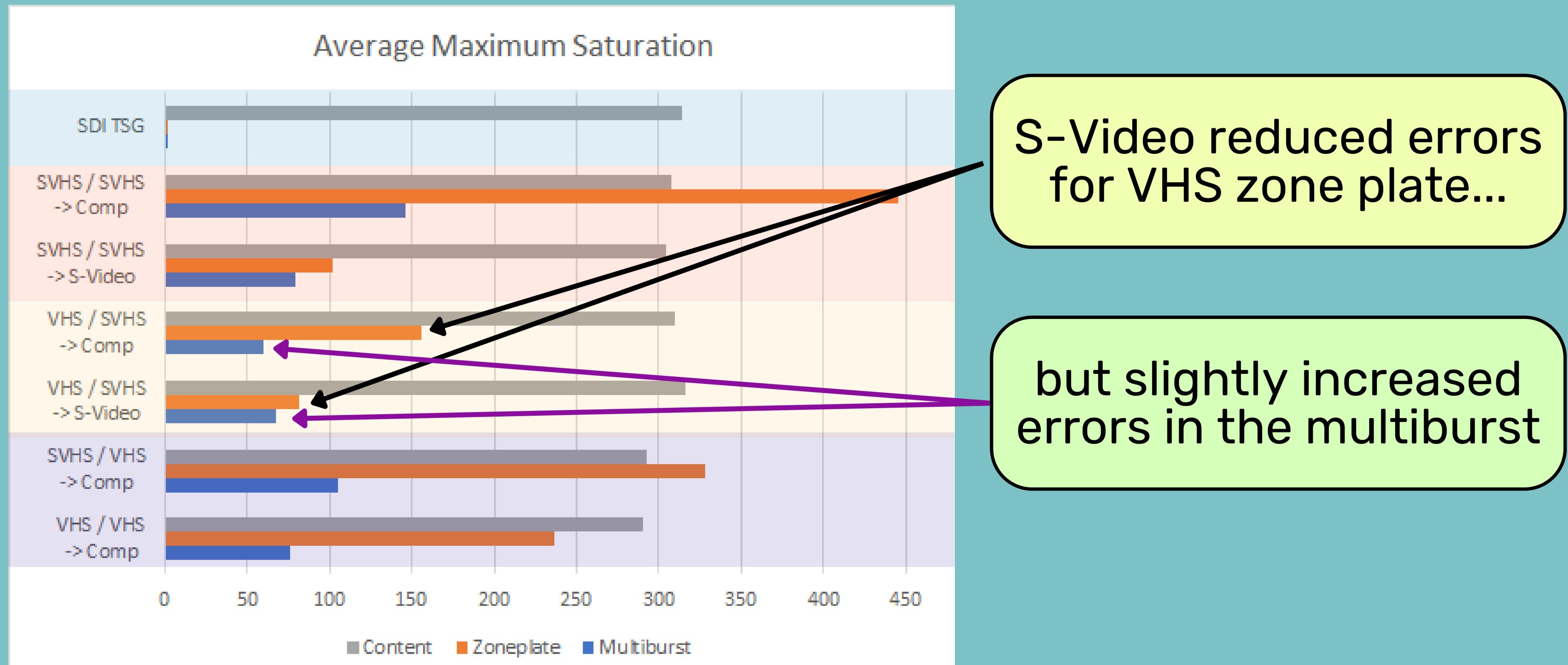


# RESULTS: DATA

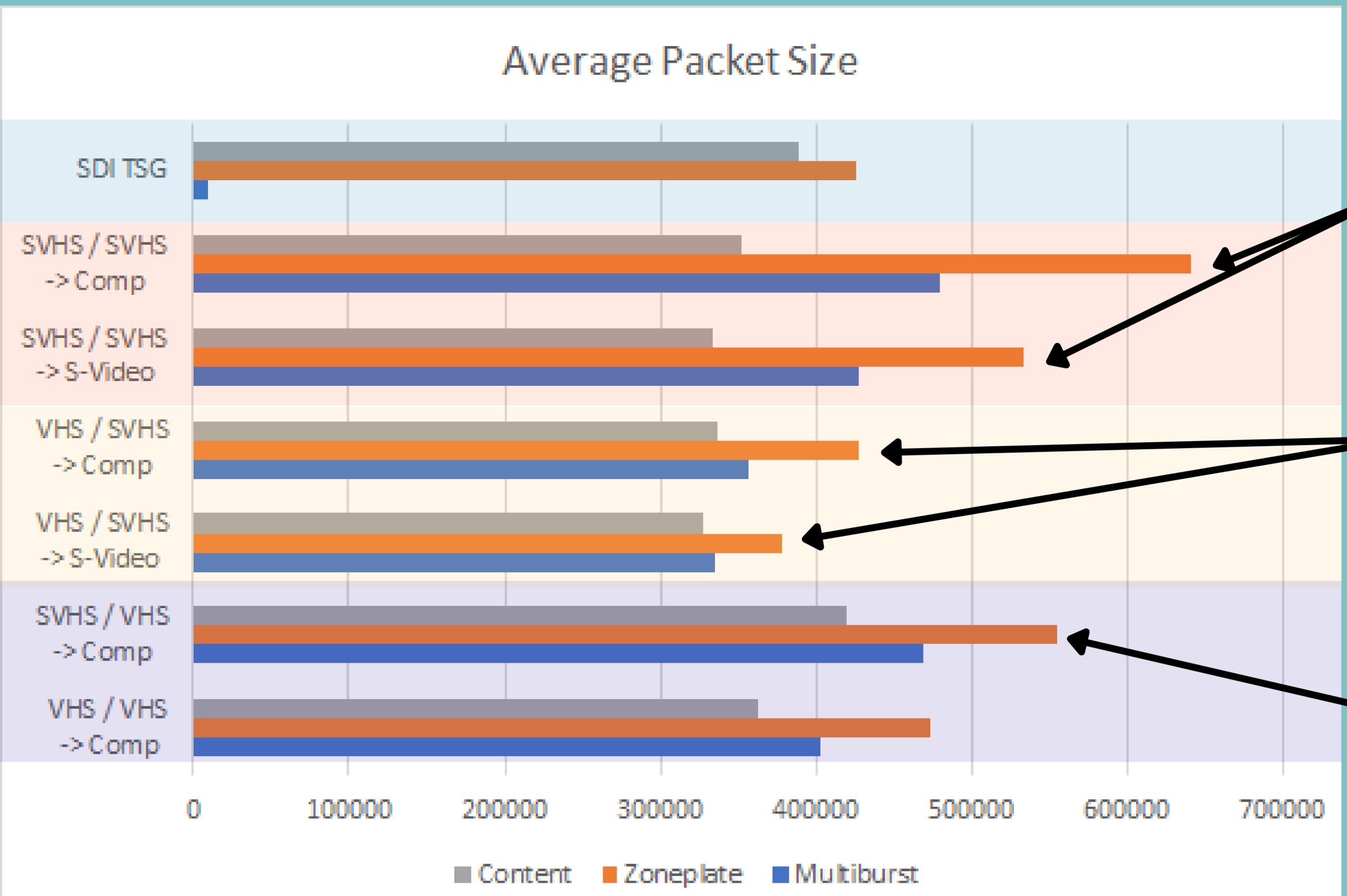


S-Video significantly  
**reduces cross-color**  
errors for SVHS tapes

# RESULTS: DATA



# RESULTS: DATA



SVHS recording offers significantly more detail...

over VHS recordings

Even if played back on an VHS deck

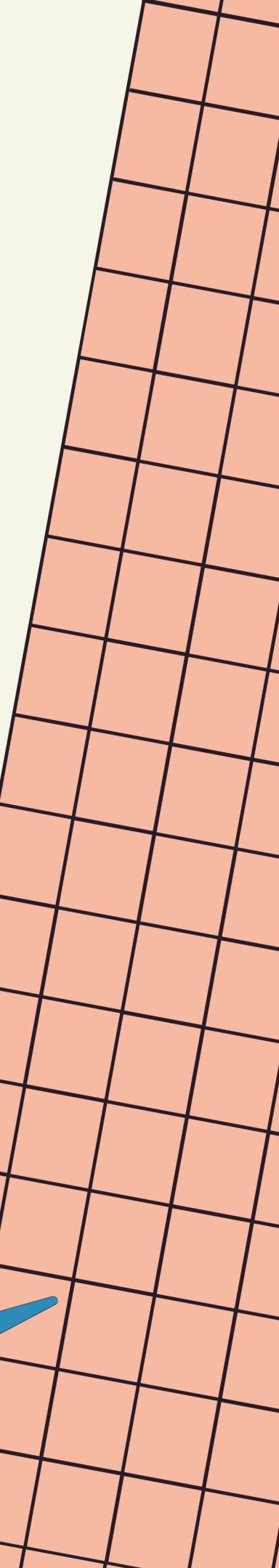
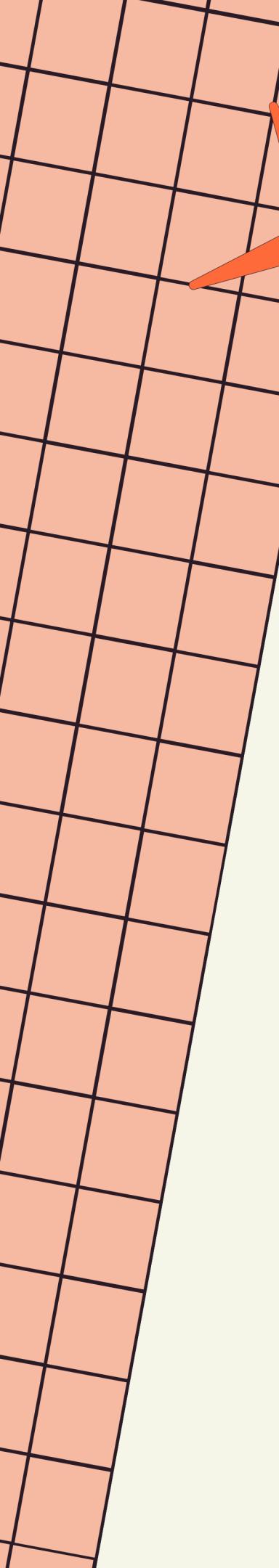
# ANALYSIS

S-VHS offers **significantly more detail** over VHS, even if the playback deck is VHS

S-Video **reduces dot crawl** errors for SVHS and VHS tapes

S-Video significantly **reduces cross-color** errors for SVHS tapes

S-Video may increase cross color errors for VHS tapes depending on the complexity and detail of the recorded content



**PART 3**

# **APPLYING IN A PRESERVATION CONTEXT**

# **RECOMMENDATIONS**

**Use S-VHS decks to transfer both S-VHS  
and VHS Tapes**

**Use S-Video to transfer S-VHS tapes**

**I cannot make a recommendation for whether  
to use S-Video or Composite VHS tapes**

# CHALLENGES

Equipment common in preservation labs does  
**not** support S-Video

Blackmagic UltraStudio

DPS 575

Equipment that does support S-Video is expensive.  
How do we prioritize our budgets?

AJA FS2

BrightEyes75

Adding more processing in signal chains adds  
more opportunities for error

# NEXT STEPS

Rerun the experiment focusing on different types of content

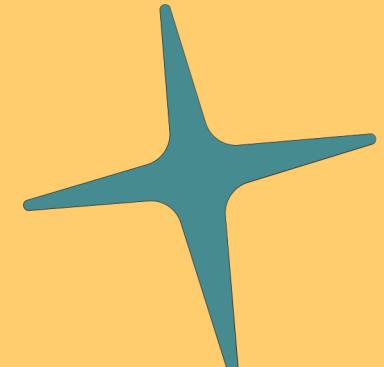
Find other QCTools parameters to use as data points

Experiment with U-matic Dub output

Further experimentation with 3D comb filters and tunable notch/bandpass filters

# THANK YOU!

Q&A



<https://www.causewaysecuritysolutions.com/resolution-calculated-tv-lines.html#:~:text=Further%20reading%20is%20set%20at%206%20MHz.%20More%20items>

<https://www.causewaysecuritysolutions.com/resolution-calculated-tv-lines.html#:~:text=Further%20reading%20is%20set%20at%206%20MHz.%20More%20items>

<https://www.causewaysecuritysolutions.com/resolution-calculated-tv-lines.html#:~:text=Further%20reading%20is%20set%20at%206%20MHz.%20More%20items>

<https://www.causewaysecuritysolutions.com/resolution-calculated-tv-lines.html#:~:text=Further%20reading%20is%20set%20at%206%20MHz.%20More%20items>

<https://www.renesas.com/us/en/document/apn/an9644-composite-video-separation-techniques>

<https://web.archive.org/web/20110926221502/http://lipas.uwas.edu/~f76998/video/conversion>

<https://adamwilt.com/DV-FAQ-tech.html>

# FURTHER READING

[https://www.renesas.com/us/en/document/apn/an9644-  
composite-video-separation-techniques](https://www.renesas.com/us/en/document/apn/an9644-composite-video-separation-techniques)

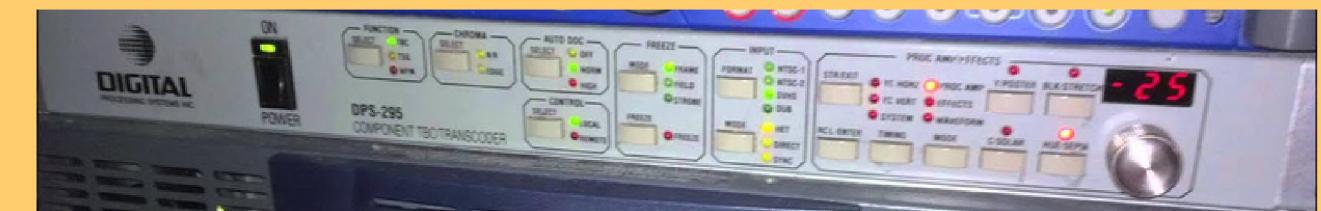
# HOW ABOUT U-MATIC?

The U-matic **Dub** output supports color separation when used with certain peripherals

Dub  
Optimizer



DPS-295



**U-matic SP** offers improved image quality,  
but require SP capable decks