

# Taking Control of MPEG Transport Streams

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Chief Design Engineer

**ENSEMBLE**

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D E S I G N S

Great

We had 50<sup>^</sup> years of  
Analog NTSC.

But now ...

Toto, this doesn't look  
like Kansas anymore.

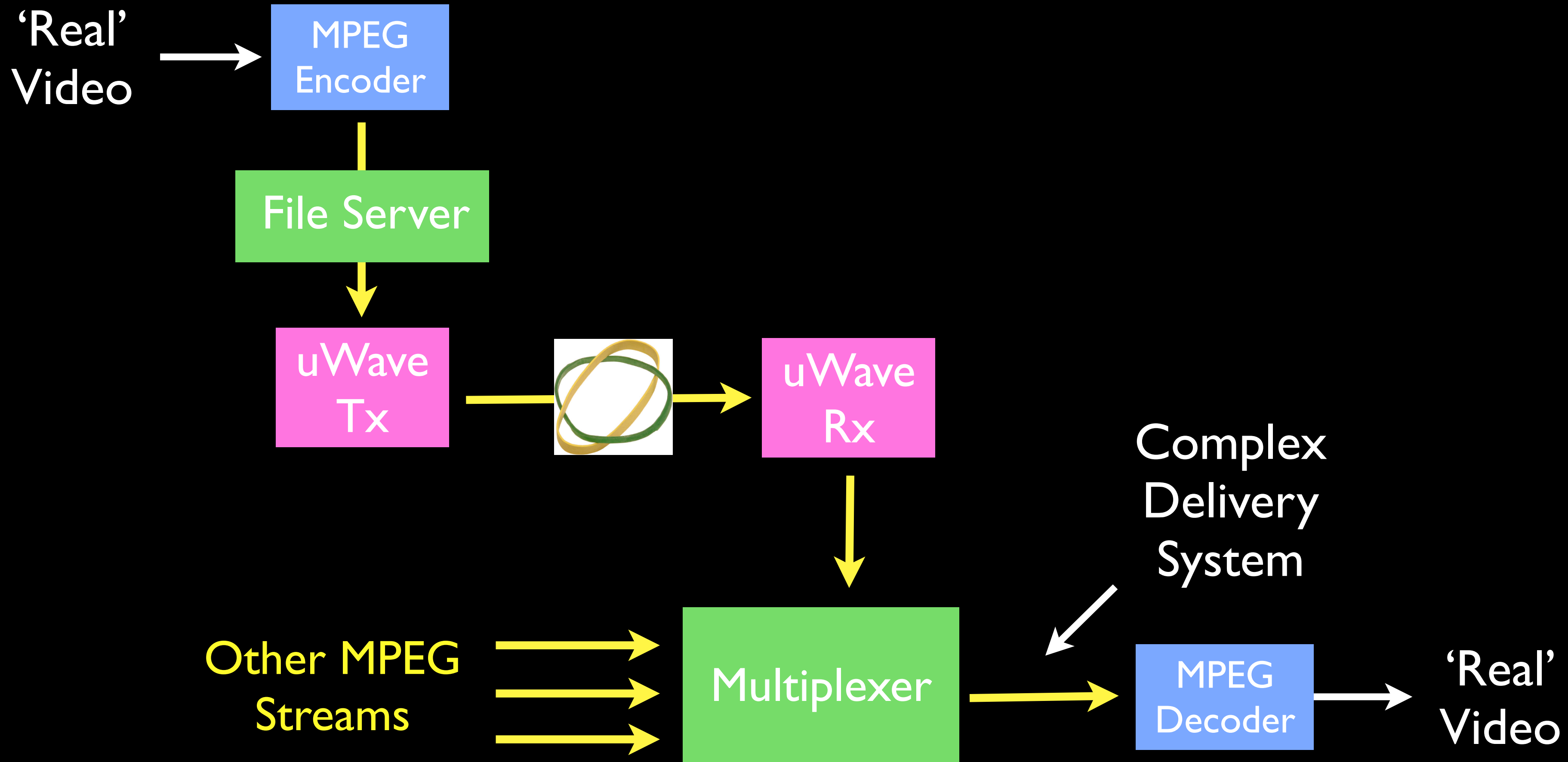
# Future Shock

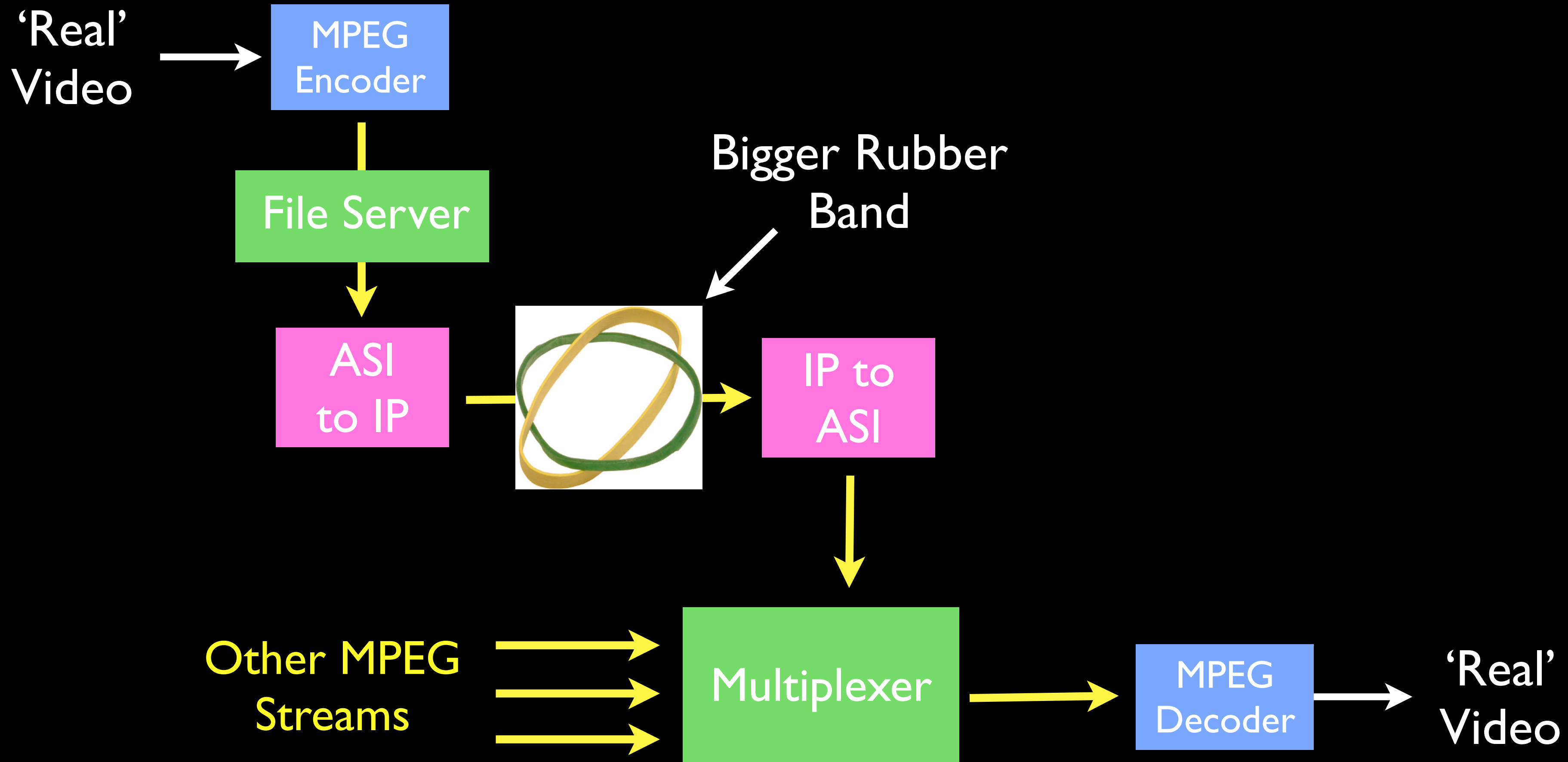
by Alvin Toffler

Published 1970

“Too much change in too short a period of time”







DVB-ASI



Bit Rate : Total of Data & Null Packets

MPEG-II SD : 5 Mb/s Data

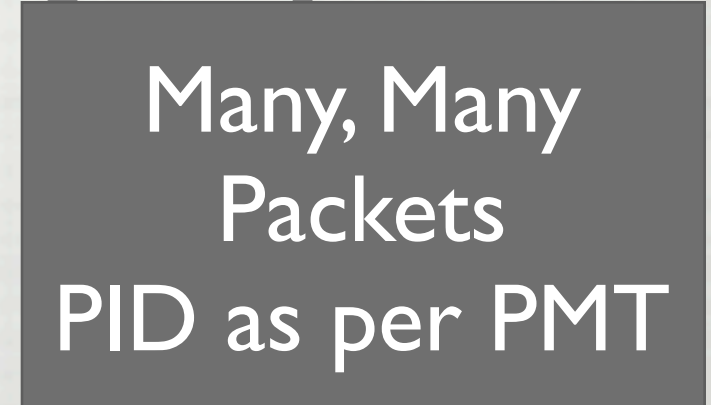
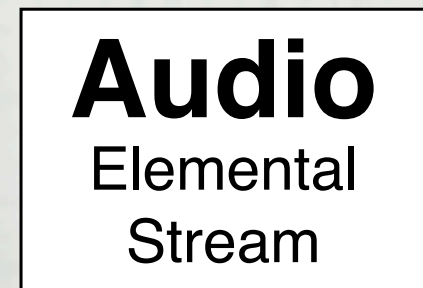
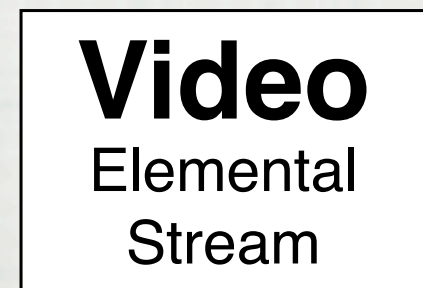
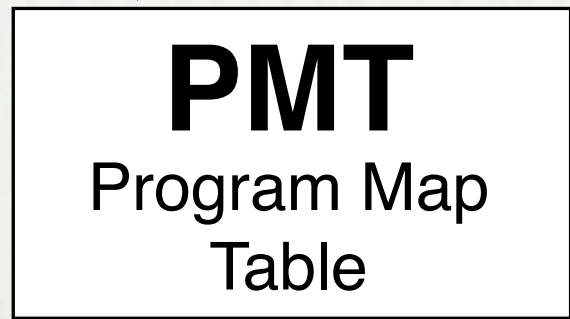
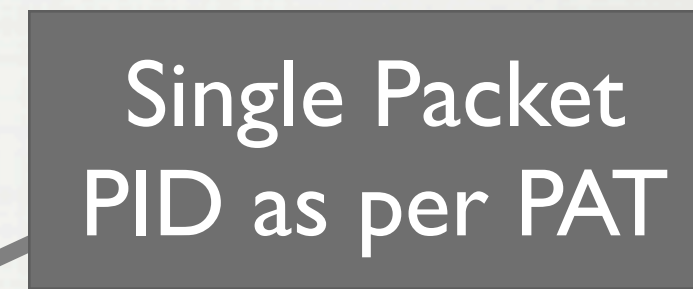
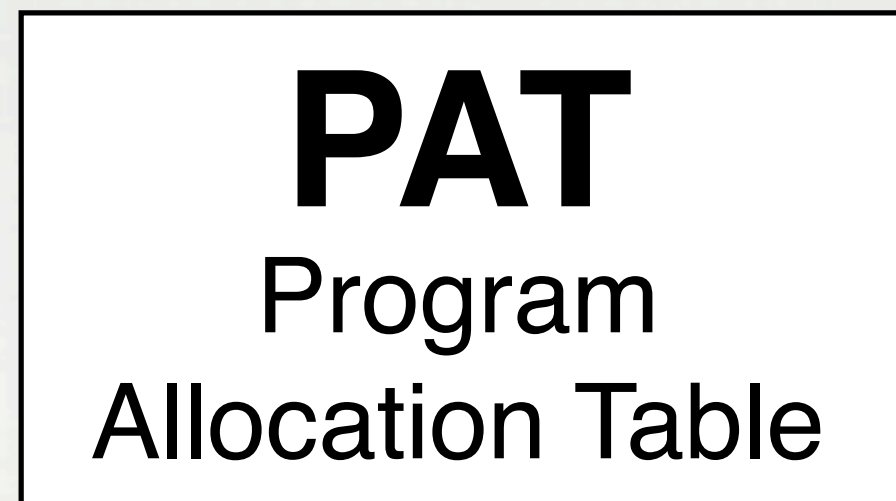
HD : 13 Mb/s Data

Clock Rate : 270 Mb/s

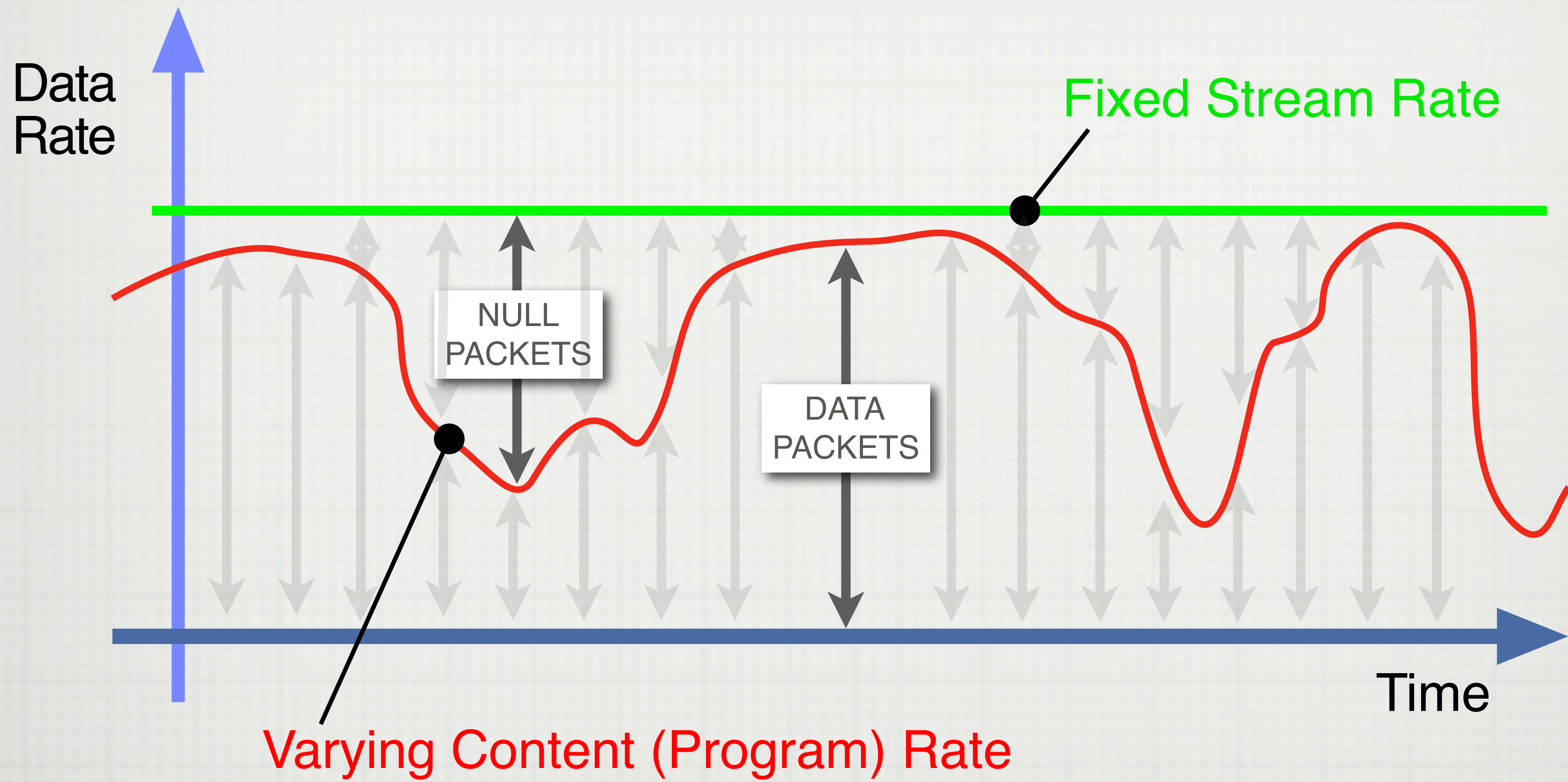
Comma Characters = Clock Rate - Bit Rate



# Transport Stream Structure







# Evolution is Messy

Even in the digital age, we still have interlaced formats.

# Challenges

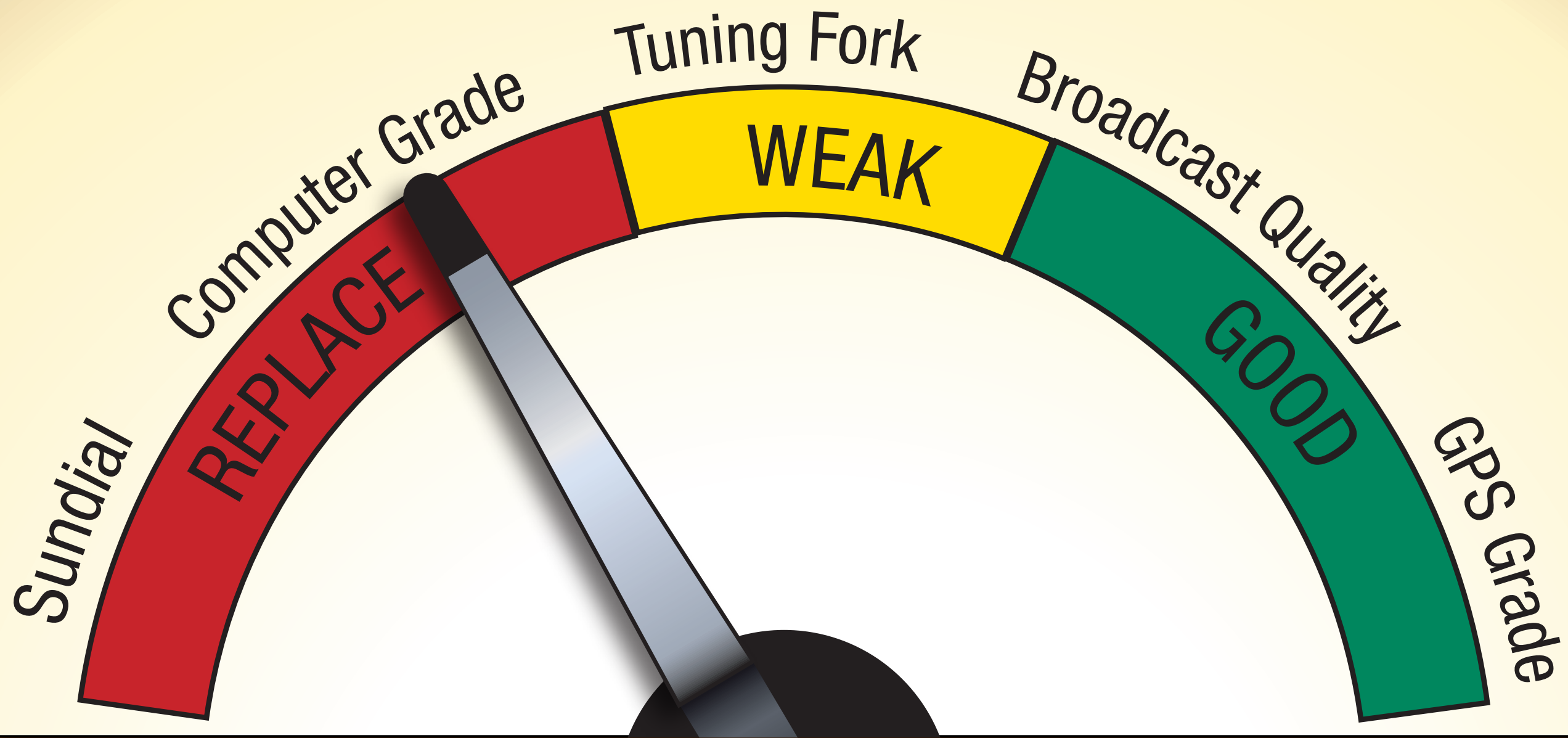
- Clock Quality
- Data Integrity and the 'Cliff'
- Switching and Latency

# Transport Stream Clock Defects

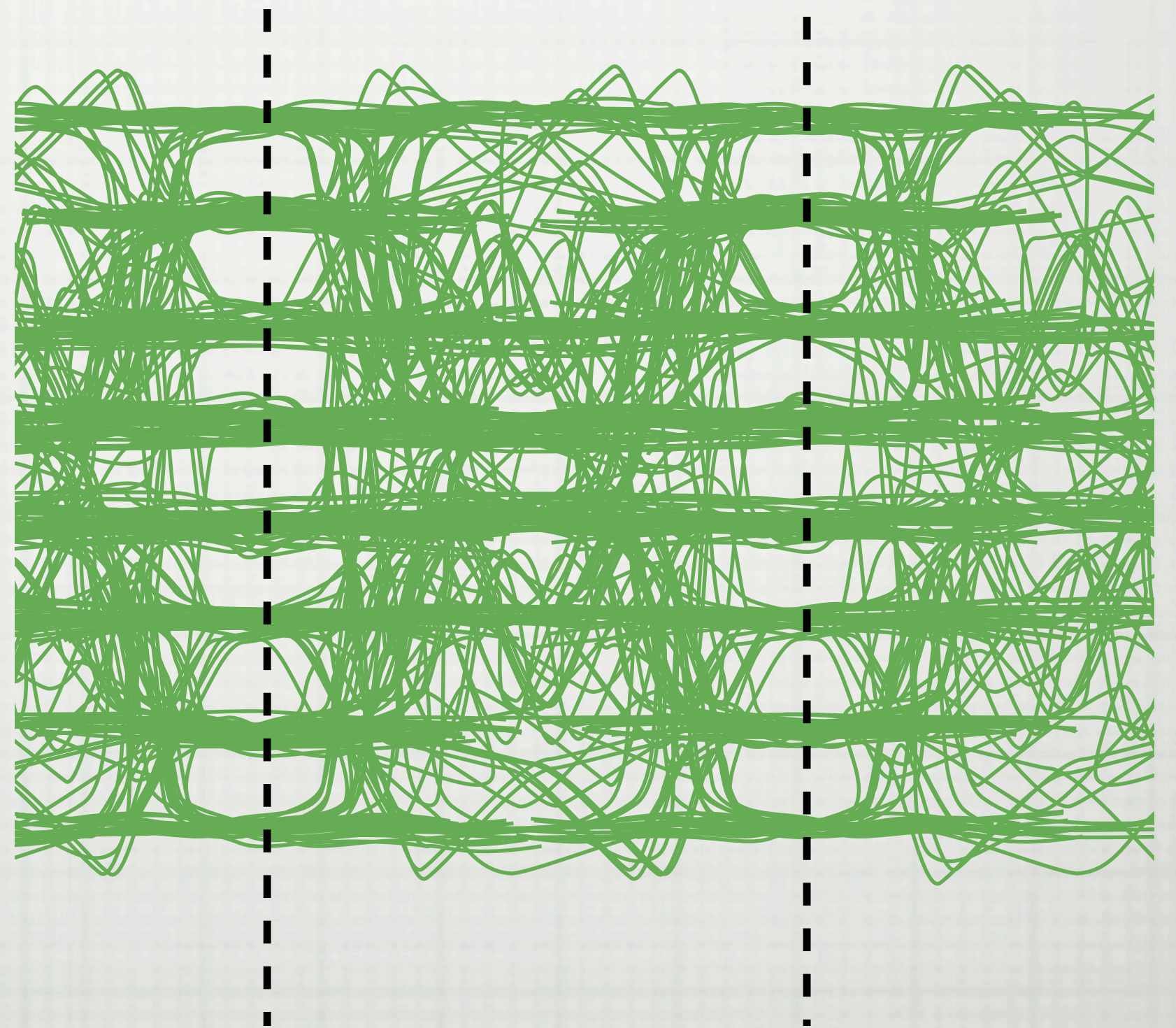
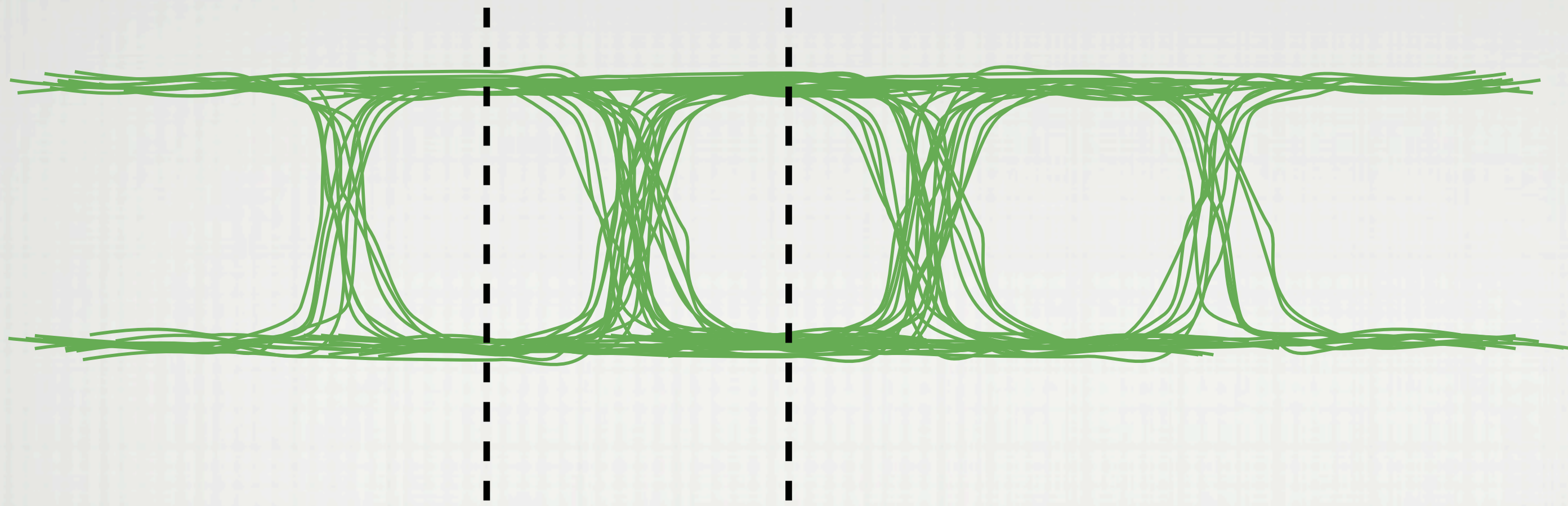
- Off Frequency - wrong bit rate
- Jitter
- Drift

# CLOCK-O-METER™

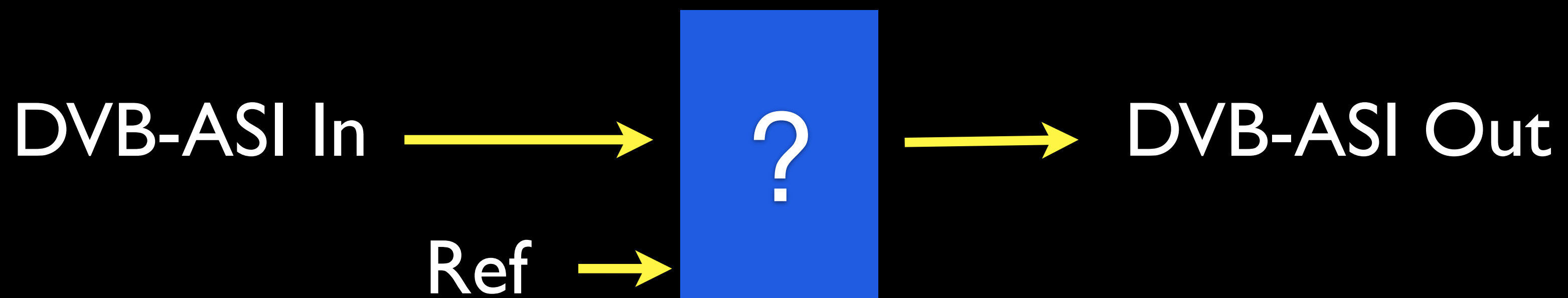
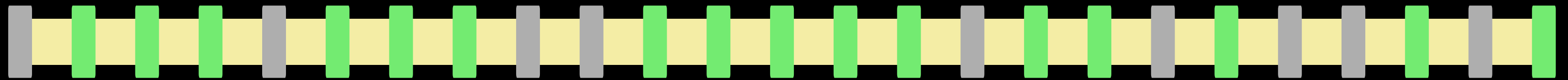
QUALITY FACTOR







# We need a Time Base Corrector for a Transport Stream

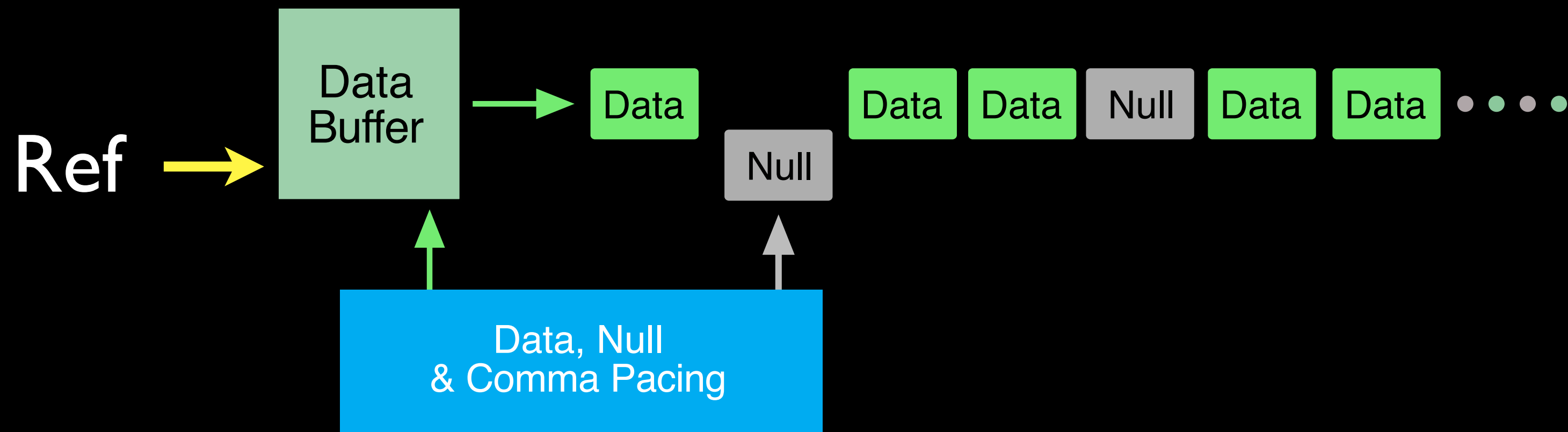


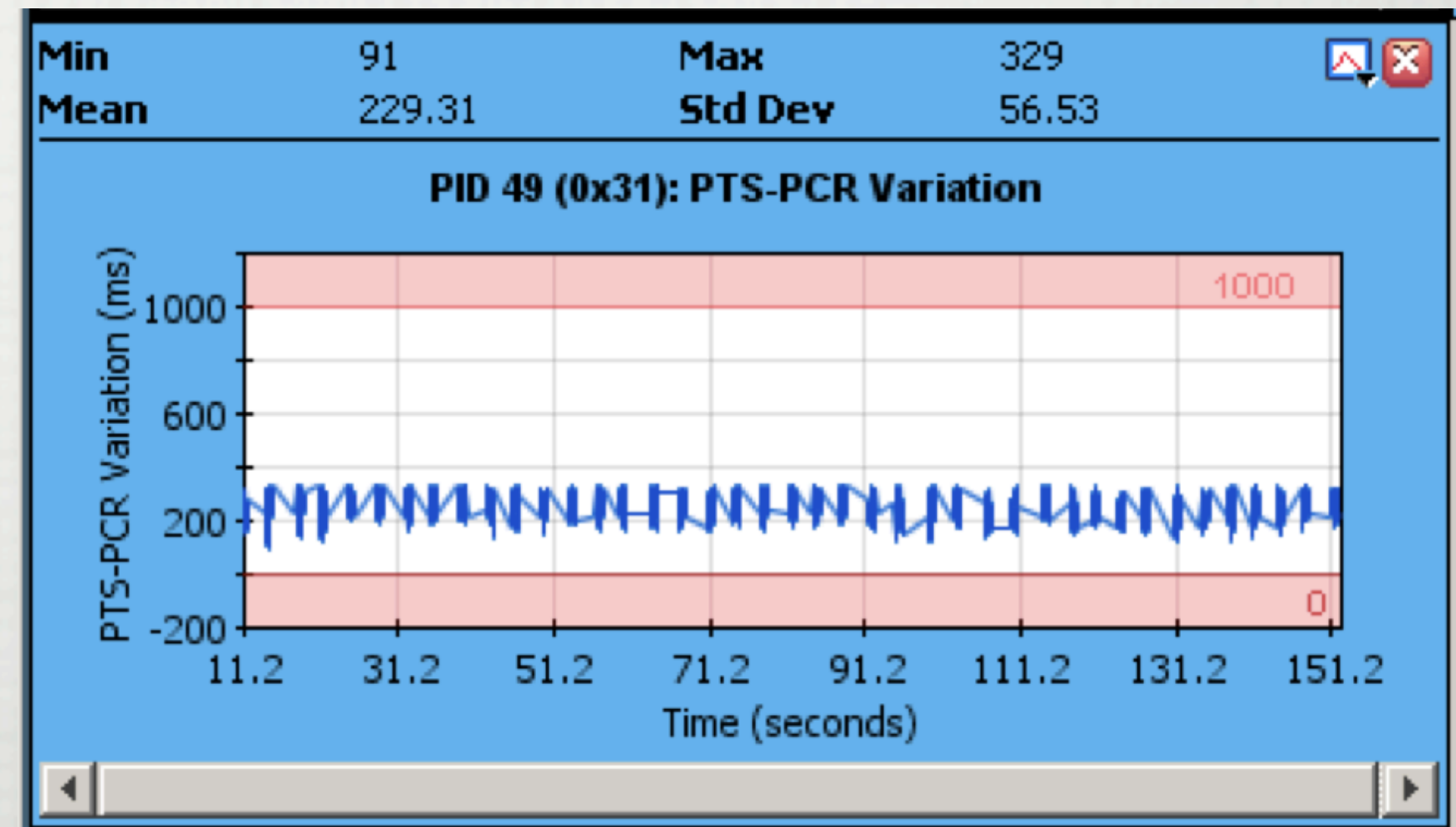
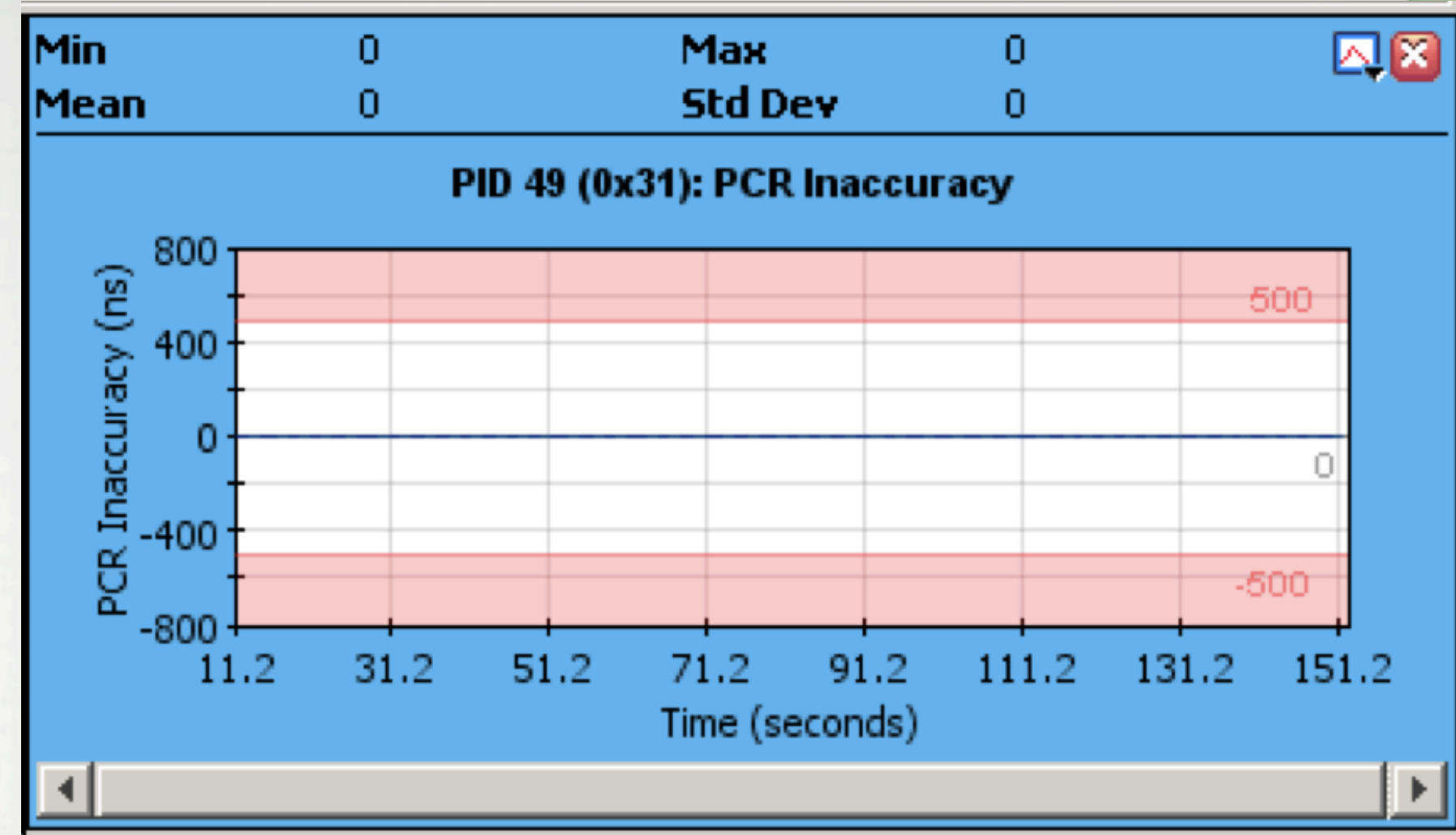
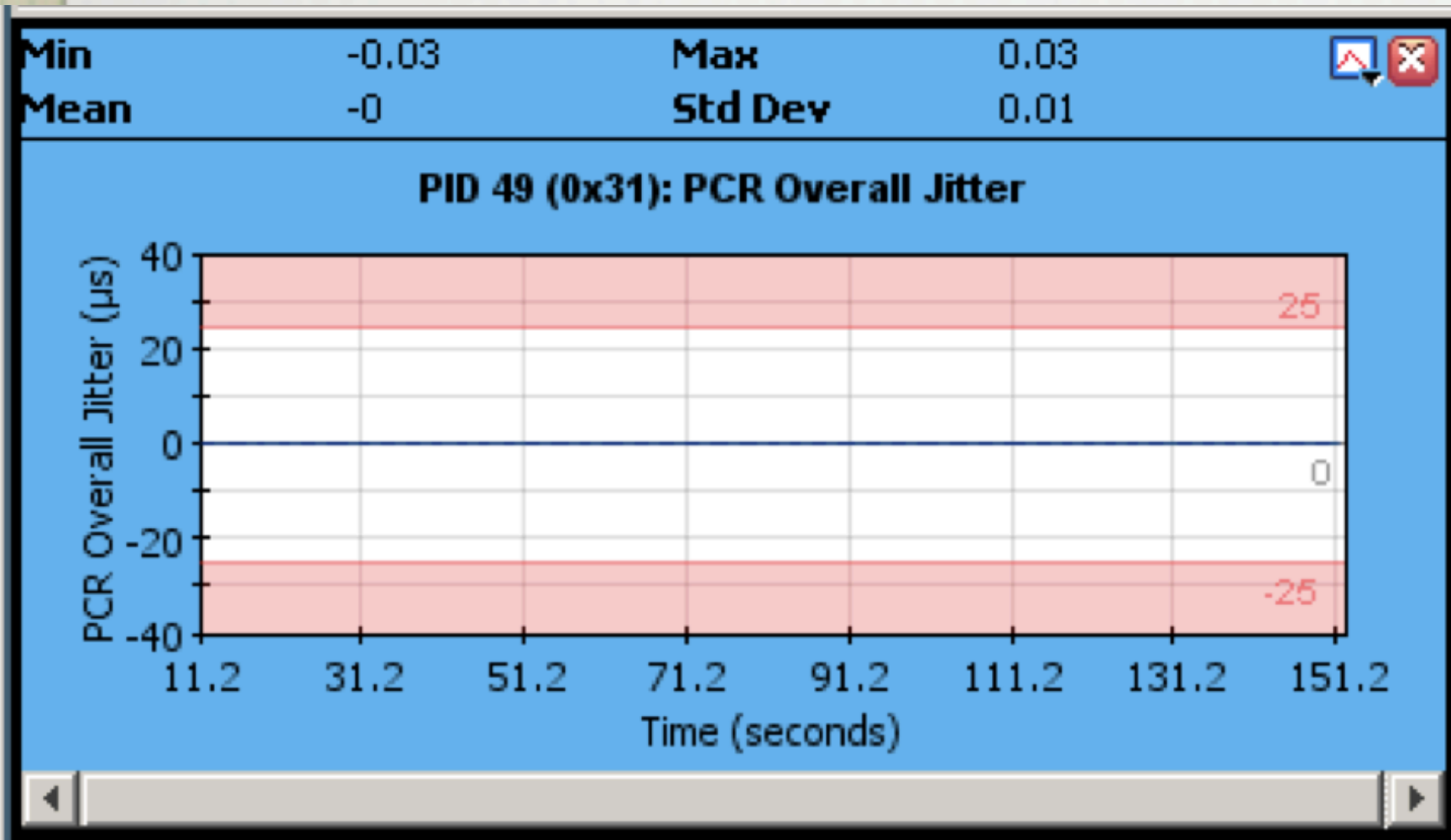


# Incoming Data

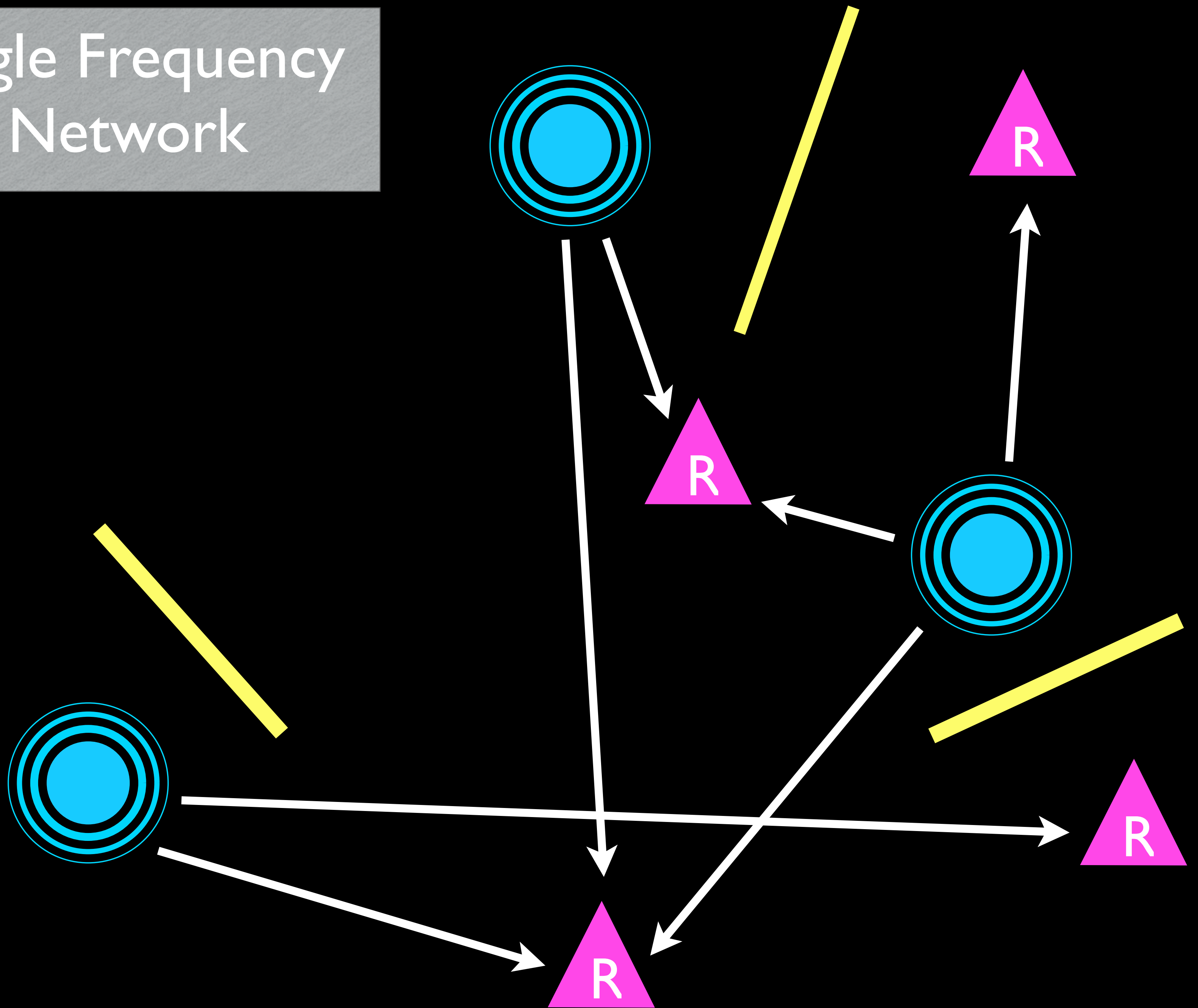


# Outgoing Data





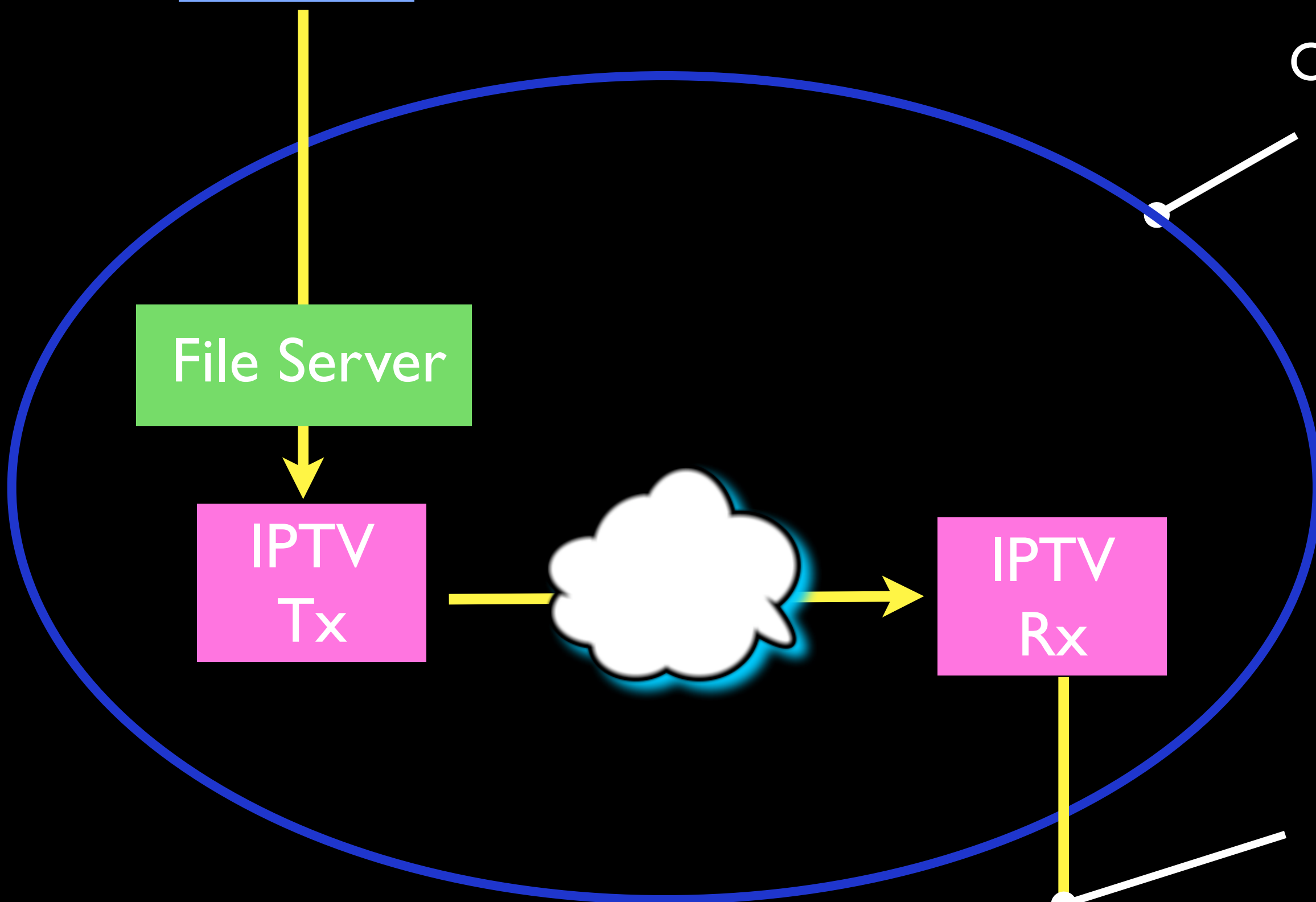
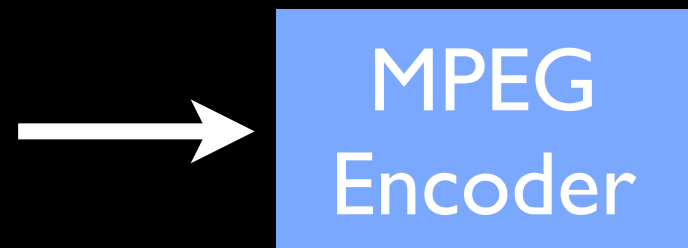
# Single Frequency Network



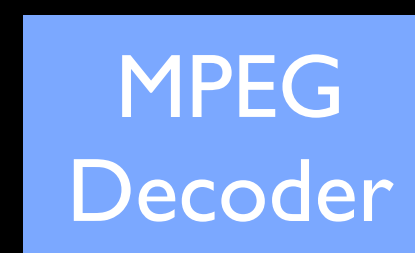
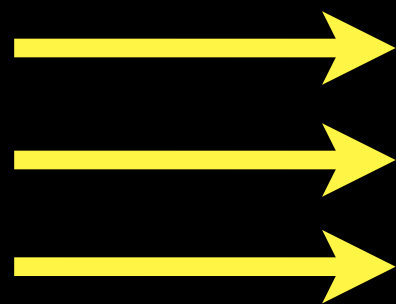
# Data Integrity

- Complex Content and Data
- Presence of Proprietary Data
- Complex path / FEC will hide problems

'Real' Video



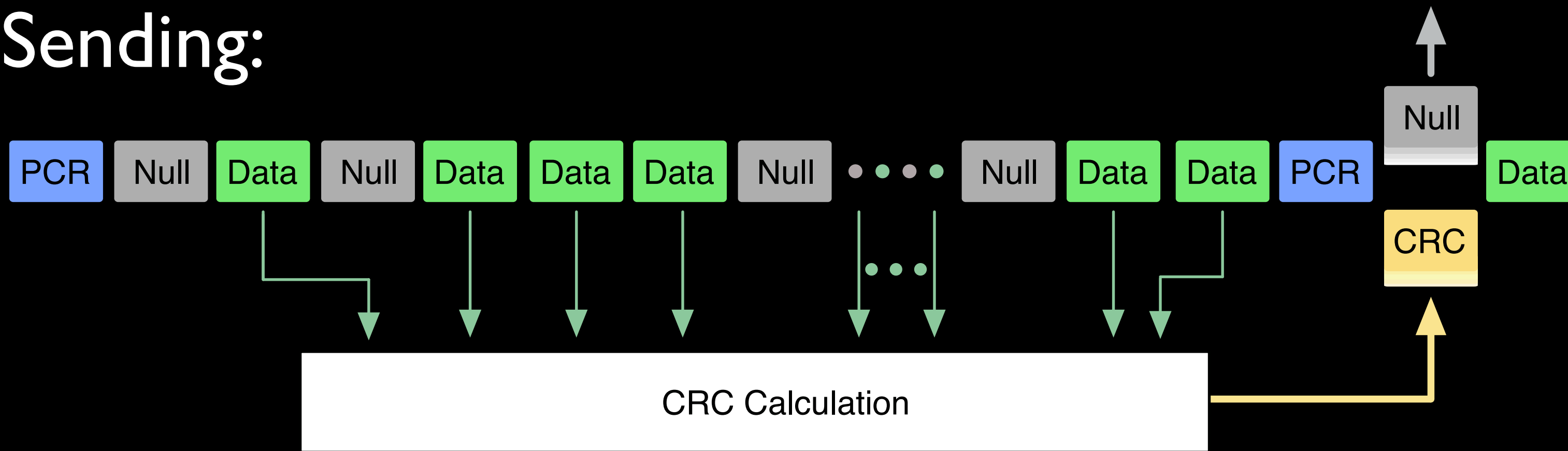
Other MPEG Streams



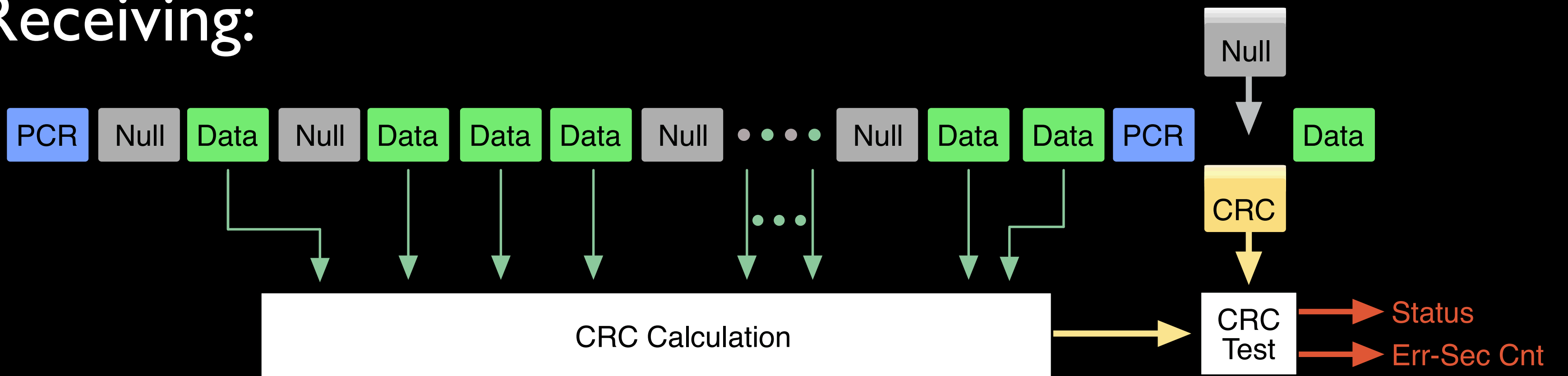
'Real' Video

How do we test it?

# Sending:

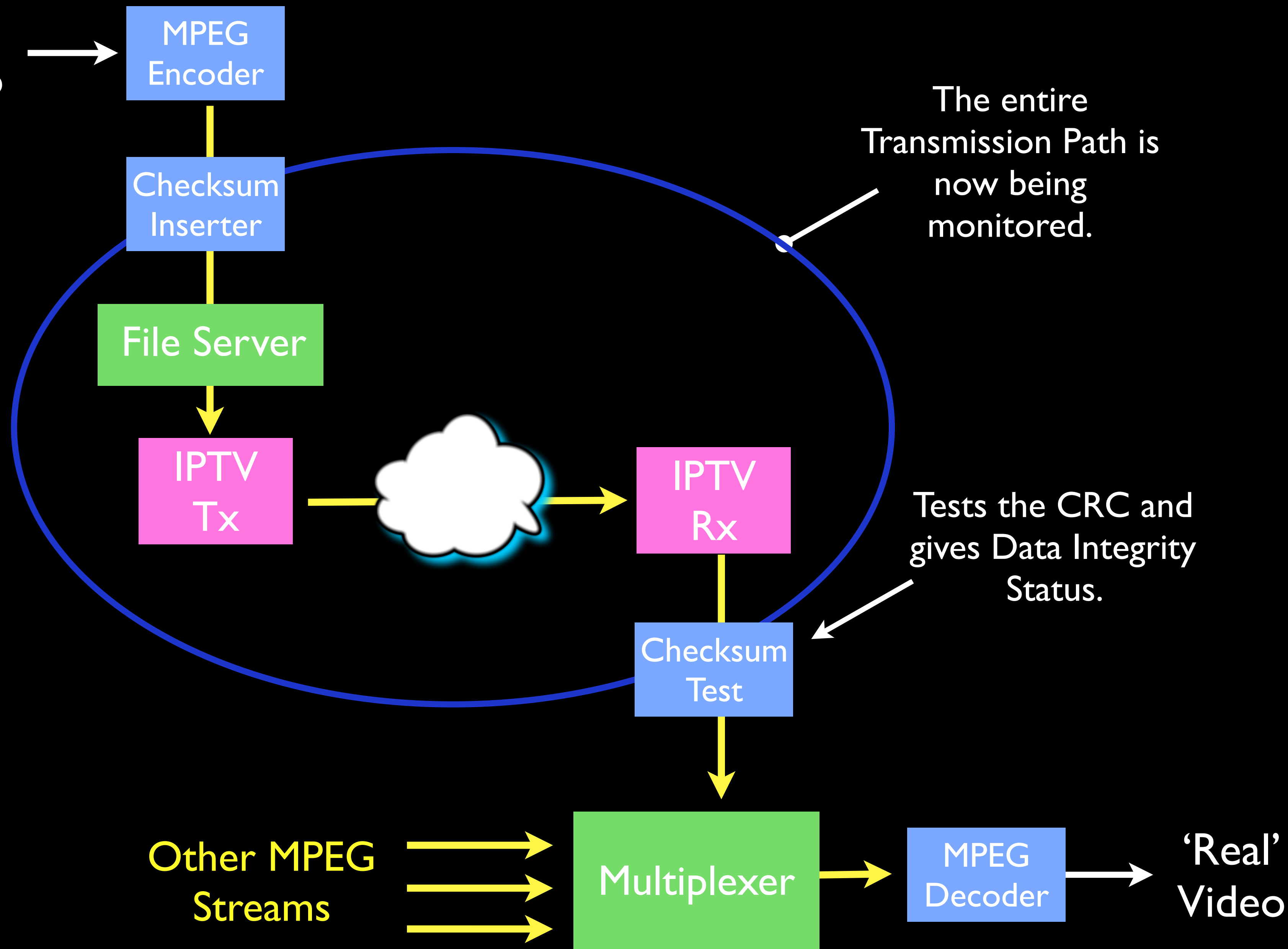


# Receiving:





'Real' Video



The entire Transmission Path is now being monitored.

Tests the CRC and gives Data Integrity Status.

Other MPEG Streams

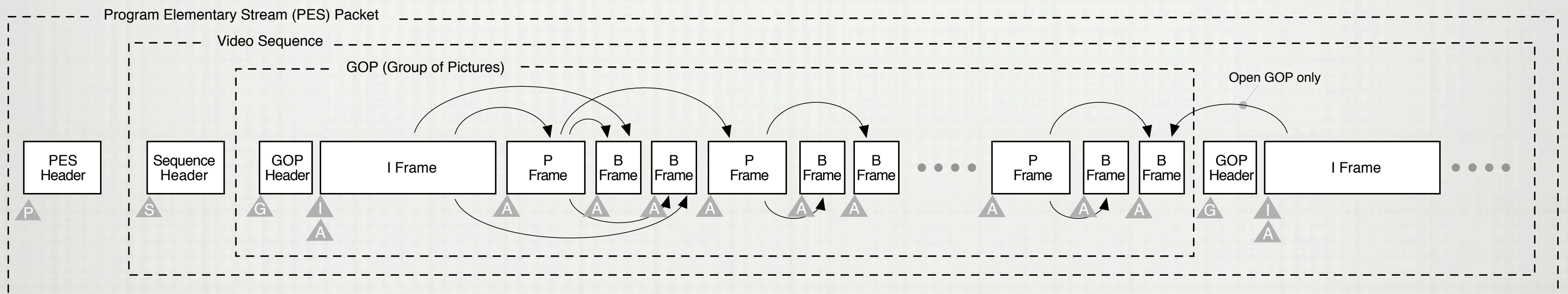
'Real' Video



# Switching

- Analog - Easy
- Digital / SD-SDI & HD-SDI - Hard
- Transport Stream - Very Difficult

# Switch Points in an MPEG-2 Transport Stream

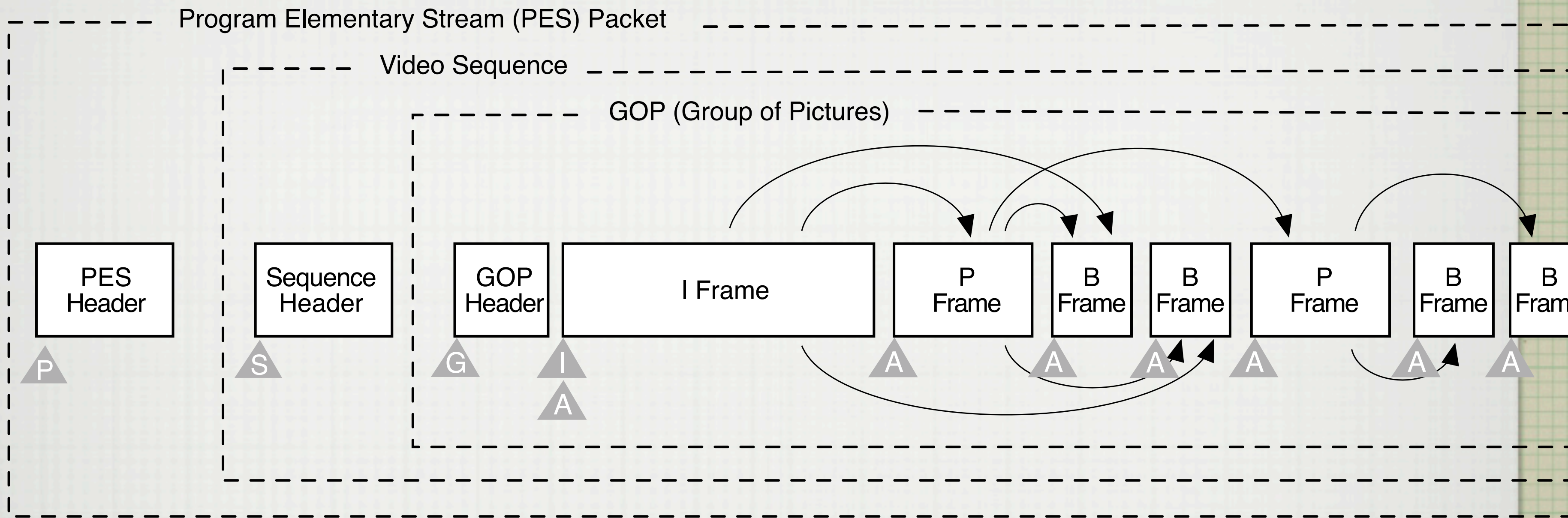


## Switch Point Targets






▲ P	PES Start	2 targets/sec
▲ S	Sequence Start	2 targets/sec
▲ G	GOP Start	2 or less targets/sec, dependent upon GOP Length
▲ I	I Frame	2 to 4 targets/sec, dependent upon GOP Length and GOP Style
▲ A	Any Frame (I, B, P)	Target rate same as original video frame rate (30/sec for NTSC)


 Direction of contribution to Video Output



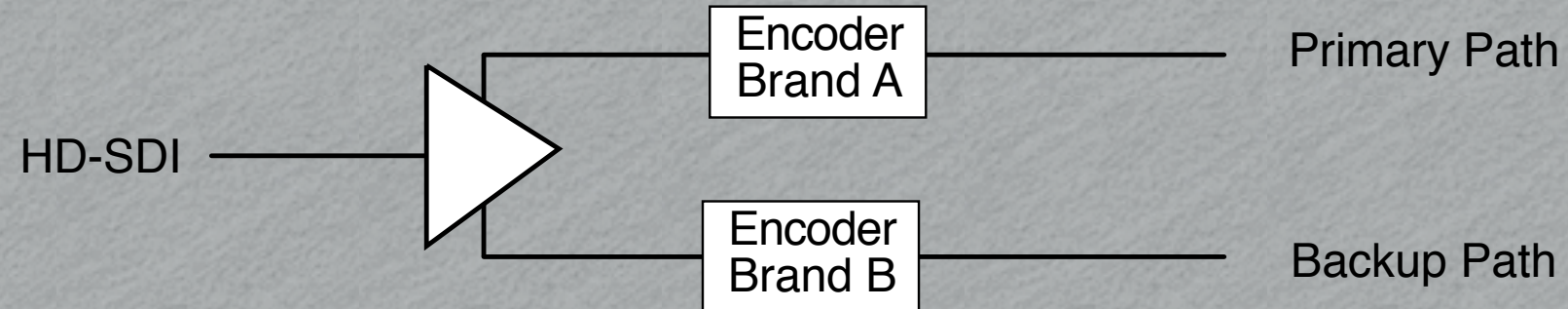
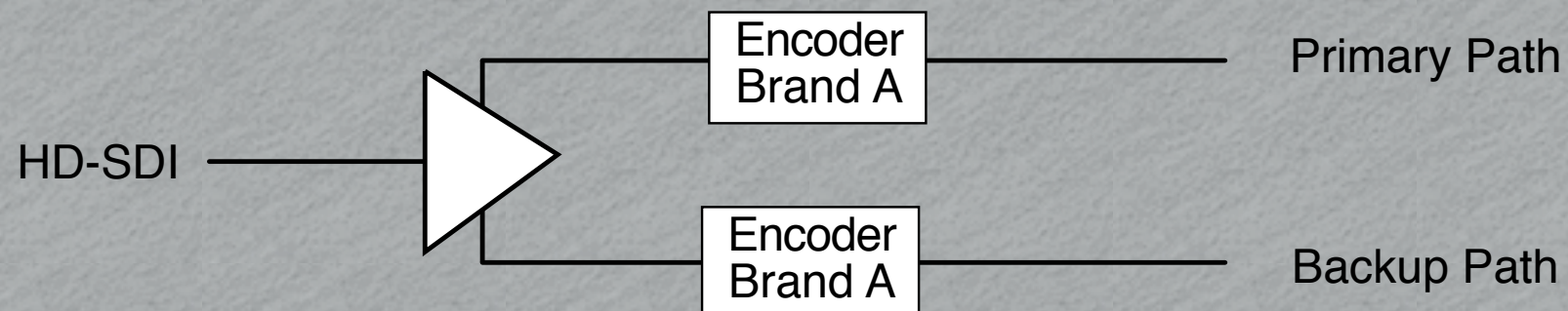
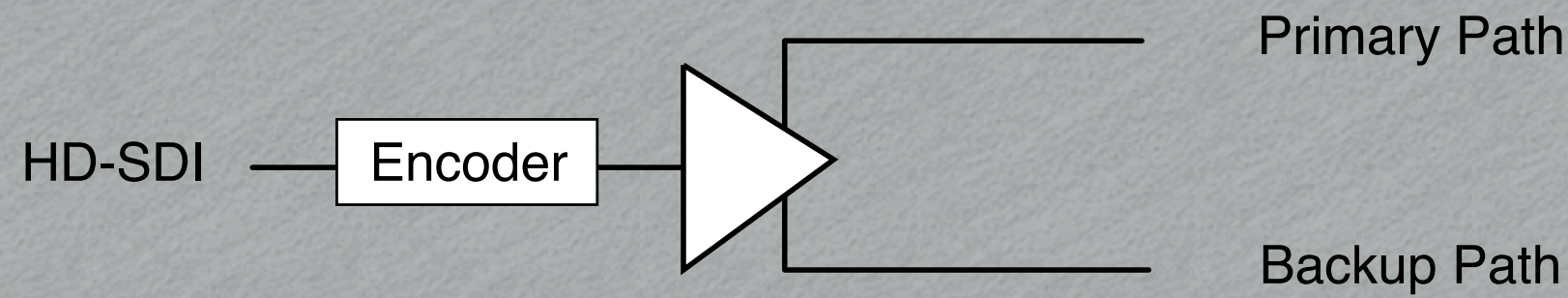


### Switch Point Targets

-  PES Start
-  Sequence Start
-  GOP Start
-  I Frame
-  Any Frame (I, B, P)

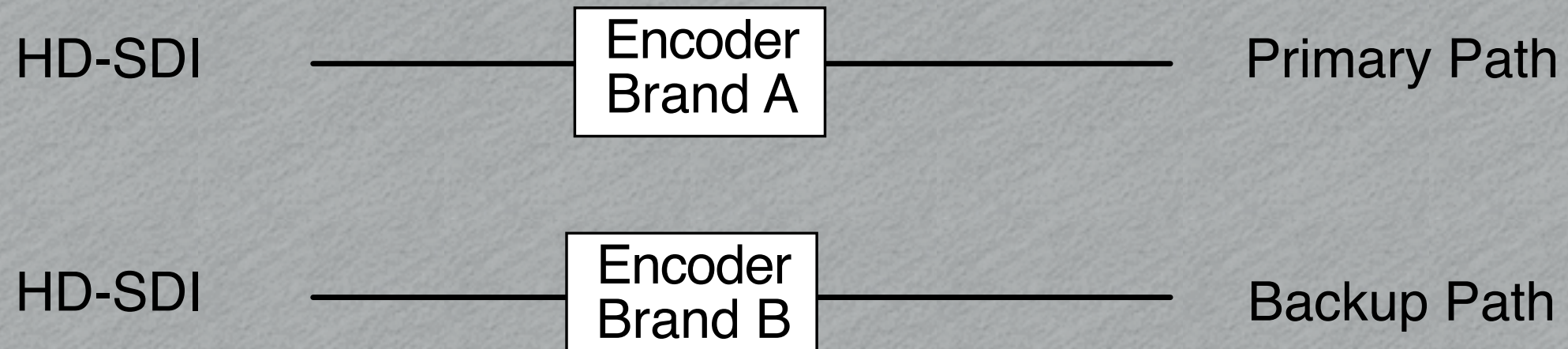


IDENTICAL  
ENCODING



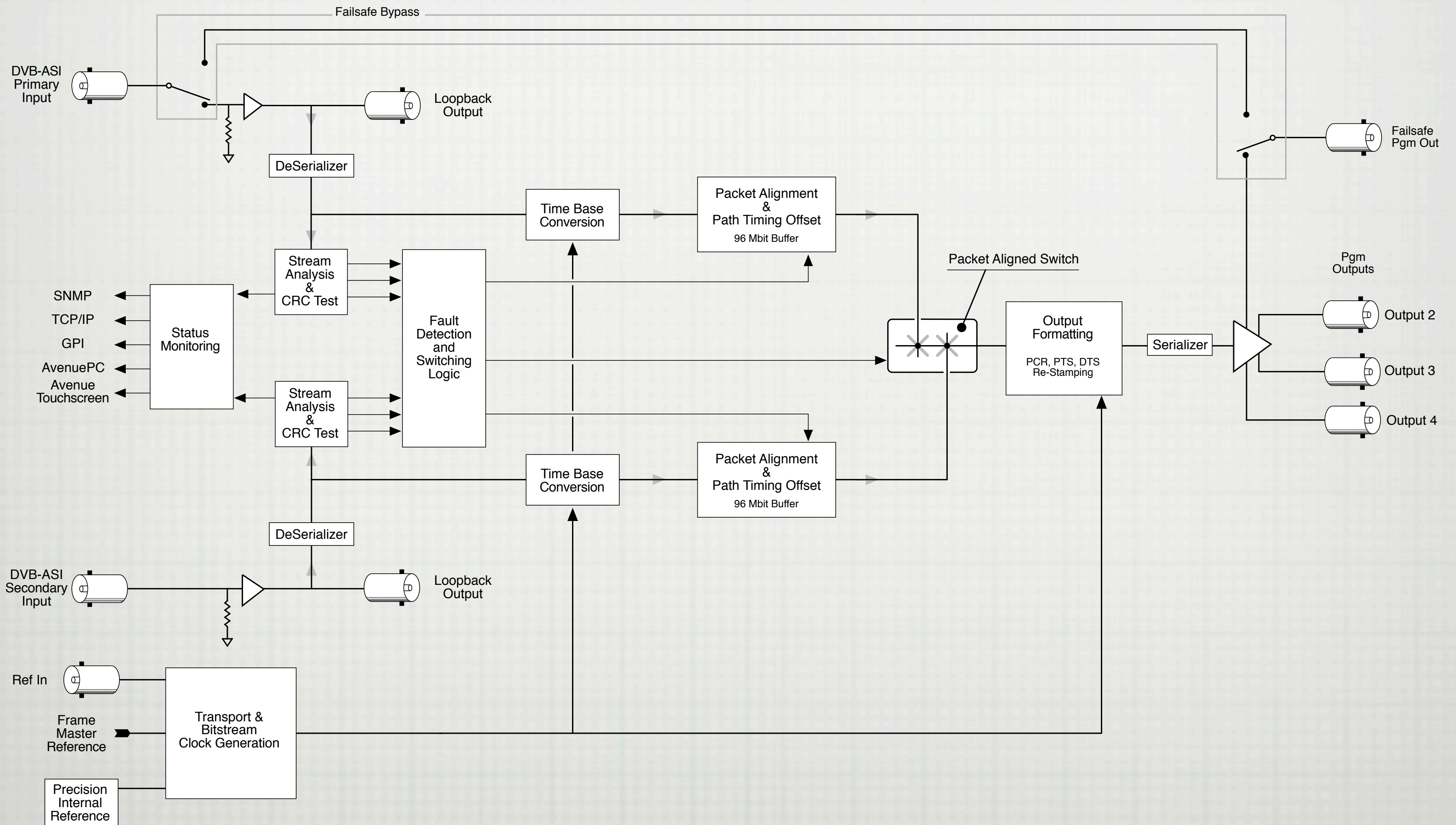
SAME CONTENT  
SIMILAR  
ENCODING

NIGHT & DAY

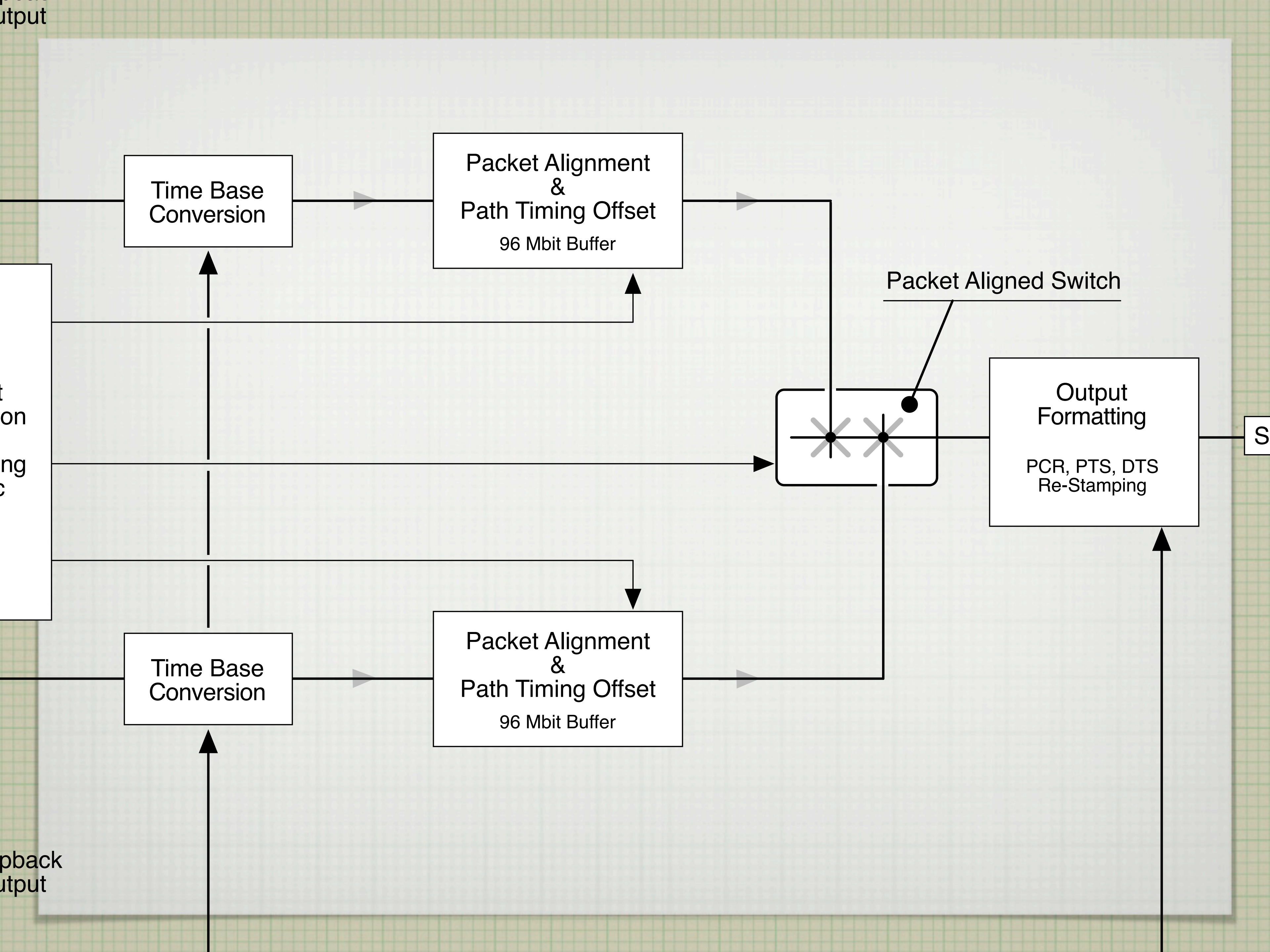




# Transport Stream Clean Switch







From the  
“Where are they now  
department”











**ENSEMBLE**

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DESIGNS