FOSS MADE US DO IT!

How switching to open source tools enabled video innovation

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AGENDA

- ANNOUNCEMENT OF GREAT SUCCESS WITH FOSS!
- FOSS AT SVT
- INTRODUCTION TO VIDEO STREAMING
- MOVING OUR VOD PIPELINE FROM PROPRIETARY COMMERCIAL SOLUTIONS TO OPEN SOURCE TOOLS

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ANNOUNCEMENT OF GREAT SUCCESS WITH FOSS!

Compared to 2 years ago, the video quality of content at SVT Play has improved substantially, and we are in a better position to improve it even more. How did we get here? And what part did open source play in the process? Stay tuned and you will see!

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But first…

… some background!

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FOSS AT SVT

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Caspar CG

- OPEN SOURCE SINCE ~2010
- LAYER-BASED REAL-TIME COMPOSITOR
- WIDELY USED IN BROADCAST INDUSTRY

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BUT OTHERWISE...

USING FOSS

PRODUCING FOSS

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TRUE STORY

- Can I release this nifty library I made as open source?
- Uh...Maybe...I don't know...let me check!

  several weeks delay as the question is escalated up the management ladder

  No you can't.

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BUT THEN…

SOME MOTIVATED DEVELOPERS STARTED WORKING TO CHANGE THIS

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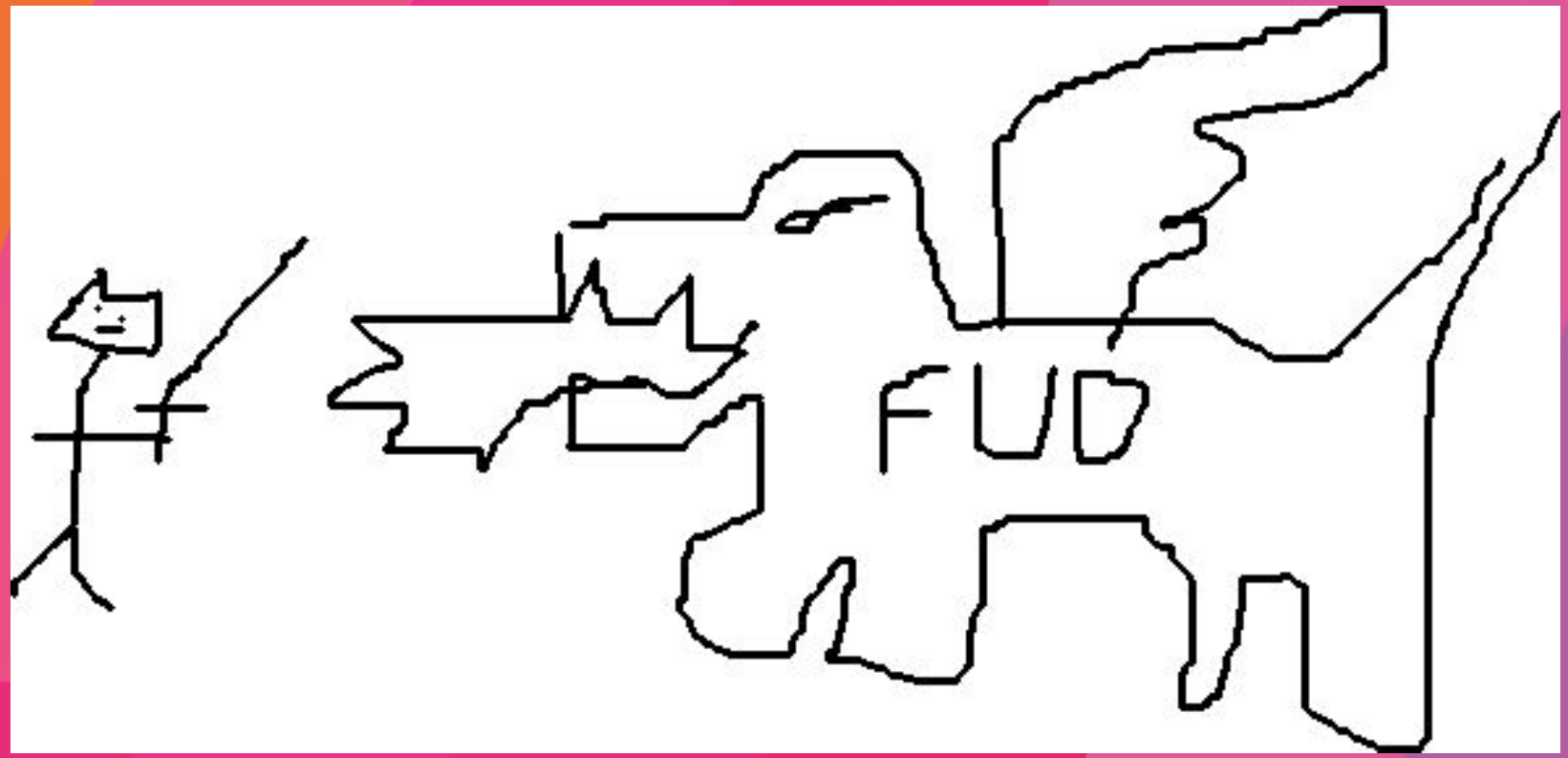
FIGHTING THE FEAR, UNCERTAINTY, DOUBT



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AFTER A HEROIC EFFORT, THEY WERE ABLE TO OVERCOME THE FUD

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AND WE GOT US AN OPEN SOURCE TEAM!

- MANDATE TO PROMOTE OPEN SOURCE WITHIN SVT
- RESPONSIBILITY FOR THE OPEN SOURCE “PROCESS”

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THE OPEN SOURCE TEAM...

- *SUPPORTS THE TEAMS AND INDIVIDUALS IN WORKING WITH OPEN SOURCE*
- *WORKS OUT GUIDELINES*
- *KEEP OVERSIGHT OF THE HEALTH OF PUBLIC PROJECTS FROM SVT*
- *KEEP CONTACT WITH OTHERS, INTERNAL AND EXTERNAL*
- *OTHER ACTIVITIES - BLOG, SPEAKERS, HACKDAY ETC.*
- *SUPPORT CONTRIBUTION CULTURE*

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AND HOW IS THAT WORKING OUT?

PRETTY GOOD!

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SVT FOSS HIGHLIGHTS OF THE LAST YEAR

- WE SEE OPEN SOURCE AWARENESS SPREADING IN THE ORGANISATION
- FOSS-STHLM MEETUP
- VALKOMPASSEN
- VIVICT
- GRAPHQL-DEFRAGMENTIZER
- FFMPEG-FILTER-PROXY

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SO OUR WORK IS DONE?

NO!

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- WE (THE OPEN SOURCE TEAM) WANT EVEN MORE PROJECTS RELEASED AS OPEN SOURCE
- MORE CONTRIBUTIONS TO OTHER OPEN SOURCE PROJECTS
- WE WANT RELEASING AS OPEN SOURCE TO BE CONSIDERED FOR EVERY NEW PROJECT
- MORE COLLABORATION THROUGH OPEN SOURCE

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VIDEO STREAMING

A basic introduction into how frames are flung across the internet to create the enjoyable illusion of motion pictures

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VIDEO STREAMING

VIDEO

SOURCE FILES

- SAR / DAR
- Colour Space
- Genre
- Interlaced?
- Legacy?

TRANSCODING

- Encoding
- Compression
- Quality
- Compatibility

STREAMING

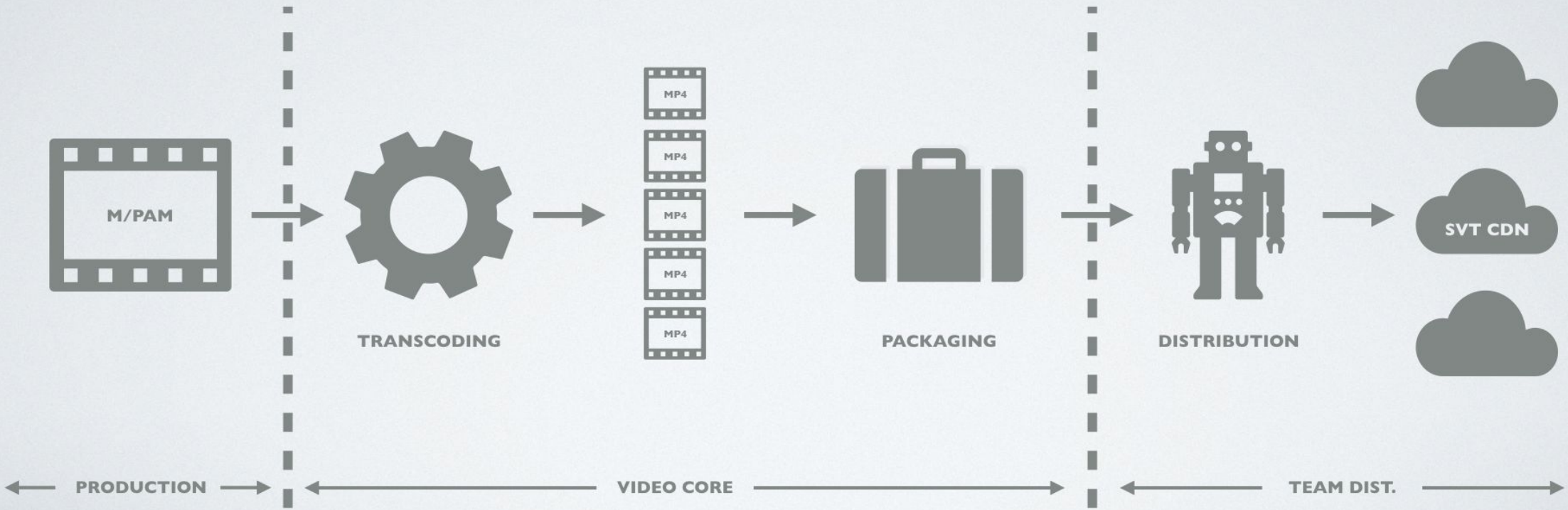
PACKAGING

- HLS / DASH
- Devices
- Standards vs Pragmatism
- Compatibility

CONTENT DELIVERY

- Storage / Cache
- Traffic
- Limitations
- Costs

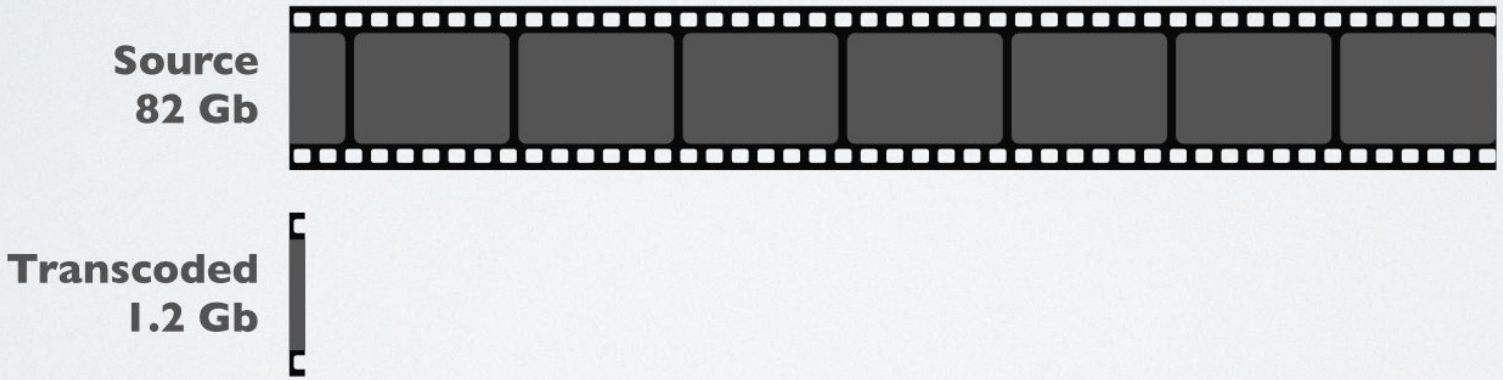
BASIC OVERVIEW



TRANSCODING

Usually referred to as Video Encoding

COMPRESSION



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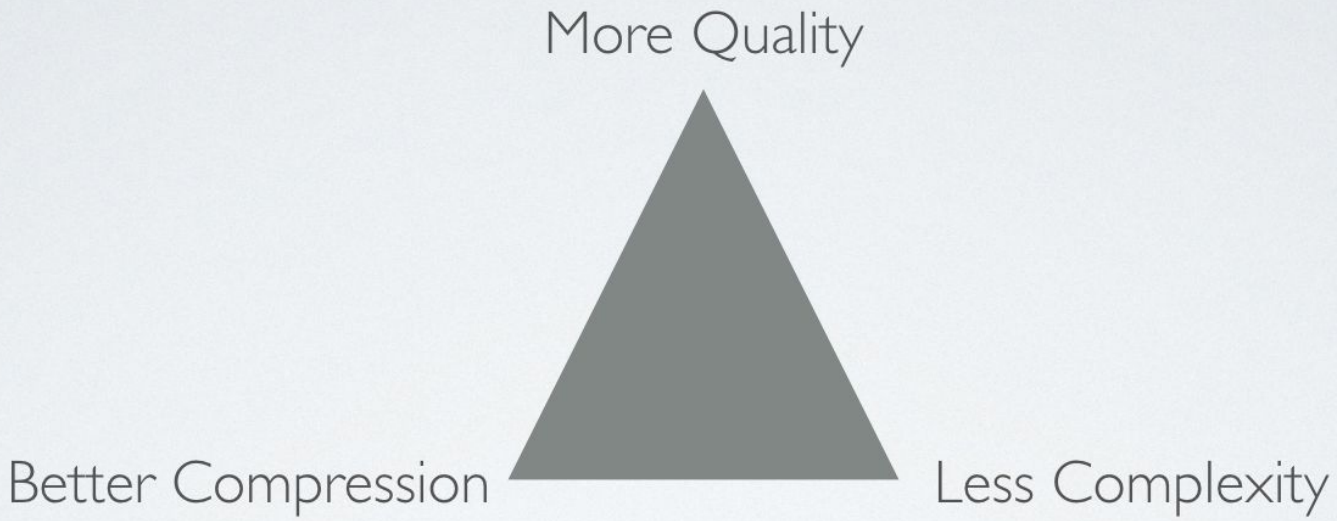
HOW THEY RELATE



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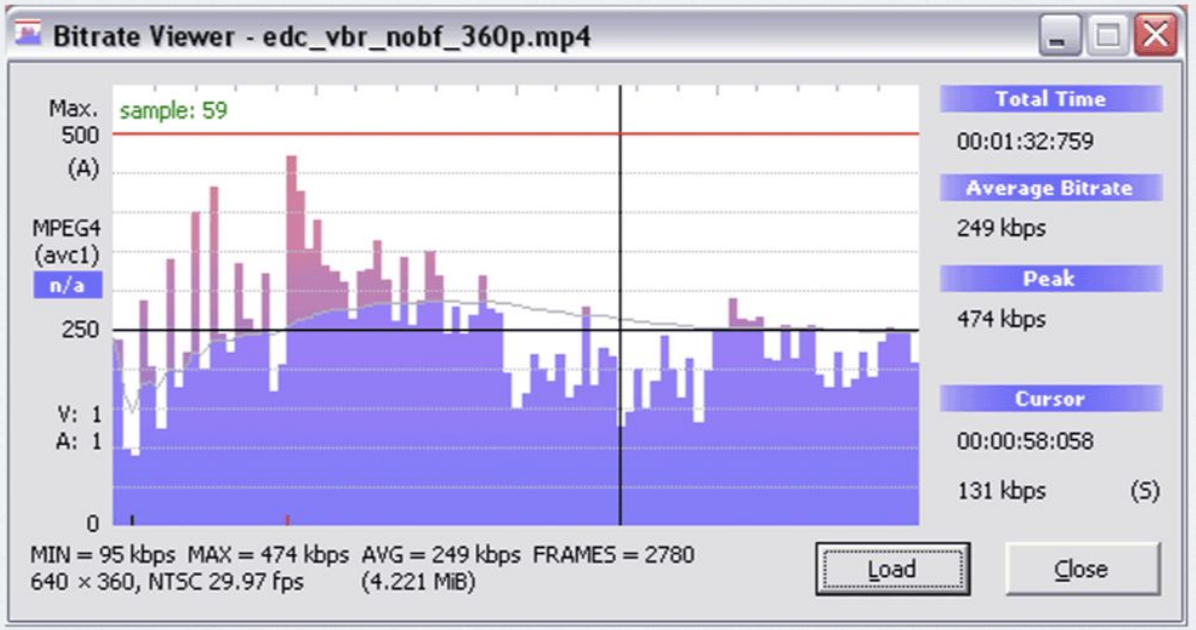
COMPATIBILITY

BITRATE

File size = ((bitrate / second) * number of seconds)



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STANDARDS, CODECS AND CONTAINERS

A video compression Standard defines a specific decoding process

H.264 / AVC is a video compression standard

A CODEC (from en**co**der / **dec**oder) is a software that compresses and decompresses digital video or audio (usually according to a standard)

x264 and OpenH264 are video Codecs

A Container is a media file format that contains digital video and/or audio

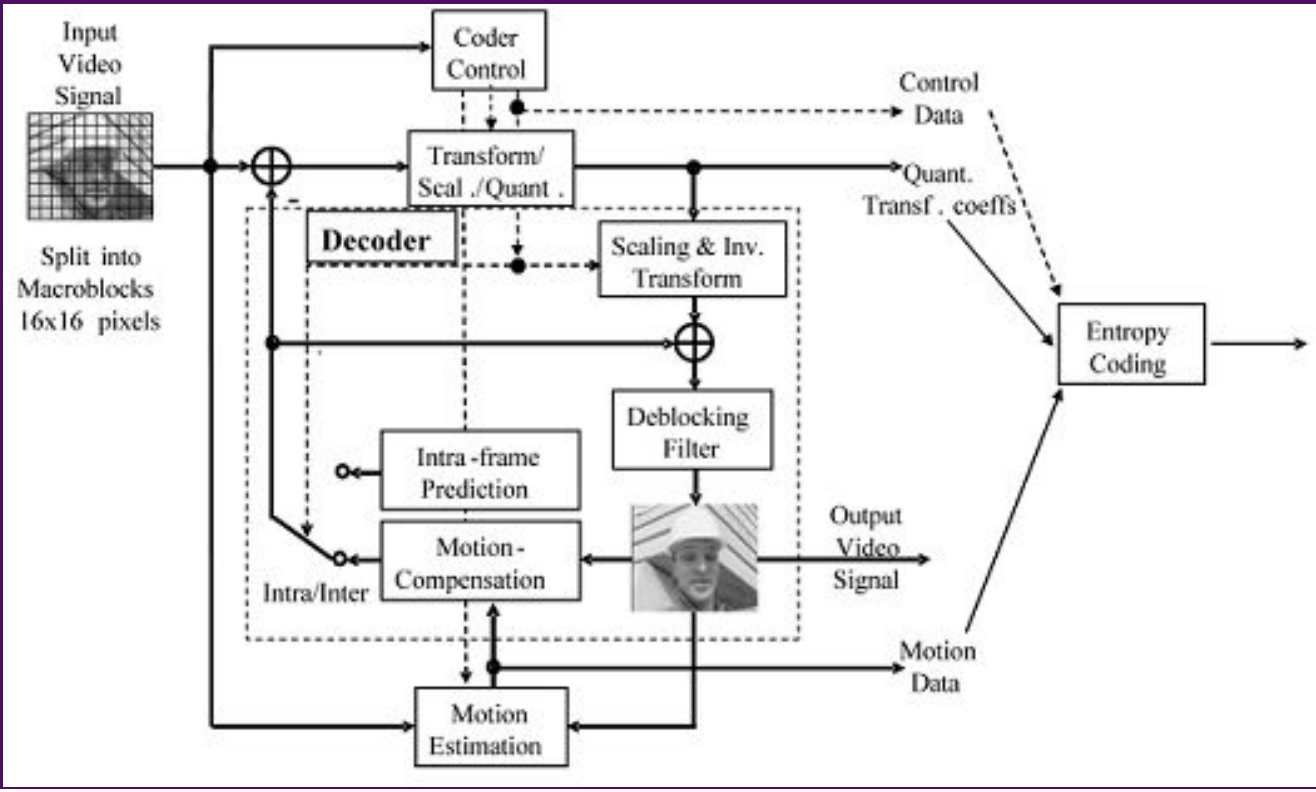
MPEG-4 Part 14, or .mp4, is a container file format.

A TYPICAL CODEC BASED ON H.264 (AVC)

Is block-oriented, motion compensated and DCT-integer coded.

Has wide decoding support, since a large percentage of video on the internet follows the H.264 standard

Is usually very mature, the standard has been around since 2003



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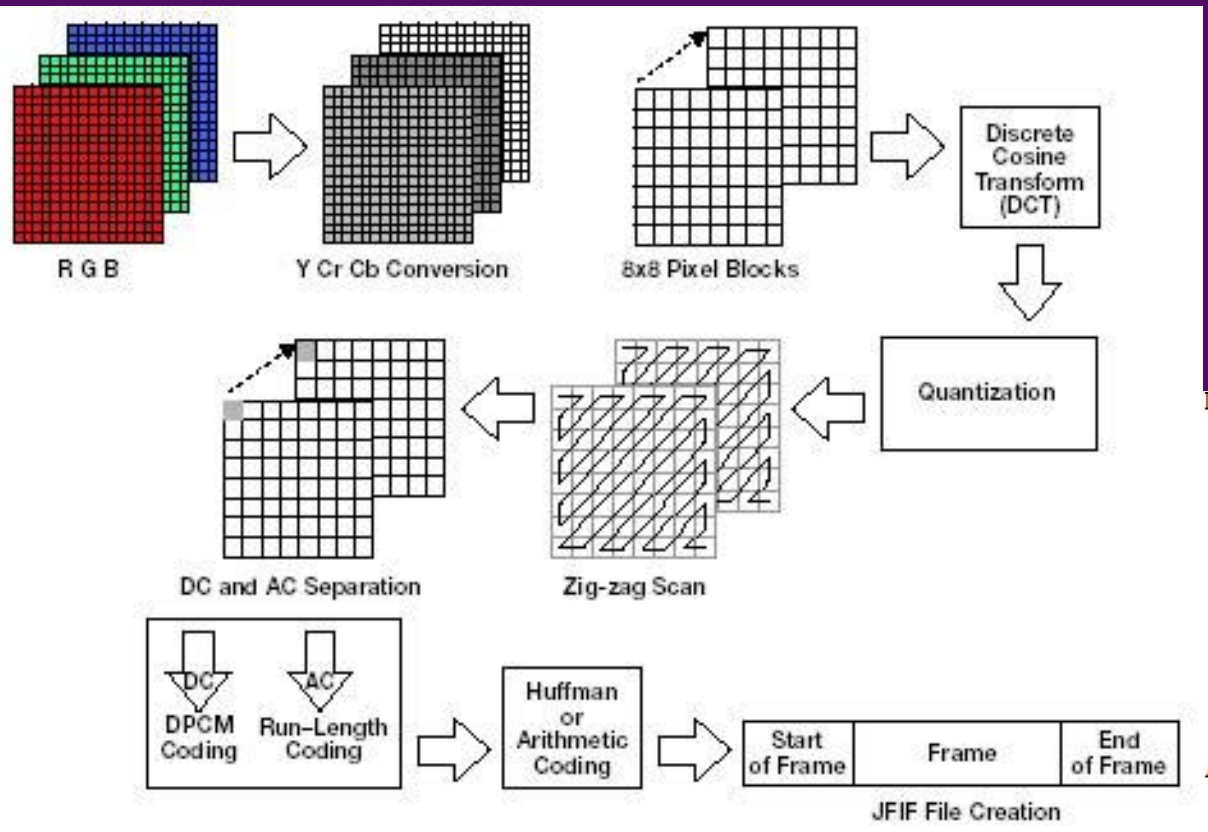
SPATIAL COMPRESSION



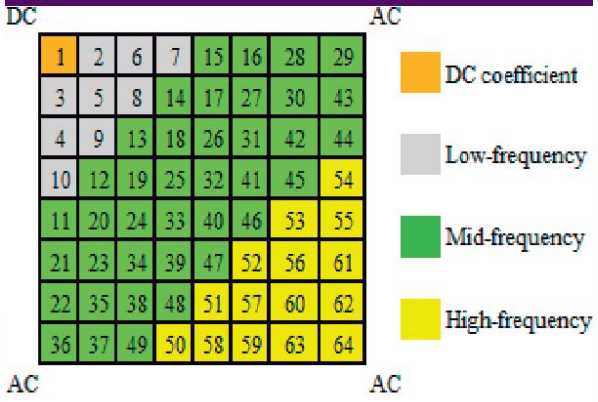
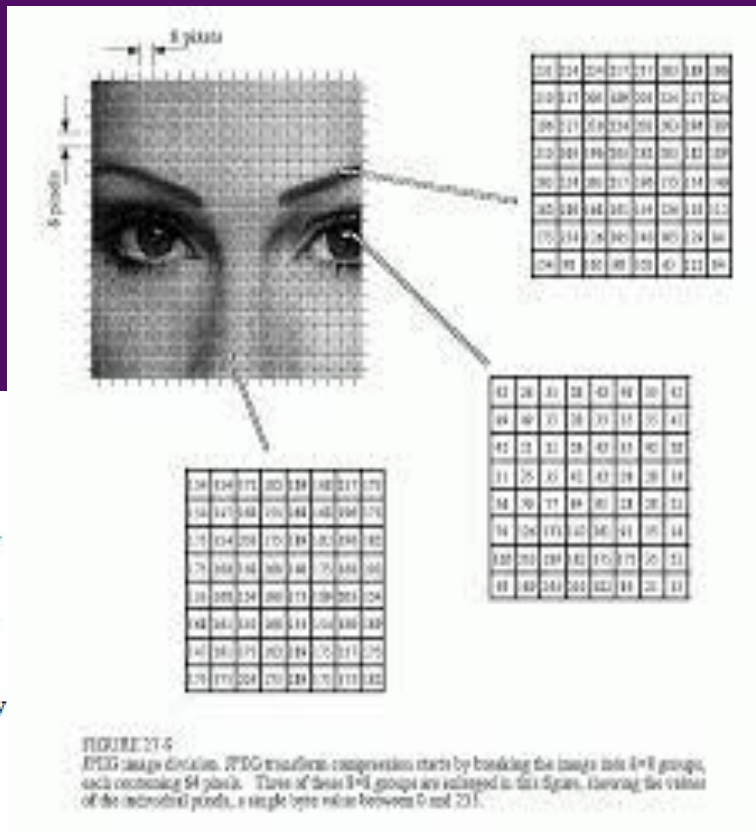


Figure 1. DCT coefficients.



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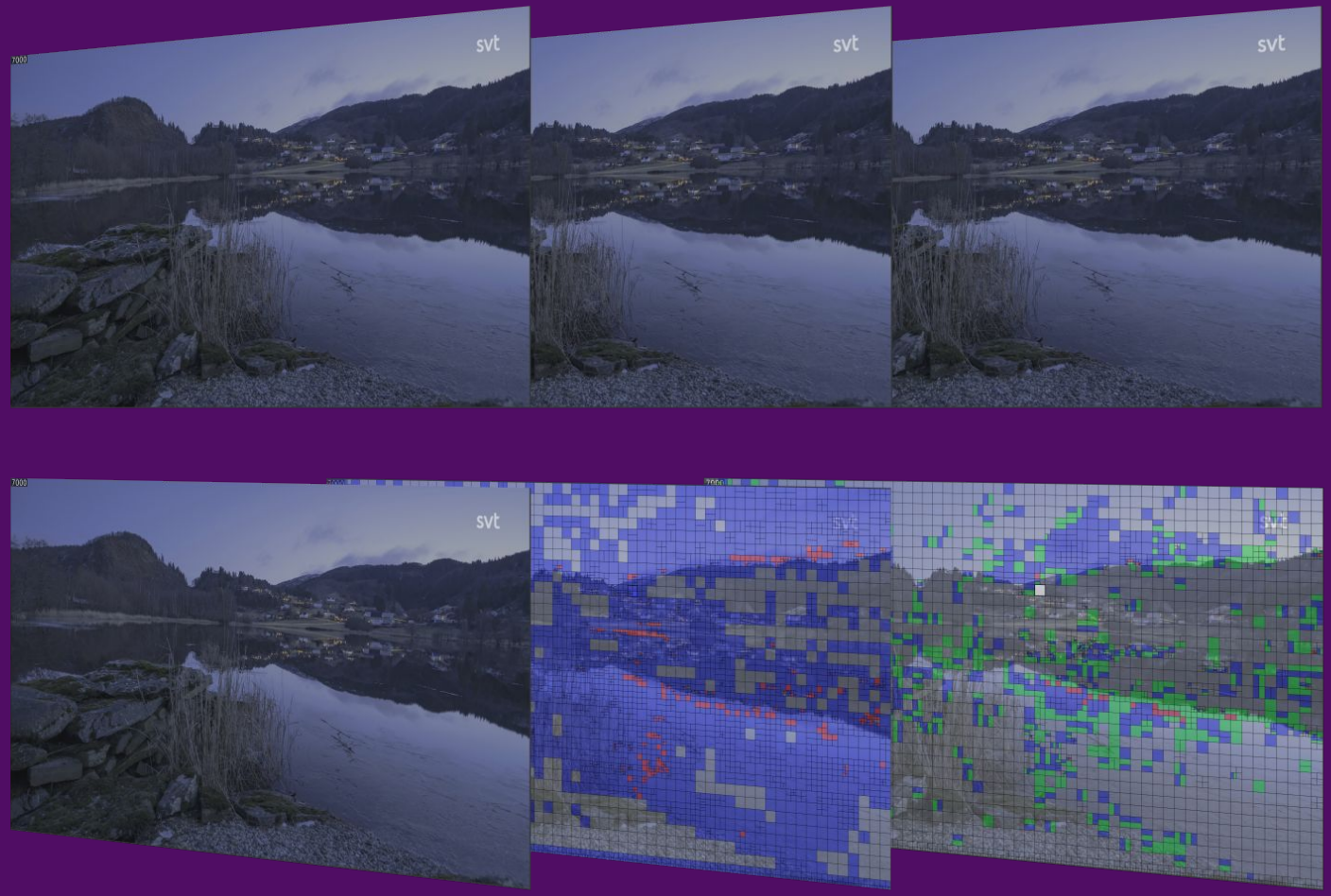
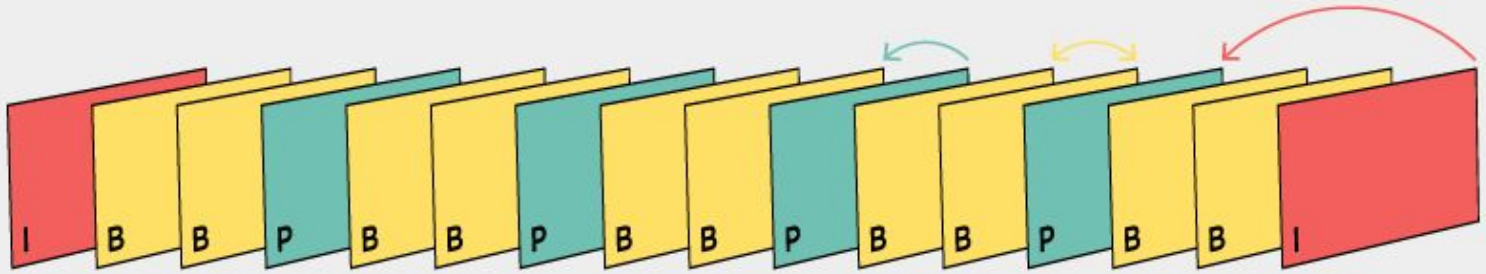
TEMPORAL COMPRESSION



GROUP OF PICTURES (GOP)



- Intra coded frame, I-Frame, is independent from all other frames. Each GOP begins with an I-Frame
- Predictive coded frame, P-frame, depends previous frames for reference
- Bipredictive coded frame, B-Frame, depends on previous frames and “future” frames for reference

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PACKAGING

How to serve fragmented video in segments

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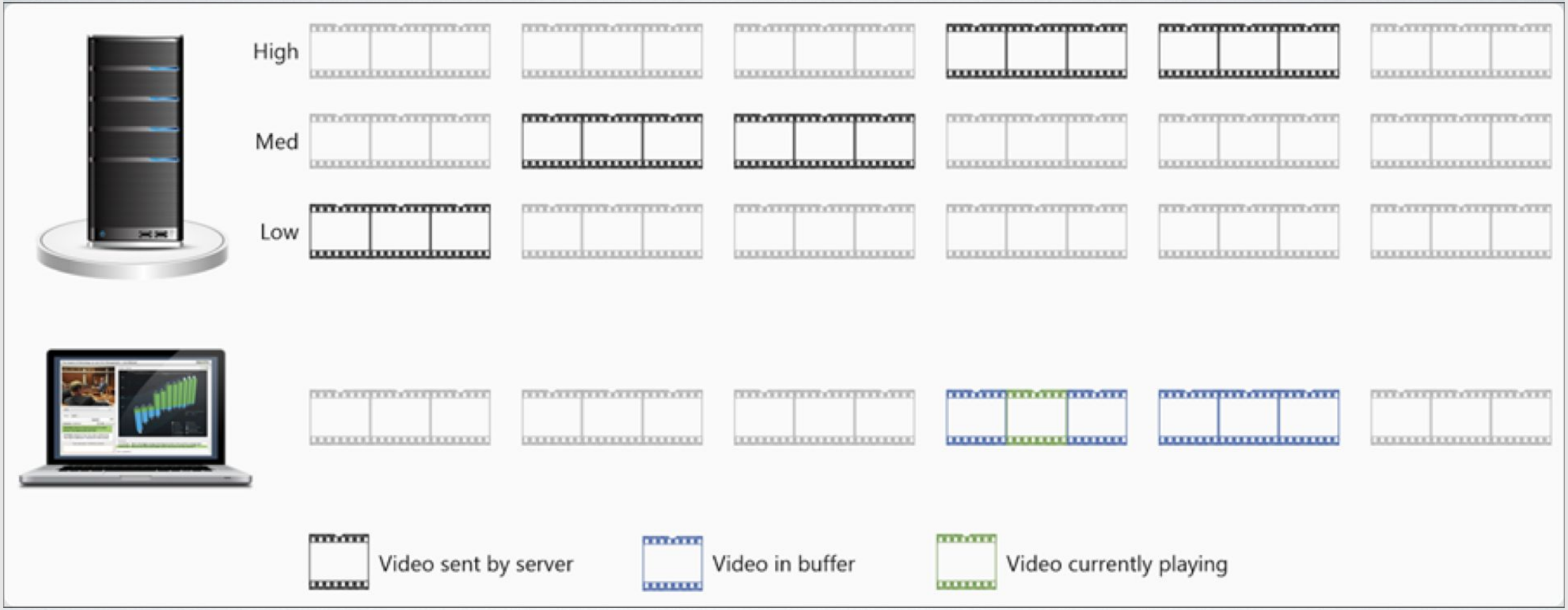
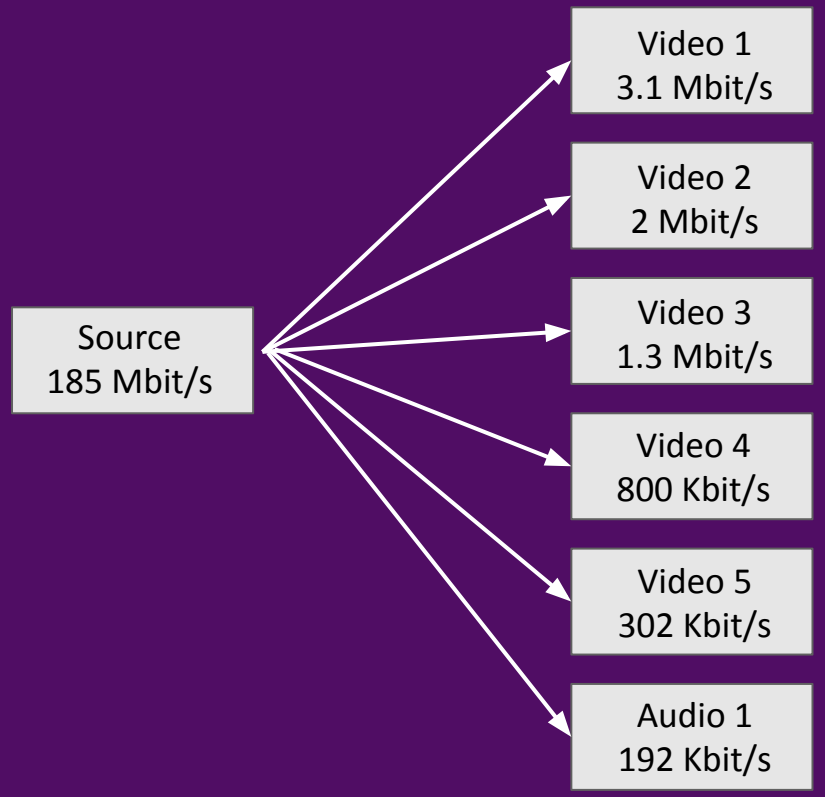

High
Med
Low
Video sent by server
Video in buffer
Video currently playing

ADAPTIVE BITRATE LADDER



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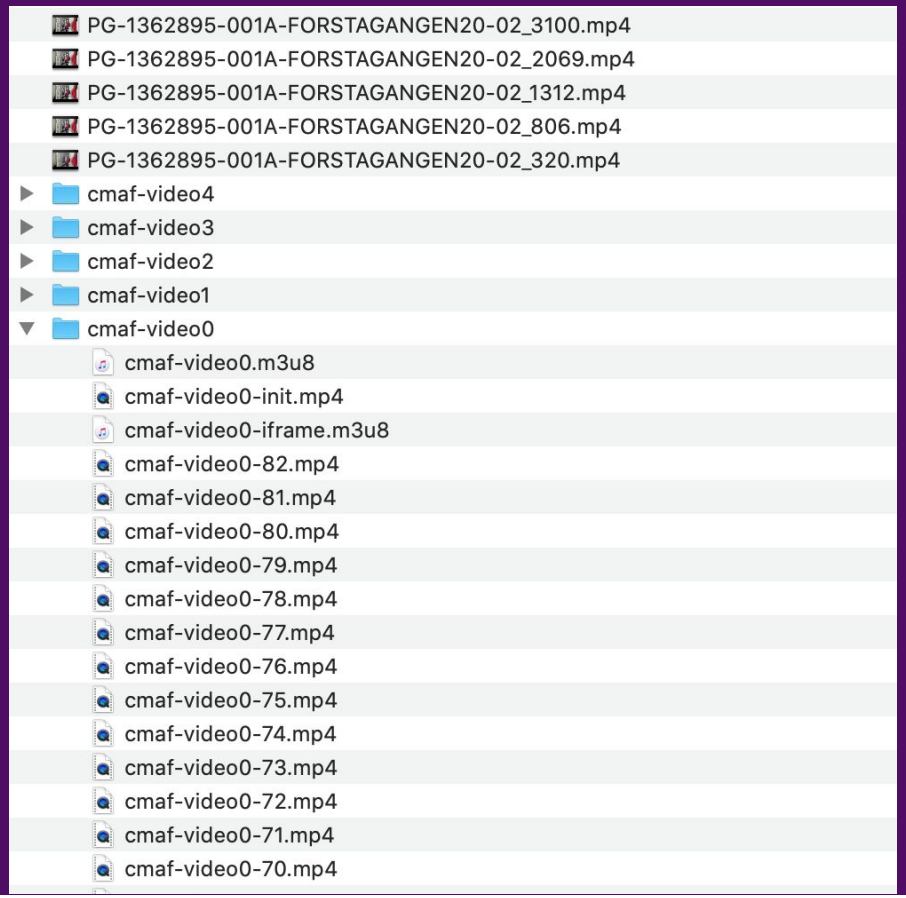
SEGMENTING VIDEO



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CREATING MANIFEST FILES

HLS

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DASH

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```

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SUMMARY OF OUR GOALS AND CHALLENGES

- WE WANT TO DELIVER HIGH QUALITY VIDEO
- WITHOUT USING TOO MUCH BANDWIDTH / DATA
- WHERE “TOO MUCH” DEPENDS ON CONTEXT
- AND DEVICE COMPATIBILITY IS PARAMOUNT

NOW YOU KNOW ENOUGH TO HEAR OUR STORY!

VIDEO PUBLISHING AT SVT IN 2018

- On site encoding cluster from a commercial provider - proprietary software and hardware
- The development of the transcoding pipeline had been stagnant since 2013
- Hardware had reached end of service
- Packaging handled by CDN provider
- Packaging service to be discontinued

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ENCODING CLUSTER REACHED END OF LIFE - WHAT TO DO?

BUY A NEW ONE ?

OR BUILD OUR OWN ?

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TEKNIKSPRINT

- TWO WEEK SPRINT, TWICE A YEAR
- SELF-ORGANISED TEAMS WORK ON INTERESTING PROJECTS THEY COME UP WITH
- PROJECT MAY OR MAY NOT BE RELATED TO OUR DAY-TO-DAY WORK
- GREAT OPPORTUNITY TO EXPLORE INTERESTING IDEAS

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2 WEEK HACKSPRINT

+ FFMPEG

+ COMMODITY HARDWARE

=> ENCODING CLUSTER POC

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encore

Encore /ɑ̃.kɔʁ/

franska och betyder 'igen', 'ännu en gång', 'ytterligare', 'också'.

KNOWLEDGE GAINED FROM POC

- FEASIBLE TO BUILD OUR OWN ENCODING CLUSTER
- FFMPEG + COMMODITY HARDWARE => DECENT PERFORMANCE
- NOT A BAD IDEA FROM AN ECONOMICAL POINT OF VIEW, IT WAS ACTUALLY A GOOD BUSINESS CASE

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BRINGING HOME PACKAGING

- MORE CONTROL AND FLEXIBILITY
- NOT DEPENDENT ON A SINGLE CDN-PROVIDER
- MORE EFFICIENT TRANSCODING/PUBLISHING PIPELINE

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HELLO SHAKA-PACKAGER!

(BENTO4 AND FFMPEG WERE ALSO CONSIDERED)

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WE LEARNED A LOT!

- MANIFEST FORMATS (HLS AND DASH)
- TESTING

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NOW WE WERE IN A BETTER POSITION TO START WORKING ON ENCODING...

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SO WE BUILT A PRODUCTION VERSION…AFTER A LONG DELAY BECAUSE OF OTHER OBLIGATIONS

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SOME OF THE TOOLS USED

- FFMPEG
- KOTLIN
- SPRING BOOT
- REDIS

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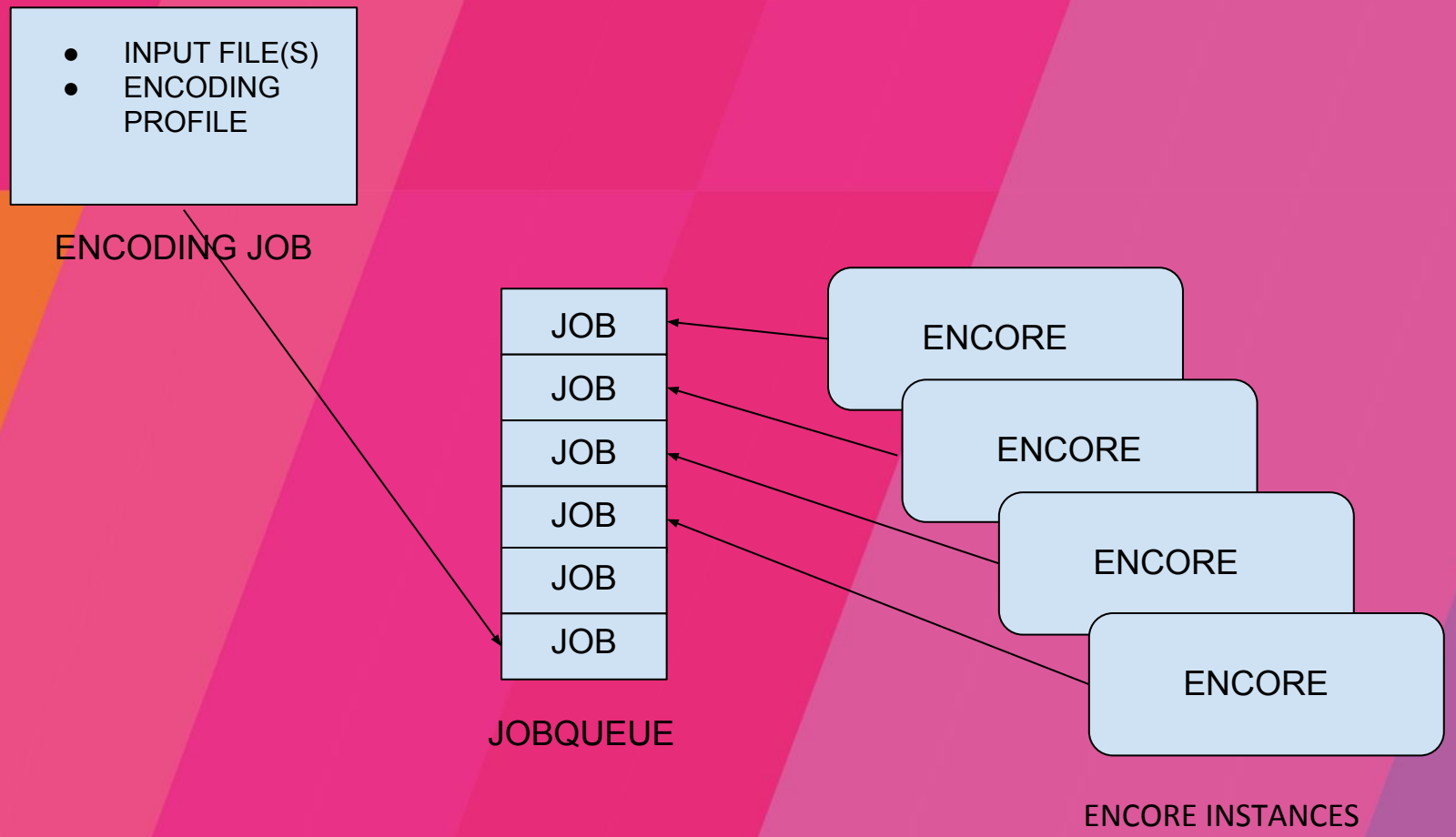
INPUT FILE(S)
ENCODING PROFILE
ENCODING JOB
JOB
JOB
JOB
JOB
JOB
JOB
JOBQUEUE
ENCORE
ENCORE
ENCORE
ENCORE
ENCORE INSTANCES

INPUT FILE + ENCODING PROFILE => A SEQUENCE OF FFMPEG COMMANDS

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- IN PRODUCTION SINCE SEPTEMBER 2019
- ENCODING ALL ONLINE VOD-CONTENT SINCE DECEMBER 2019

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SO YOU BUILT YOUR OWN ENCODING CLUSTER BASED ON FFMPEG AND OTHER OSS TOOLS. IS THIS WHAT YOU MEAN BY ‘VIDEO INNOVATION’?

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NOT EXACTLY
TO US, ‘VIDEO INNOVATION’ MEANS

- NOT NECESSARILY COMING UP WITH SOMETHING COMPLETELY NEW
- BEING ABLE TO ADAPT QUICKLY IN A FAST MOVING FIELD
- TO BE ABLE TO EXPERIMENT WITH NEW TECHNOLOGY EFFECTIVELY

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SO HOW THEN DID BUILDING YOUR OWN ENCODING CLUSTER ENABLE VIDEO INNOVATION?

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TO BE INNOVATIVE, WE NEED:

. KNOWLEDGE
. TOOLS
. PROCESS/ORGANIZATION

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- GREAT LEARNING EXPERIENCE
- NO BLACK BOXES!
- MORE CONTROL OVER THE TOOLCHAIN
- DEVICE TESTING EXPERIENCE
- ‘INNOVATIVE SPIRIT’ SPREADING WITHIN THE ORGANIZATION

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SO WHAT KIND OF INNOVATIVE STUFF HAVE YOU BEEN WORKING ON?

- 50 FPS
- ‘PER GENRE’-ENCODING
- NEW CODECS (based on HEVC and VP9)
- 5.1 AUDIO
- ENHANCED DIALOGUE AUDIO
- HDR

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AND IN CASE YOU ARE WONDERING: THE PLAN IS TO RELEASE ENCORE AS OPEN SOURCE, BUT WE ARE NOT THERE YET

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THANKS FOR LISTENING!
WE NOW HOPE THAT EVERYTIME YOU ARE ENJOYING THE VIDEO QUALITY AT SVTPLAY, YOU REMEMBER THAT

FOSS MADE US DO IT!

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svt.se/opensource

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