

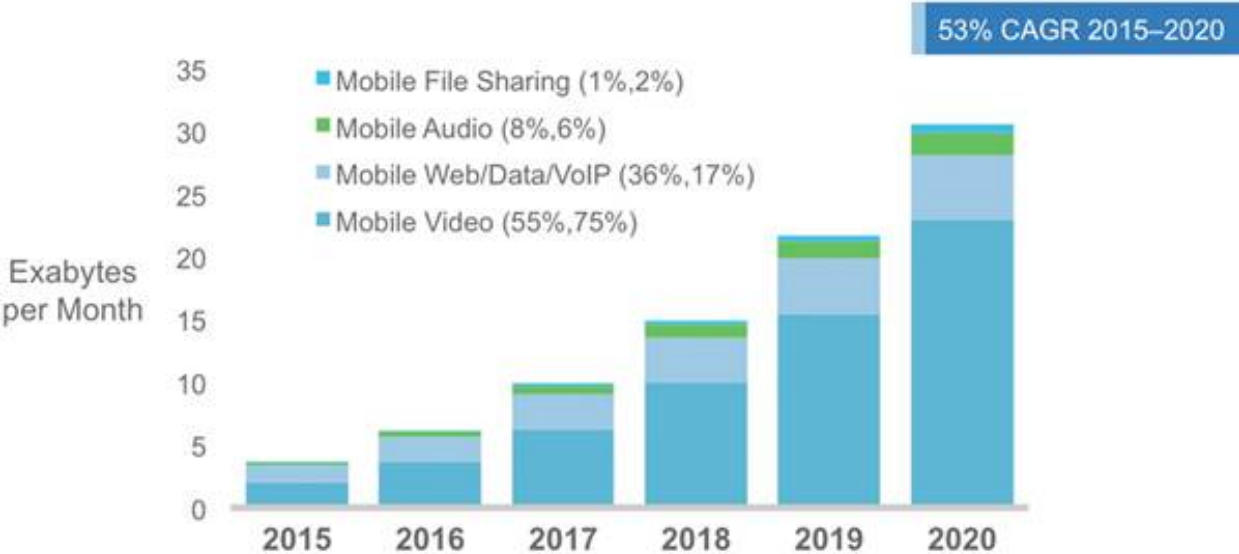
Greening The Video Transcoding Service With Low-Cost Hardware Transcoders

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University of Wisconsin-Madison

Video Streaming Service Is Popular



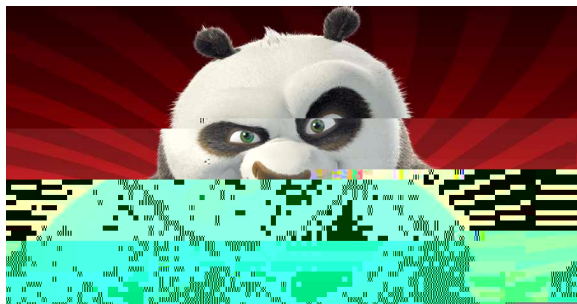
Mobile Video Will Generate Three-Quarters of Mobile Data Traffic by 2020.

Source: Cisco VNI Mobile, 2016

Wireless Live Video Streaming

- Challenges to stream live video to mobile devices

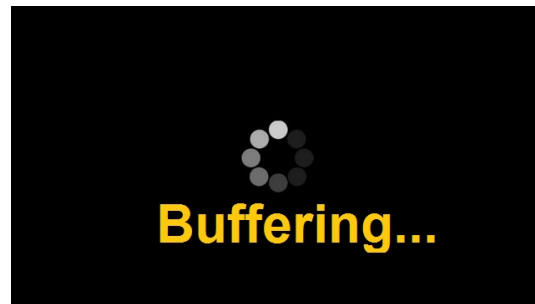
Glitch/Jitter



Interruption



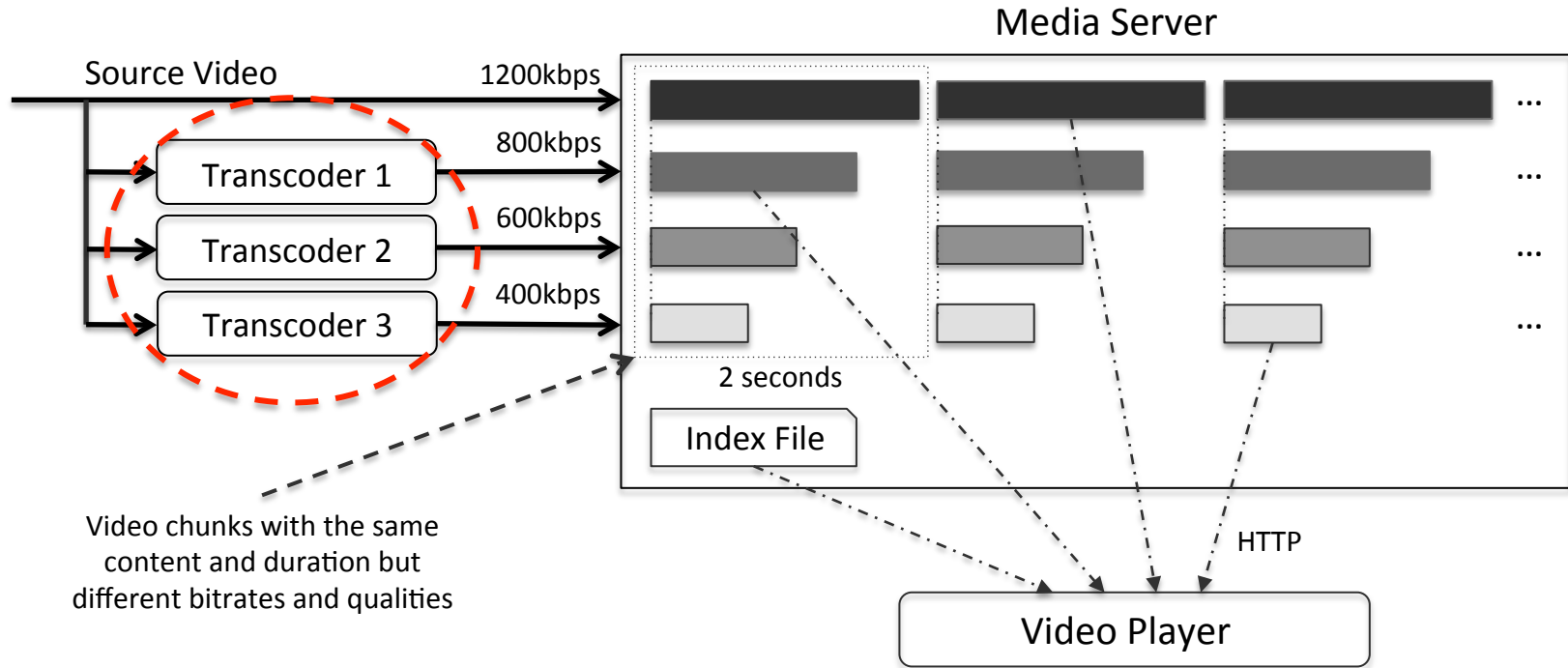
Buffering



A TV Streaming Service On Campus

- We have a deployment based on UDP multicast
- We developed a new system based on Adaptive BitRate (ABR) streaming over HTTP

ABR Streaming Over HTTP



Challenges Of Video Transcoding

High
computational
complexity

High power
consumption
on GPP

High
throughput
does not help
for live video

Video quality is
critical

Goal

A low-cost, highly efficient transcoder cluster to provide reliable service for a live video streaming service.

Outline

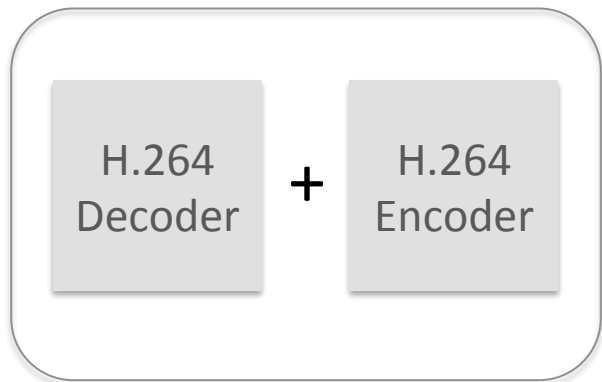
- Video transcoding overview
- Video decoder and encoder selection
- VideoCoreCluster architecture
- Implementation
- Evaluation
- Deployment and summary

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Video Transcoder Implementations

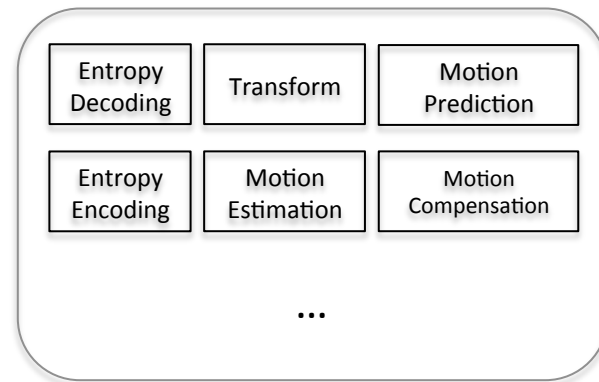
Combination of decoder and encoder



Flexible



Specialized H.264 to H.264 transcoder



VS

Efficient

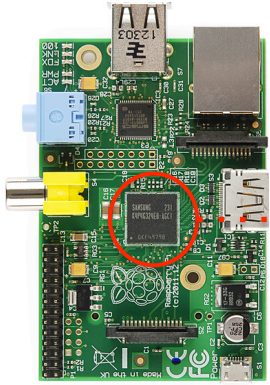
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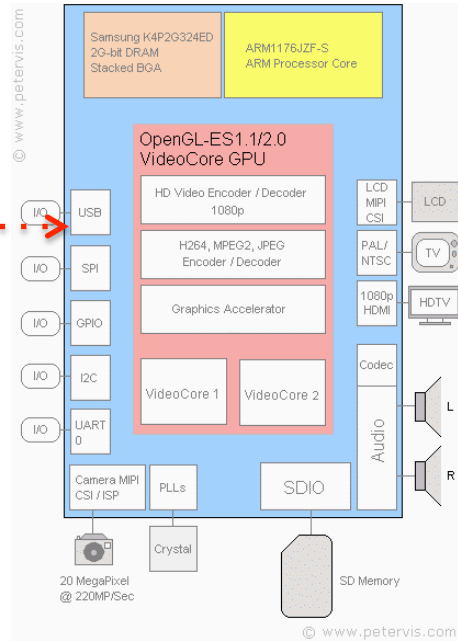
Available Video Decoder/Encoder

Implementations	Advantages	Disadvantages
Software on GPP	Flexible, good video quality	High power consumption
GPU-based	Medium power consumption	Expensive, inflexible
FPGA-based	Medium power consumption, flexible	Expensive
Hardware (ASIC or hardware IP in SoCs)	Low power consumption	Inflexible, medium video quality

Decoder & Encoder In Our System



Raspberry Pi



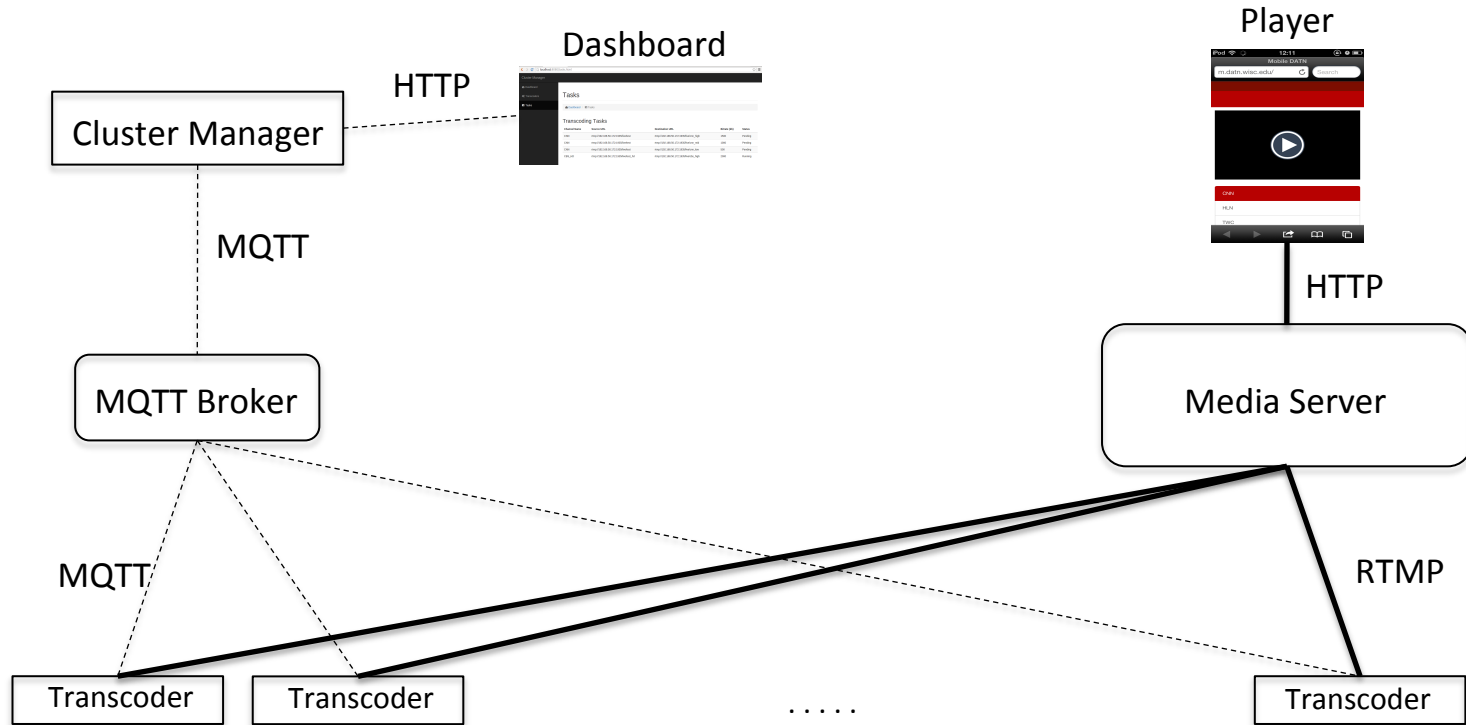
BCM2835

- The GPU (**VideoCore IV**) of BCM2835 has high performance hardware H.264 video encoder and decoder.

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VideoCoreCluster Architecture



Outline

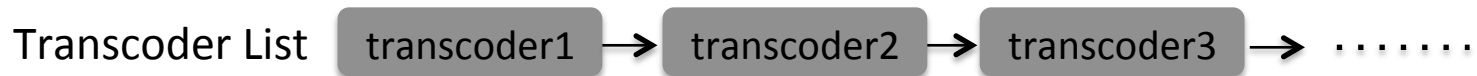
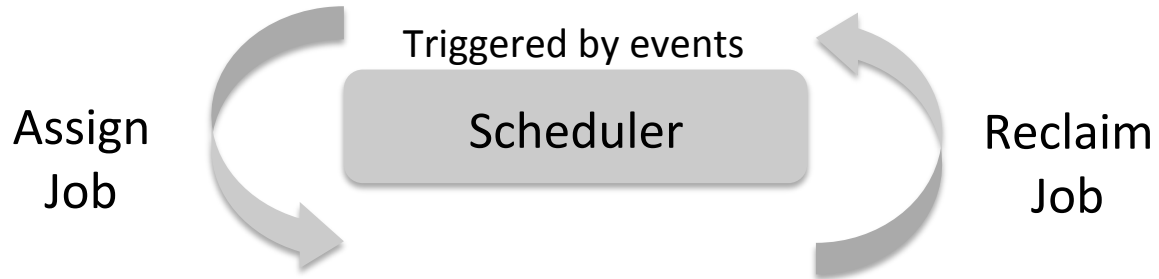
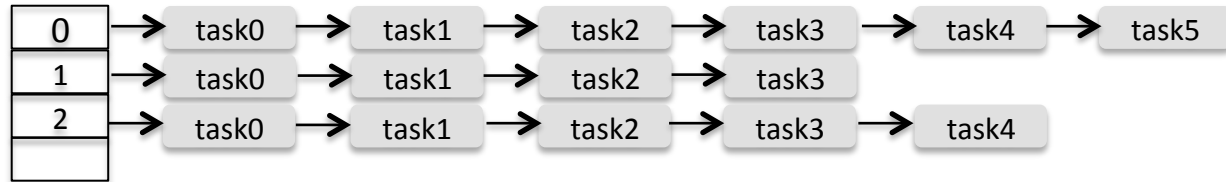
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Media Server

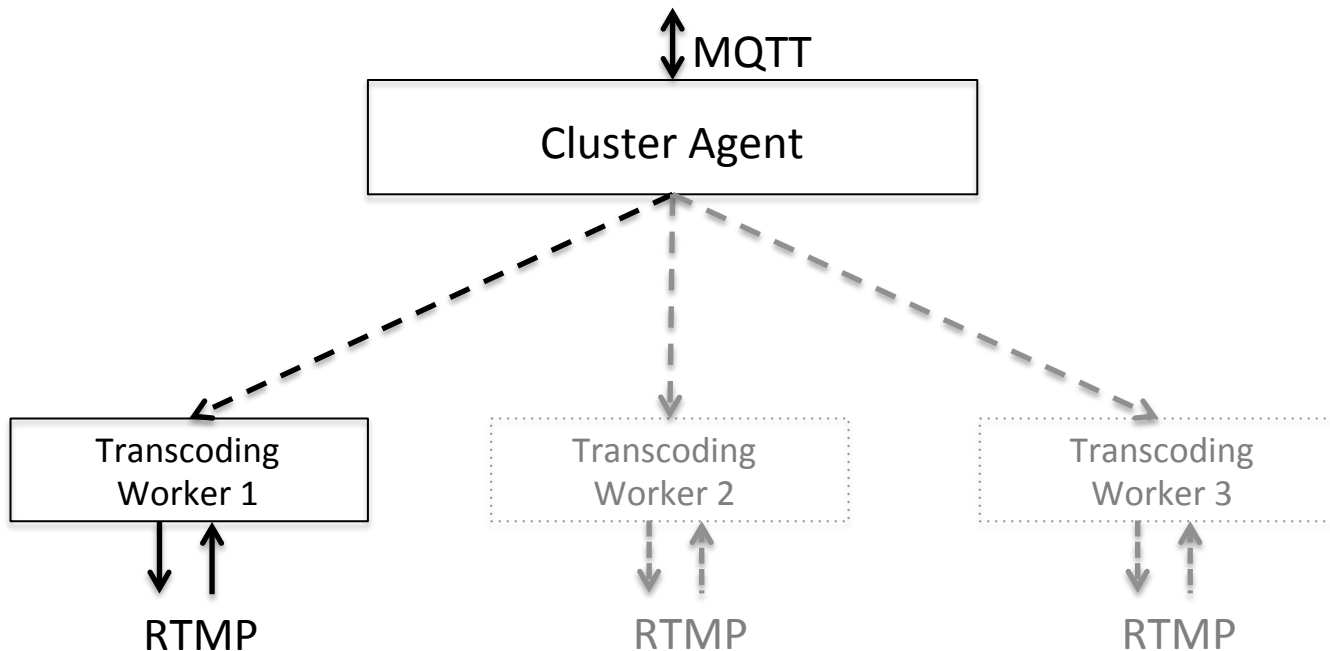
- Receives RTMP pushes
- Cuts the video stream to chunks
- Generates the index files on the fly
- Supports both HLS and MPEG-DASH

Cluster Manager

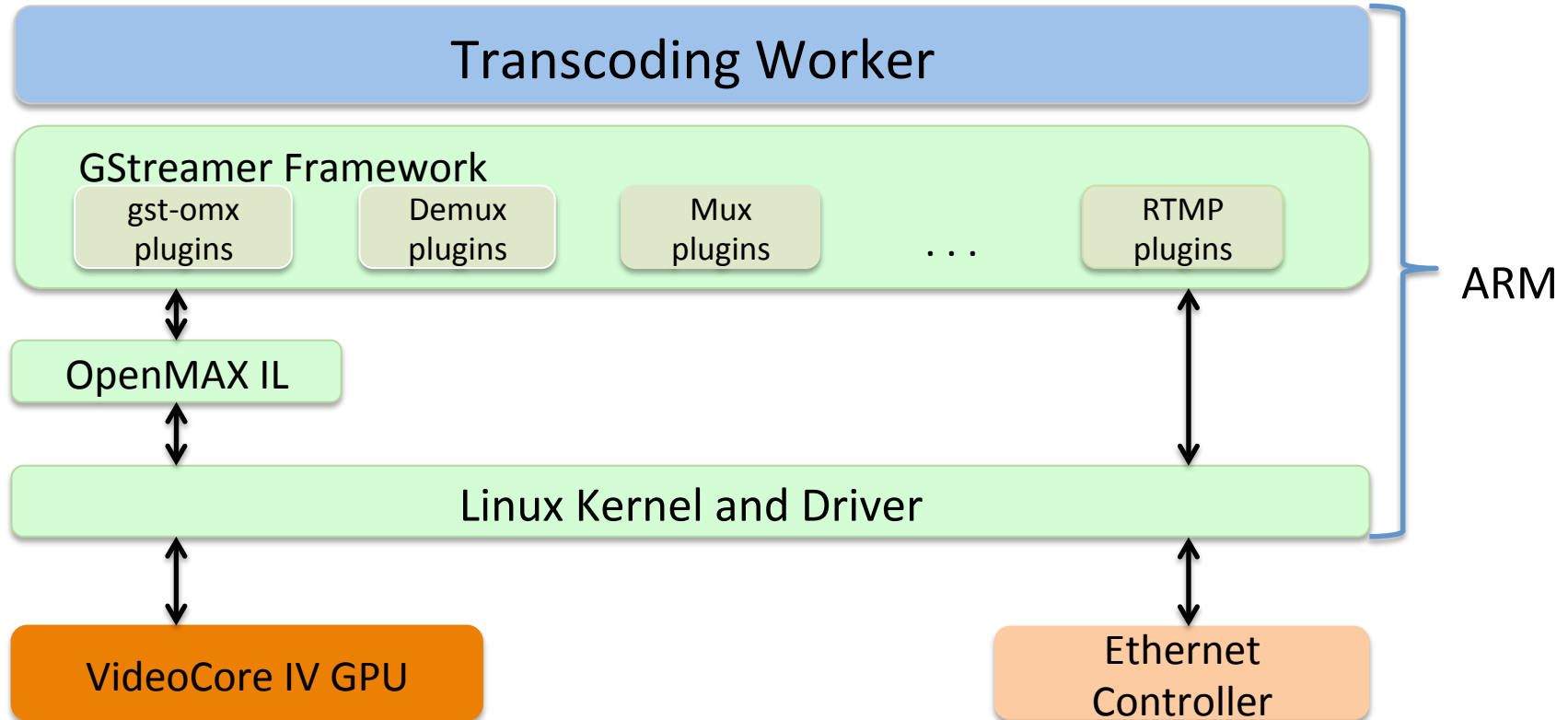
Task lists with different priorities



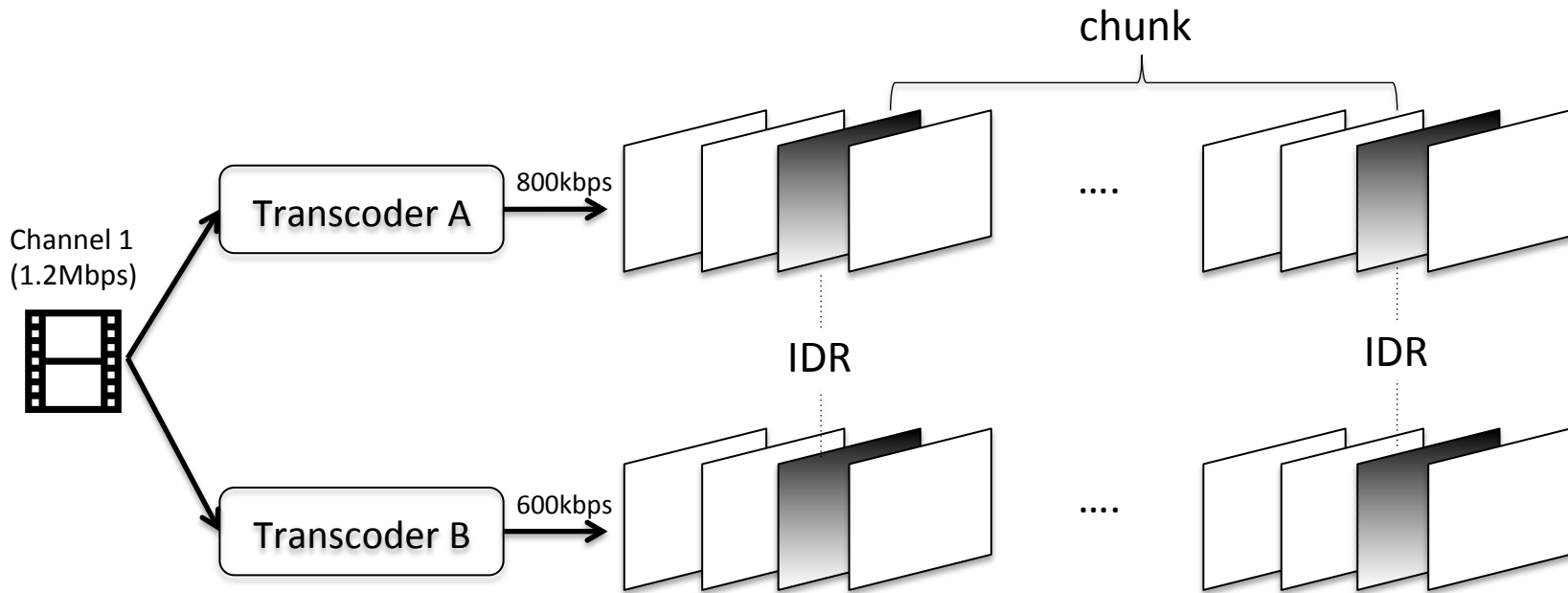
Transcoder Software Overview



Transcoding Worker Implementation

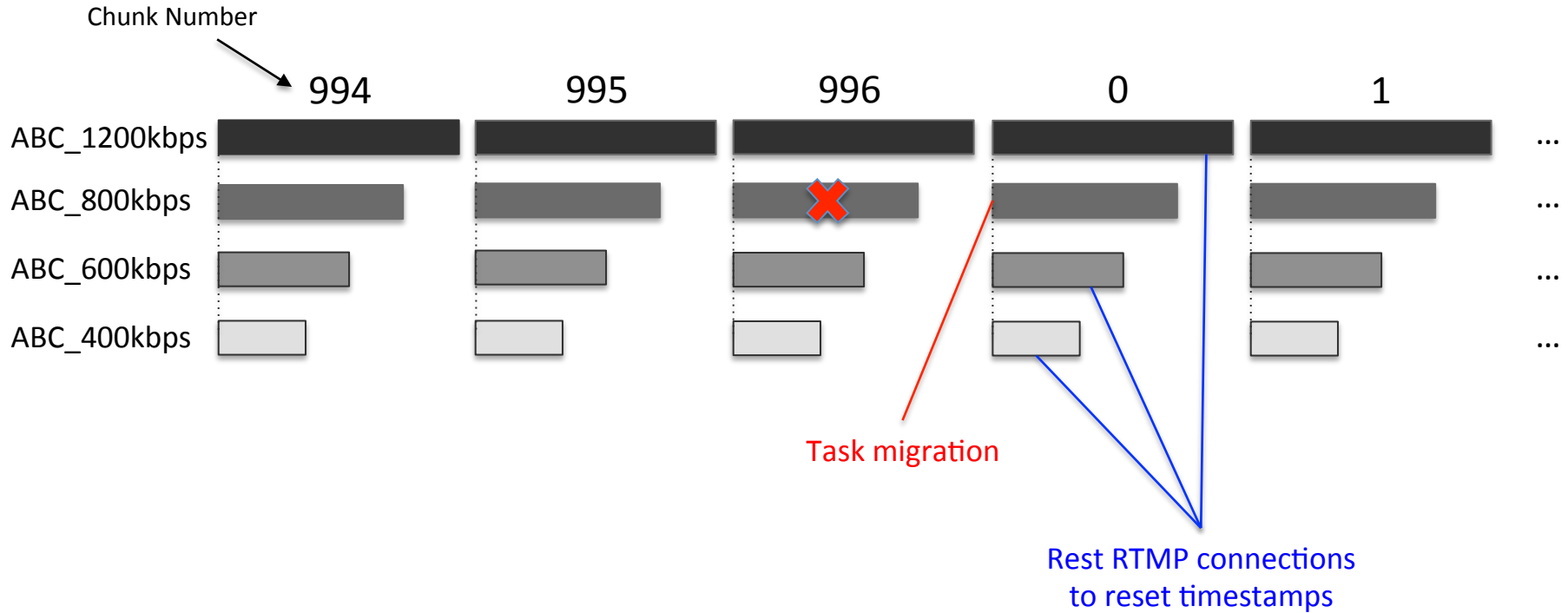


Transcoder Synchronization



Chunk numbers are generated from frames' timestamps

Transcoder Failure Handling



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Evaluation Setup

FFmpeg H.264 decoder +
x264 H.264 encoder

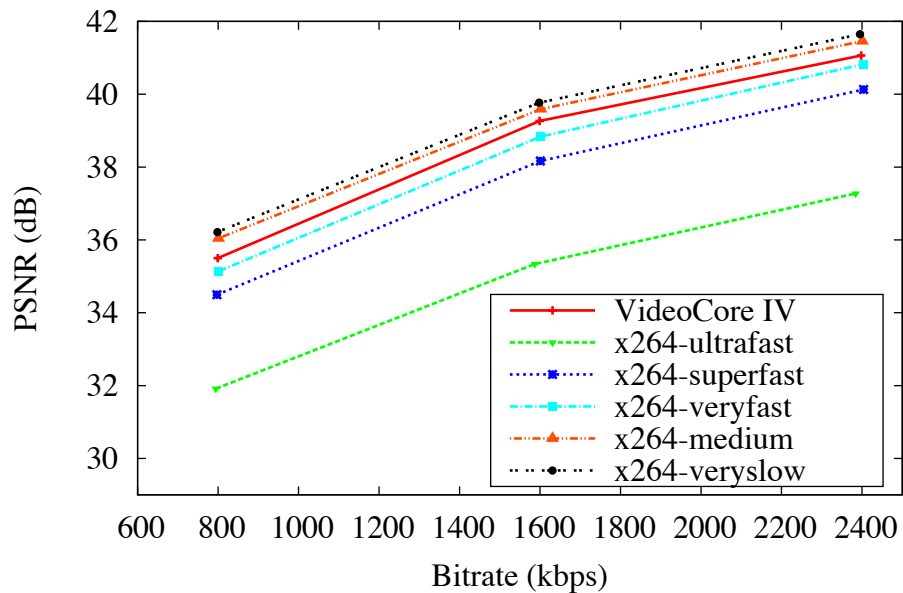
Intel i5 processor with all
the CPU capabilities
(MMX, SSE2, AVX etc.)
enabled

vs.

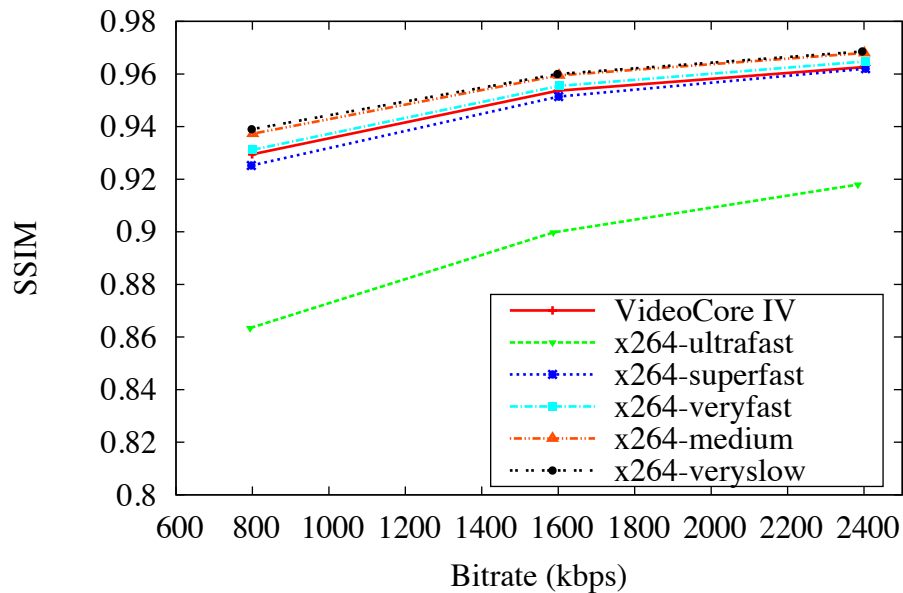
Transcoding worker on
Raspberry Pi Model B

Video Quality Evaluation

PSNR vs Bitrate



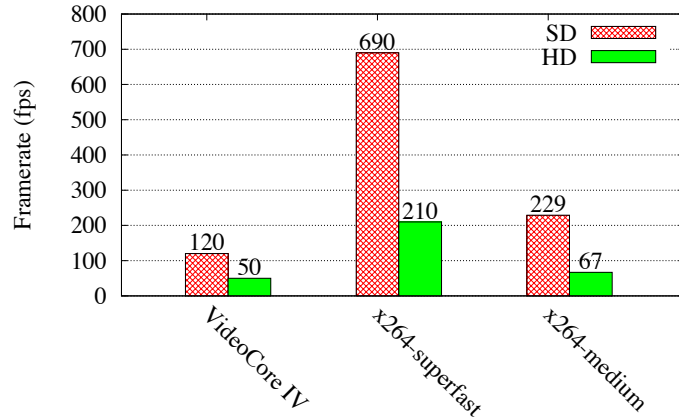
SSIM vs Bitrate



Source: An HD channel (1280x720, 30fps) with bitrate 4Mbps

Transcoding Speed And Efficiency Evaluation

Transcoding Speed



Transcoders

Video Sources:

SD: 720x480, 30fps, 1.2Mbps

HD: 1280x720, 30fps, 4Mbps

Transcoding Efficiency Estimation (SD)

	Speed(fps)	Power Consumption (W)	Efficiency
VideoCore IV	120	2.5	7
x264-superfast	690	100	1

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Deployment

- We are deploying VideoCoreCluster in a hybrid and incremental way
- Currently 27 channels are being transcoded
- More than 4000 sessions and about 480 total watching hours in a month (April 2016)

Summary

- A low-cost, highly efficient video transcoder cluster (VideoCoreCluster) for a live video streaming service

Thanks!
Q&A