BLUEDOT

Fast and Intelligent Visual Cloud Computing
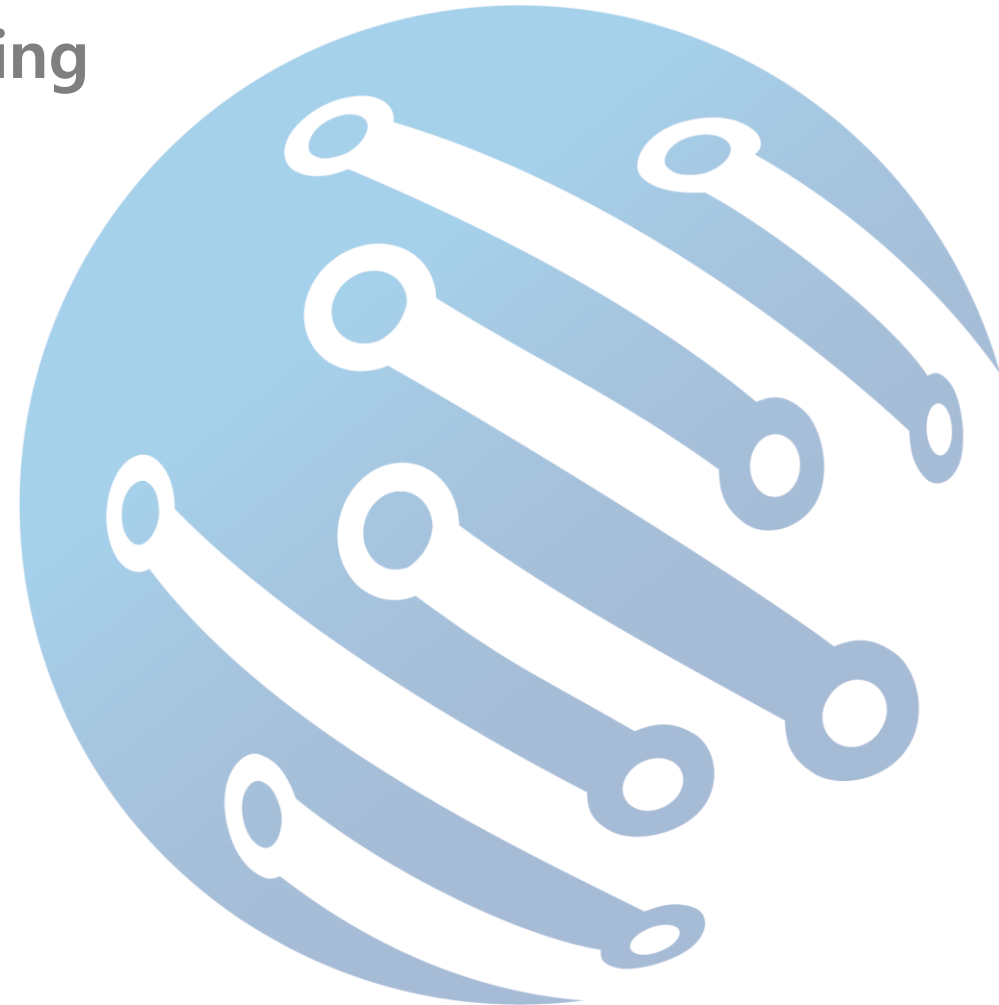
■ Contents

1. Company Profile

BLUEDOT is a video technology company specialized in developing AI for video processing algorithm and also in Semiconductor IP for video processing and codec.
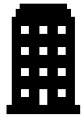
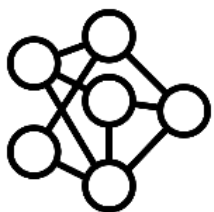Founded (2019.08)

Seoul, Korea

28 Employees (R&D 20)

Series B

Investors

bluepoint partners

Square Ventures

Smilegate Investment

POSTECH HOLDINGS

D2 STARTUP FACTORY NAVER

GU Equity Partners (유)지유투자

KB Investment

Partners

AMD XILINX

NAVER

2. Core Technologies Overview

Algorithm Development   Implementation   **Acceleration**

Software

Pretrained AI inference

Lightweighted,
Hardware optimized

GPU

Deployed on
GPU Acceleration Card

ON-PREMISE

CLOUD

AI models trained for
video processing algorithms

**High performance
Highly efficient
Higher quality per bit rate**

Hardware IP

Hardware IP

FPGA

Deployed on
FPGA Acceleration Card

ON-PREMISE

CLOUD

**Next generation
Video and Image Codec**
(**AV1 AVIF**)

3. Product Line-up

Accelerator Card for Data Center Server or CLOUD

Integrated into ffmpeg framework

Developers
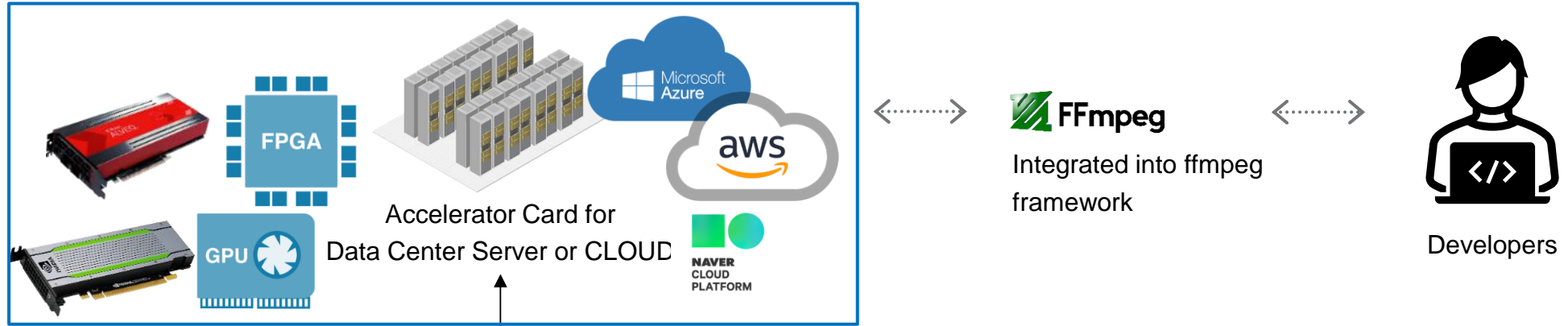
PROCESSING
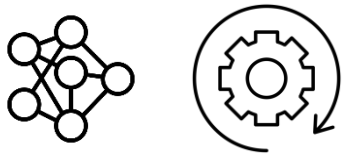
AI-based

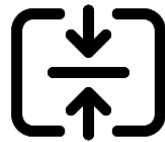1. Video **Super Resolution** for enhancing and upscaling
2. **Burn-in subtitle remover**
3. Video **Perceptual Quality Optimizer** for better encoding efficiency

ENCODING

4. **AV1** Video Encoder
5. **AVIF** Image Encoder

QUALITY MEASURING

6. **VMAF** video quality metric Accelerator

Solutions for customers' service value-up and differentiation

DeepField-SR

DeepField-Subtitle Remover

3-1. DeepField-SR : Video Super Resolution (Enhancing & Upscaling)

Pretrained AI techniques upscale your older contents to 4K and 8K with sharpness and details compared to conventional methods

Noise removal
- AI based
- Noise & Coding Artifact

Enhancing
- AI based
- Sharpness
- Texture
- Human face
- Low light

Upscaling
- AI based
- x1 ~ x4
- SD, HD -> FHD, 4K, 8K

▶ New revenue can be generated by leveraging past contents.
▶ Viewing Experiences can be enhanced.

1st place in Xilinx Adaptive Computing Challenge 2020

Bicubic Interpolation (HD -> 4K)　　　**BLUEDOT AI MODEL (HD -> 4K)**

VS.

Original (2004yr)
SD (720x480)

Upscaled
FHD (1920x1080)

3-2. DeepField-BSR : Burn-in Subtitle Remover / Extractor

Global OTT platforms demand the video contents from the world
but require them meet the global standards such as non-subtitled version contents required.

Days of work by one man is required to remove burn-in text and in-painting from one video

AI burn-in subtitle/text remover + **AI** video in-painting

extracted subtitle.srt

textless Master version

extracted subtitle.srt for translation

▶ Task Efficiency surpasses manual efforts.
▶ Allowing for the effective reallocation and utilization of existing manpower.

Subtitle remove

수입, 배급 | ㈜ 이놀미디어

Solutions for lowering the cost
to stream and store media

DeepField-PQO
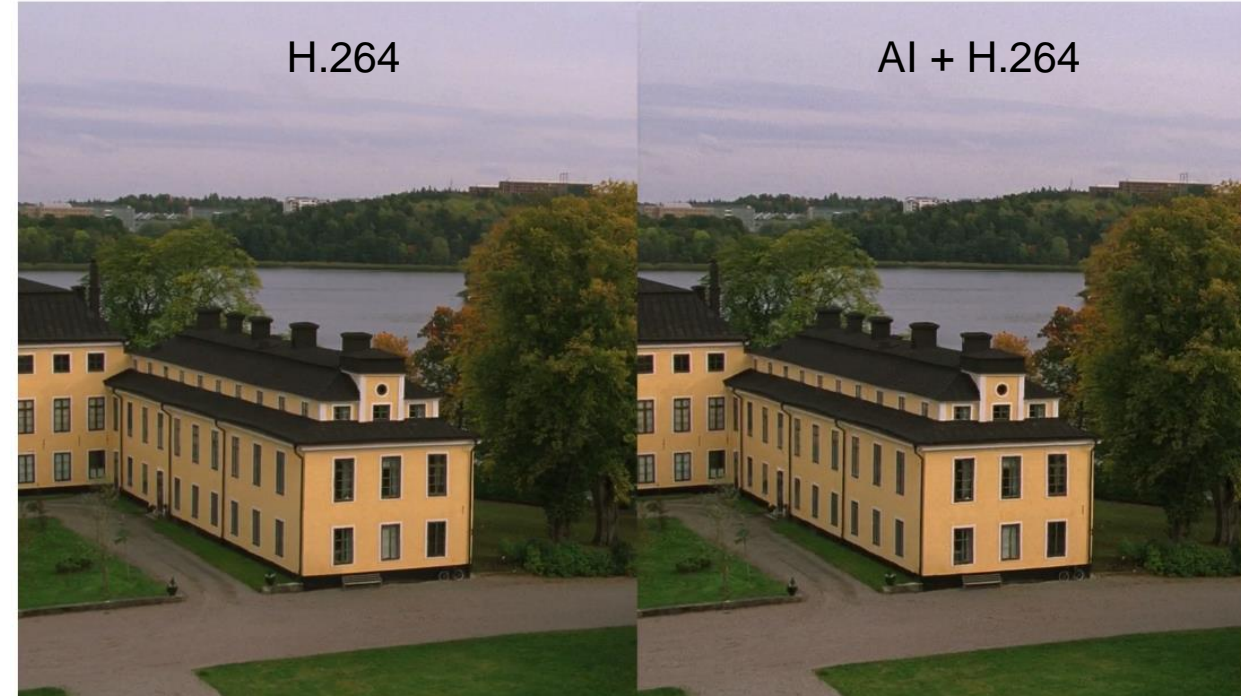
Pulsar-AV1

Pulsar-AVIF

Pulsar-VMAF

3-3. DeepField-PQO : Perceptual Quality Optimizer for Video Encoding

Perceptual Quality Optimizer is an AI based pre-processor that improves **Video Encoding Efficiency** while sustaining original video quality

Why Perceptual Quality Optimizer needs?

✓ Providing high quality video streaming service but under low bandwidth network

✓ Cutting the increased cost of storage and network for video data

✓ Still high cost to replace the existing codec with new codec

BLUEDOT deployed AI based Perceptual Quality Optimizer

on U250 at MS Azure, processing **4K60p** x 4ch ~ 5ch

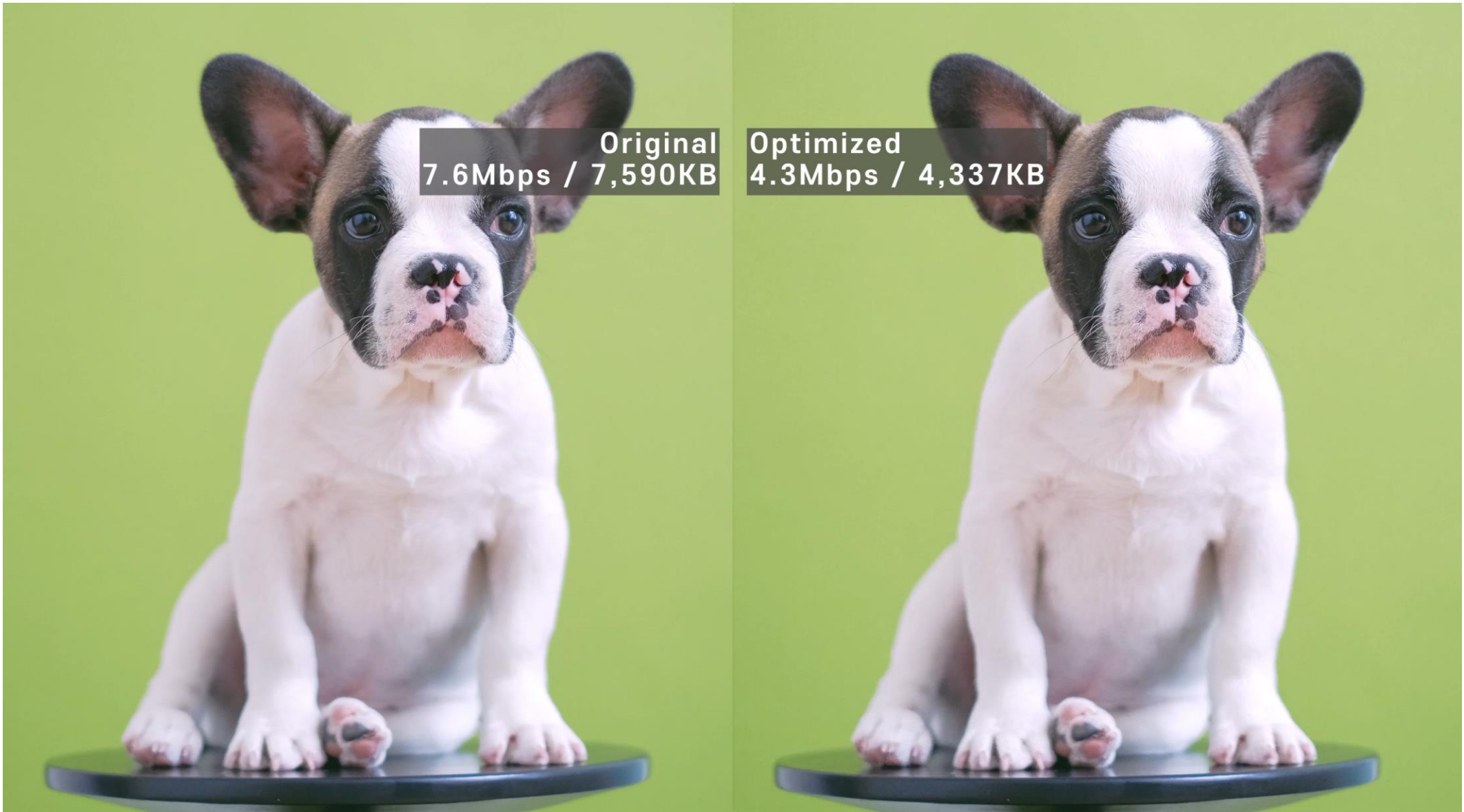H.264   AI + H.264

No preprocess
- 8,198kbps
- VMAF score = 83

AI preprocess
- 5,452kbps
- VMAF score = 87

33% data rate reduced with BLUEODT's

perceptual quality optimizer
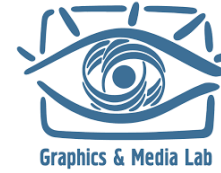
Original
7.6Mbps / 7,590KB Optimized
4.3Mbps / 4,337KB

3-4. Pulsar-AV1 : FPGA-accelerated AV1 Video Encoder

50% more efficient than h.264

20% more efficient than h.265

Graphics & Media Lab

Top 3 Best AV1 Encoder at MSU benchmark

SW_AV1 on CPU vs. BLUEDOT_AV1 on FPGA

Encoding Efficiency

Screen content, B-frame=0

Anchored to x264 at placebo preset

-25.75

svt-av1 preset=8

-42.27

BLUEDOT_AV1

| 0 | -5 | -10 | -15 | -20 | -25 | -30 | -35 | -40 | -45 |

BDBR in VMAF (%)
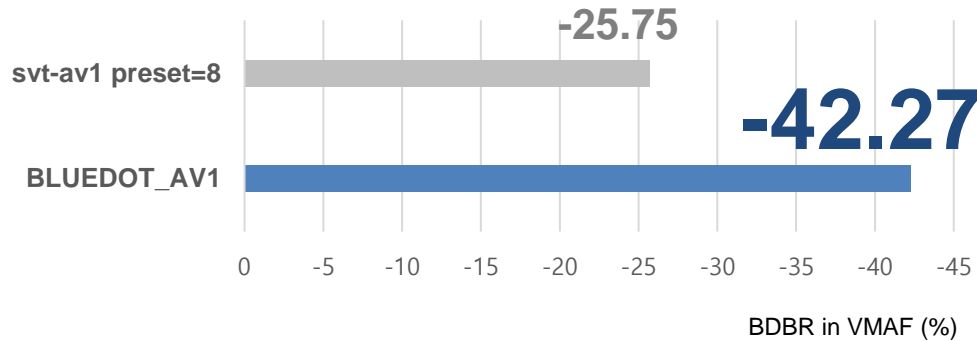
BLUEDOT_AV1 is more encoding efficient

than svt-av1 SW(CPU) encoder

- Better quality at given bitrate
- Smaller file size at the same quality

Encoding Speed

Screen content, B-frame=0

based on 1920x1080 resolution

svt-av1 (v1.2.1) on AWS EC2 c5.9xlarge

BLUEDOT_AV1 on MS Azure NP-series

(AMD Alveo U250 FPGA)

43.87

svt-av1 preset=8

60

BLUEDOT_AV1

| 0 | 10 | 20 | 30 | 40 | 50 | 60 |

Frame rate (fps)
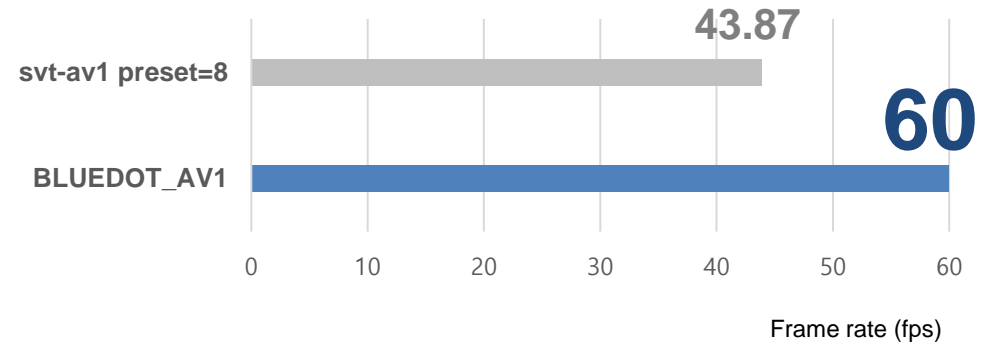
BLUEDOT_AV1 encodes **1.4**x faster

than svt-av1 SW(CPU) encoder

Better quality at given bitrate

x264_placebo
1080p 2.6Mbps

BLUEDOT_AV1
1080p 2.6Mbps

3-5. Pulsar-AVIF : FPGA-accelerated AVIF Image Encoder

80% more efficient than PNG

40% more efficient than JPEG

SW_AVIF on CPU vs. BLUEDOT_AVIF on FPGA

General AVIF Image Encoder svt av1 3840x2160

Status : Running

AWS c6i.12xlarge
Intel(R) Xeon(R) Platinum 8375C CPU @ 2.90GHz, vcpu 48

$ 2.04 /hour

1.07 img/sec

77 processed images

x20.1 FASTER   CHEAPER

BLUEDOT AVIF Image Encoder Pulsar-AVIF 3840x2160
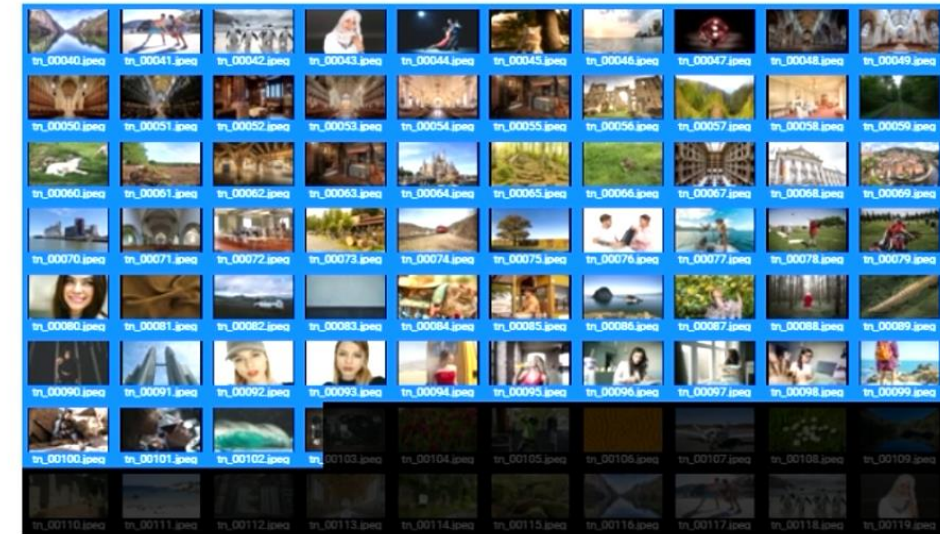
Status : Running

Azure NP10
Xilinx FPGA U250 / Intel(R) Xeon(R) Platinum 8171M CPU @ 2.60GHz vcpu x10
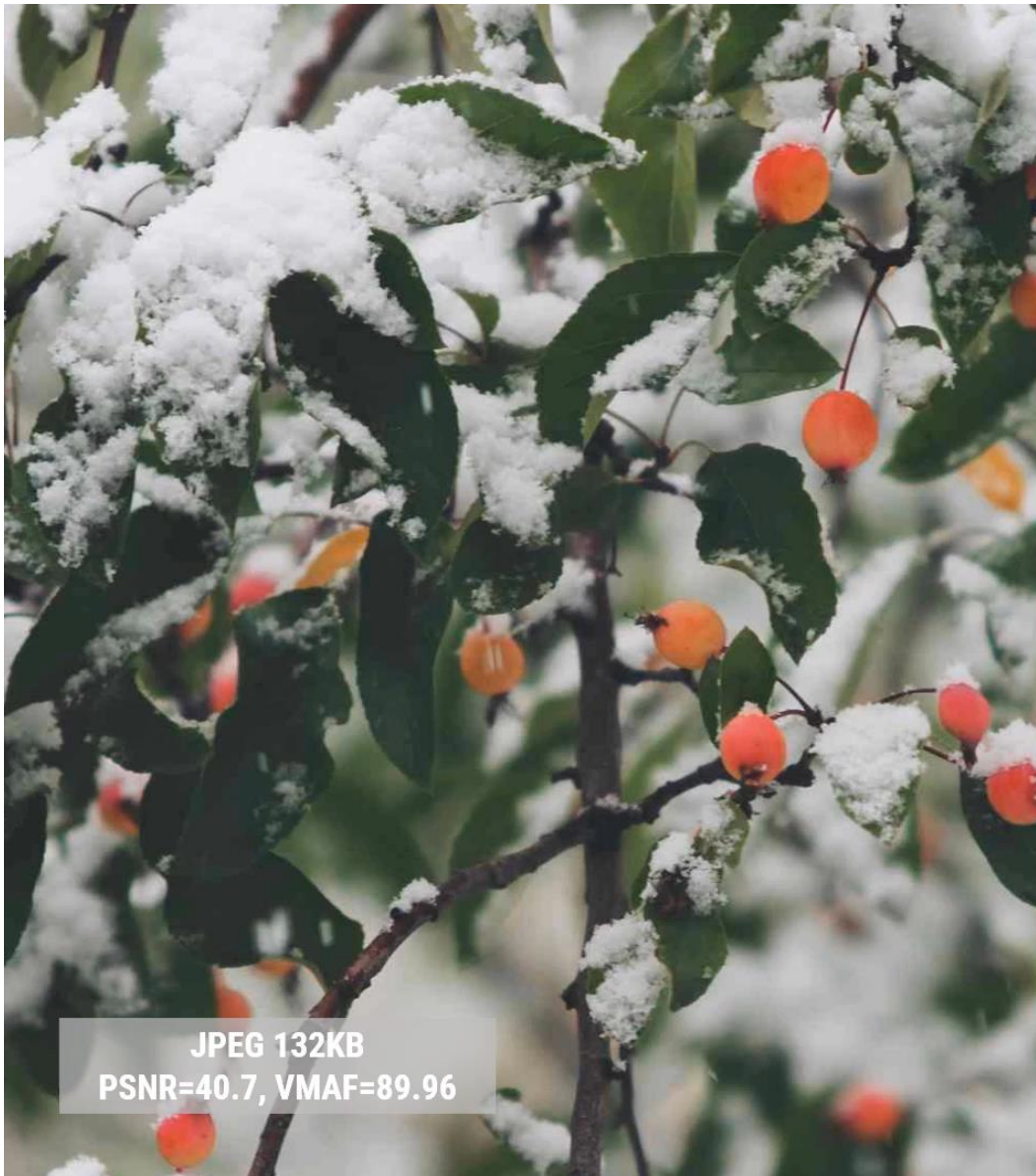
$ 1.65 /hour

21.50 img/sec

1706 processed images

BLUEDOT_AVIF encodes **20**x faster
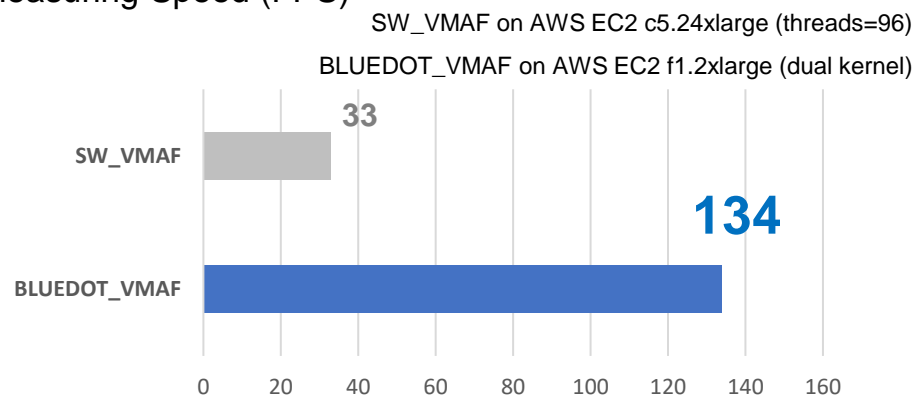than SW_AVIF

JPEG 132KB
PSNR=40.7, VMAF=89.96

AVIF 67KB
PSNR=42.01, VMAF=88.62

3-6. Pulsar-VMAF : FPGA-accelerated Video Quality (VQ) Metric

SW_VMAF on CPU vs. BLUEDOT_VMAF on FPGA

Measuring Speed (FPS)

SW_VMAF on AWS EC2 c5.24xlarge (threads=96)
BLUEDOT_VMAF on AWS EC2 f1.2xlarge (dual kernel)

BLUEDOT_VMAF measures **4**x faster
than SW_VMAF

	FPS	Price/hr	Cost Per Frame
SW_VMAF	33	$4.080	$0.124
BLUEDOT_VMAF	**134**	**$2.350**	**$0.018**

BLUEDOT_VMAF costs **7x** lower
than SW_VMAF

For Per-title, Per-shot Video Encoding

In order to deliver a quality video streaming service that is appropriate for screen size or network conditions, service providers encode video in various combinations (bitrate, resolution). This is called ABR (Adaptive Bitrate).

By finding the optimal combination (bitrate, resolution) per Per-title or Per-shot, service providers can offer the better viewing experience and save network usage cost

BUT, finding the optimal combination (bitrate, resolution) requires **dozens** of iteration of encoding and measuring VMAF

Pulsar-VMAF

▶ reduces time and cost and increases the speed

4. Use Case

Various Industries

Value-UP & Cost-Down

4-1. CLOUD : Ex) DeepField-SR

Deployed in CLOUD Data Center By. BLUEDOT

APIs

Web Server

API Service

WebUI Service

REST API with FFMPEG
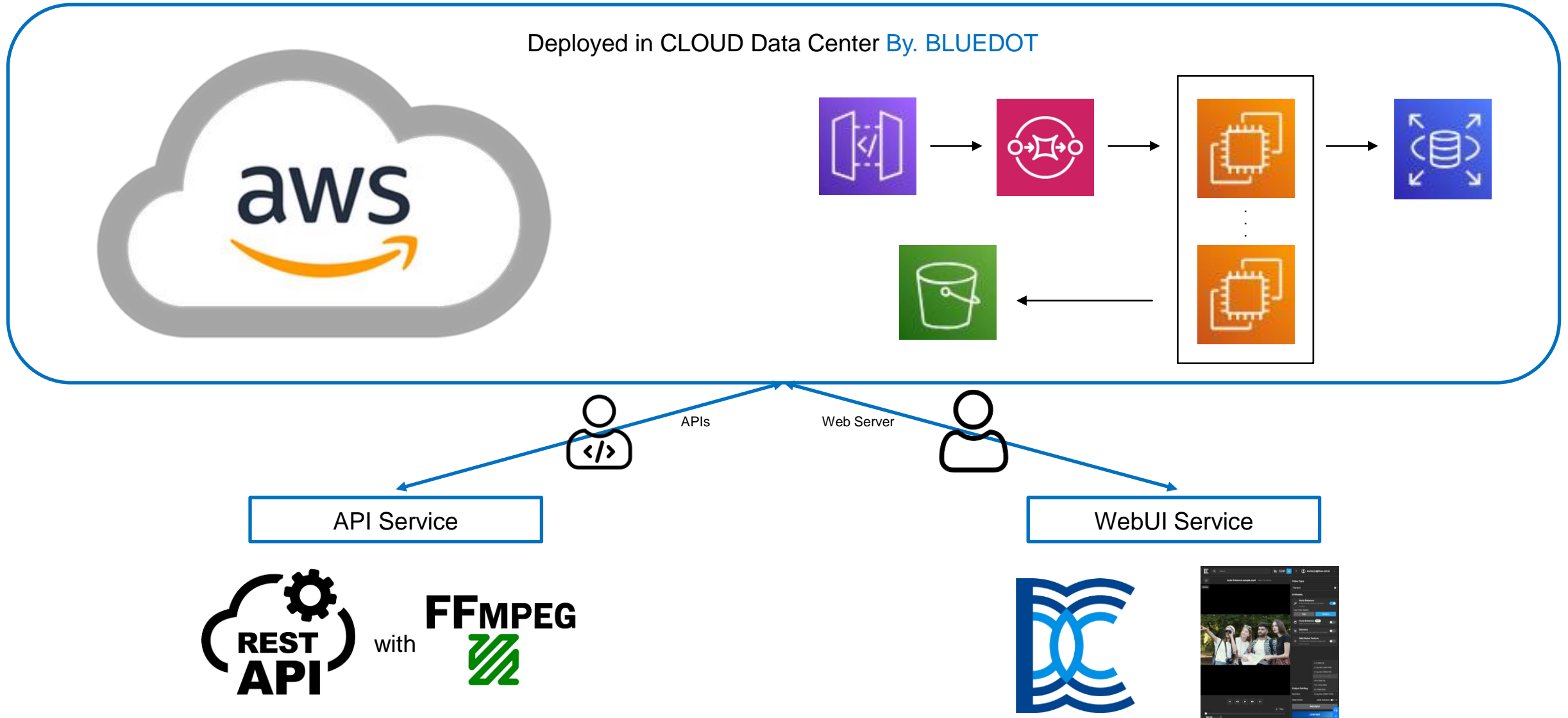
4-2. On-Premise : Ex) DeepField-PQO

Deployed in On-Premise(ex. Transcoder) By. BLUEDOT

GPU

FPGA

DeepField-PQO in **FFMPEG**

Transcoder

Acceleration Card

FFMPEG

LIVE

VOD

DEMUX

REMUX → PACKAGING

DECODE
(H.264/H.265)

ENCODE
(H.264/H.265)

Video Codec

DeepField-PQO
Acceleration Card

**Video Processing
by BLUEDOT**

CDN

STORAGE
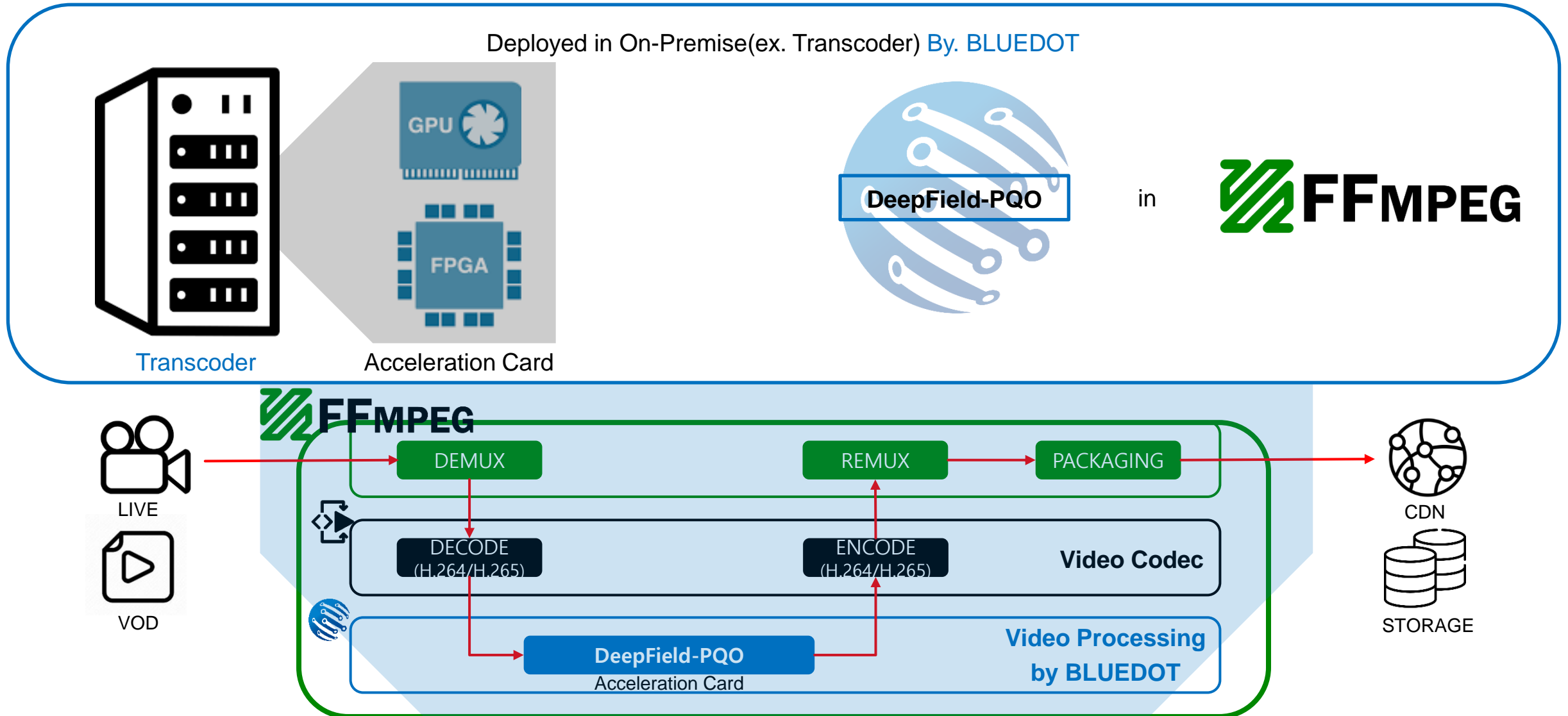
THANK YOU

Contact : daniel.ju@blue-dot.io

■ Pulsar-VMAF 및 DeepField-PQO 를 활용한 최적화 Use Case

		FHD to UHD (Upscale)			FHD to Resolution					
		Customer	**BLUEDOT**		Customer	**BLUEDOT**		Customer	**BLUEDOT**	
Version				**Saving Bitrate**			**Saving Bitrate**			**Saving Bitrate**
	Option	Opensource+H.265	**SR+PQO+H.265**		H.265	**PQO+H.265**		H.265	**PQO+H.265**	
Resolution		2160p	2160p		1080p	1080p		720p	720p	
Bitrate		9629 Kbps	6630 Kbps	**31.15%**	5134 Kbps	1485 Kbps	**71.08%**	2114 Kbps	915 Kbps	**56.72%**
VMAF ※ VMAF score based Original UHD & FHD	MIN.	72.77412	70.00650		74.32695	72.65739		70.74099	71.03288	
	MAX.	100.00000	100.00000		100.00000	100.00000		98.76622	100.00000	
	AVG.	93.00877	**94.96309**	Score High	92.73882	**94.82429**	Score High	90.26926	**91.55025**	Score High
	95th Percentile	87.33115	**89.18284**	Score High	87.43298	**88.74992**	Score High	84.25068	**85.21113**	Score High

Original Source FHD (1080p)

■ VMAF Score Sample Frame   ※ Frame no. 762

UHD Original / -   UHD Customer / 90.445093   UHD BLUEDOT / 98.53573   FHD Original / -

FHD Customer / 92.024642   FHD BLUEDOT / 100.000000   720p Customer / 87.160792   720p BLUEDOT / 96.210519

DeepField-SR 을 활용한 가치제고 Use Case

FHD -> UHD (by. DeepField-SR)

FHD -> UHD (by. DeepField-SR)

FHD -> UHD (by. DeepField-SR)

FHD -> UHD (by. DeepField-SR)

※ 출처 : Jurassic World 2015 Trailer (1080p)