WHITE PAPER

Product performance for ARTPEC-8

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AXIS COMMUNICATIONS

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1 Introduction

At Axis, we develop our own integrated circuits. They provide our broad portfolio of video cameras and encoders with optimal video compression abilities, as well as superior imaging, opportunities for advanced analytics applications, and much more. Our latest SoC (system on a chip) is ARTPEC-8.

This white paper presents measurement results for a systematic understanding of the performance, in terms of streams and frame rates, of Axis products based on ARTPEC-8. The paper is intended for technical personnel and system integrators.

2 Quantifying performance

The performance of a video product can be measured by how many simultaneous streams (with given resolutions and frame rates) it can deliver. Each stream should be individually configured, meaning that the clients should not access cached data. A video product can, in general, deliver many more streams that have identical configurations, than individually configured streams.

3 Factors affecting performance

It is hard to predict exactly how many simultaneous, individually configured streams with maximum resolution and full frame rate a video product will deliver in all situations. The overall performance depends on:

- CPU load or video compression load (ARTPEC-8) in the video product
- Total data throughput (bandwidth) from the product and network infrastructure
- Client performance
- SoC configuration: ARTPEC-8 hardware comes in two different designs: normal configuration and limited configuration. Axis chooses which design to use in each product in order to optimize product performance. It is not possible to change this configuration in a finished product.

From a user perspective, the following are the most common parameters that could affect the overall performance negatively:

- High image resolution
- Low image compression level
- Mixing Motion JPEG and H.264/H.265 streams
- A large number of clients accessing the server simultaneously
- Clients accessing different image settings (resolution, compression, etc.) simultaneously
- Heavy usage of event settings
- Motion detection enabled
- HTTPS
- Poorly performing client PC which does not decode all images
- Limited or poor network infrastructure. Frames will be dropped when network is congested.

There are also factors in the monitored scene that could affect the performance:

- The complexity of the image
- The lighting conditions

4 Measurements and results

We investigated the performance through measurements using the following setup:

- Factory default values
- Image complexity: realistic scene
- Each stream was unique, meaning that the clients should not access cached data. The compression level varied from 30 to 39 (up to ten different streams) for H.265 and H.264.

4.1 4K (3840x2160), max 60 fps, normal configuration

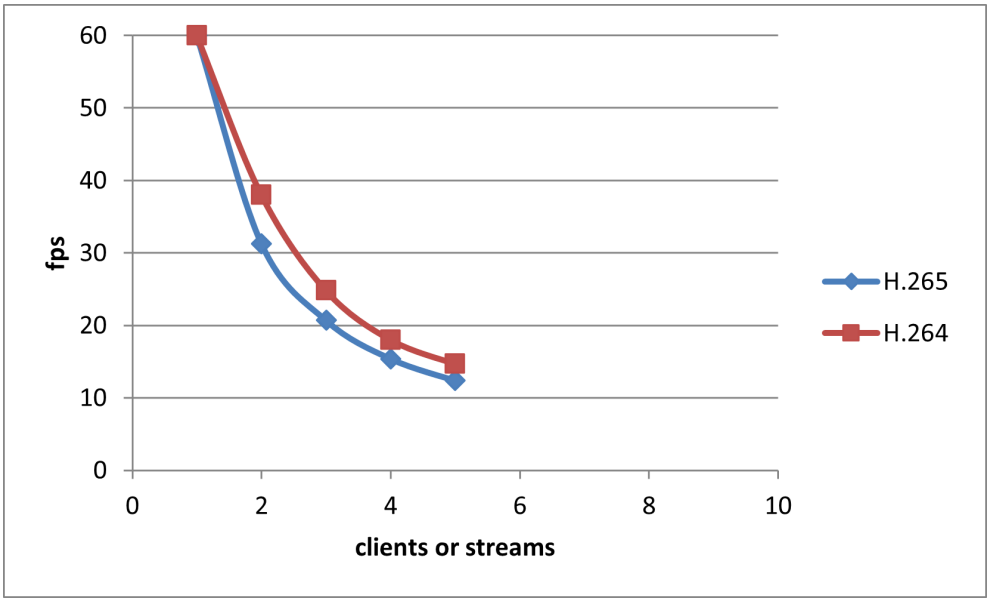

Figure 1. 4K (3840x2160) resolution, realistic scene, max fps: 60. The tested product had the normal ARTPEC-8 hardware configuration.

4.2 4K (3840x2160), max 30 fps, normal configuration

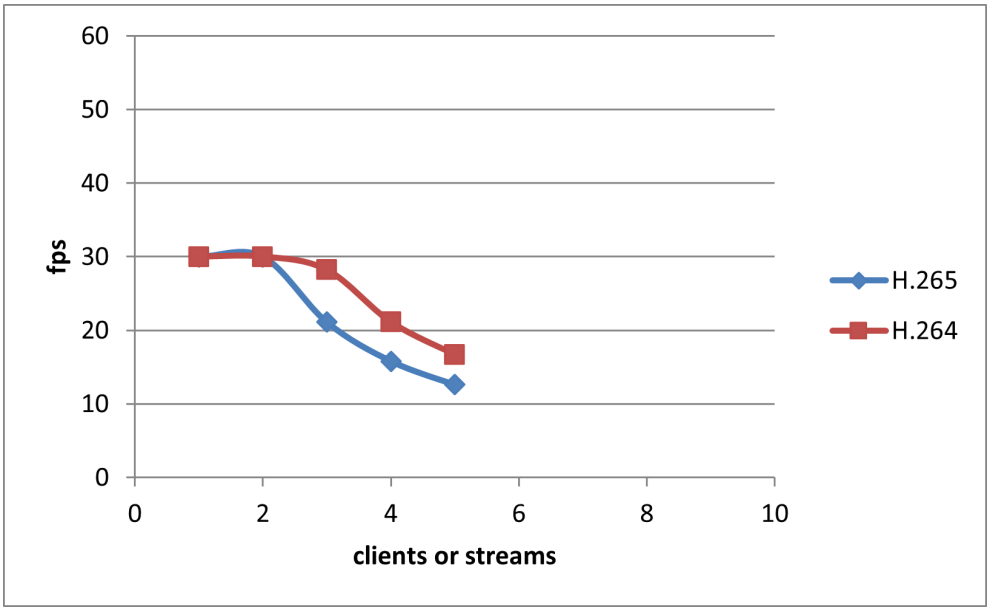

Figure 2. 4K (3840x2160) resolution, realistic scene, max fps: 30. The tested product had the normal ARTPEC-8 hardware configuration.

4.3 HDTV 1080P (1920x1080), max 60 fps, normal configuration

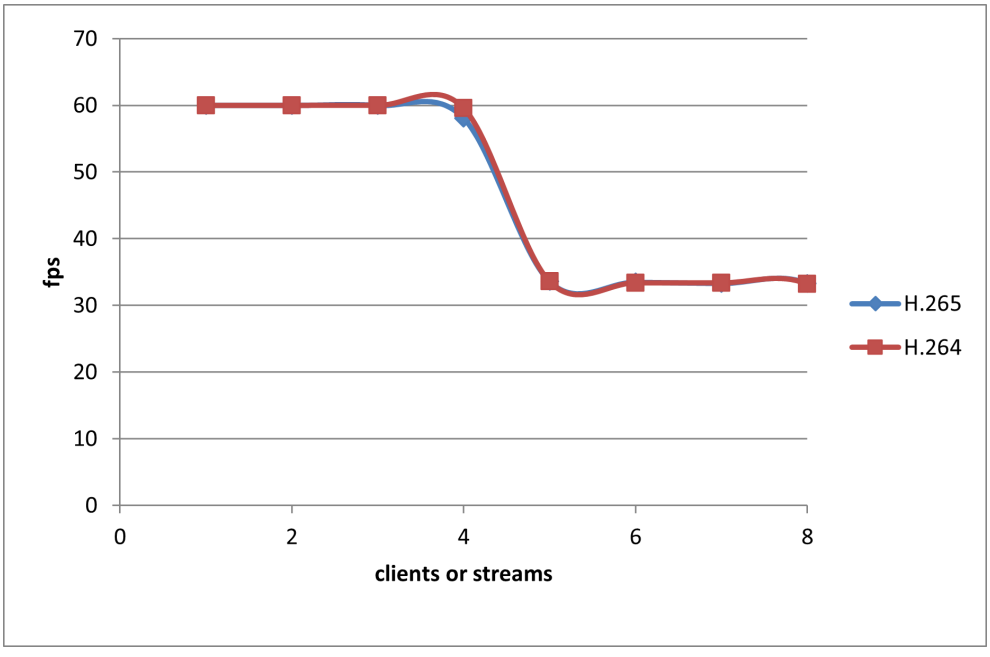

Figure 3. HDTV 1080P (1920x1080) resolution, realistic scene, max fps: 60. The tested product had the normal ARTPEC-8 hardware configuration.

4.4 HDTV 1080P (1920x1080), max 30 fps, normal configuration

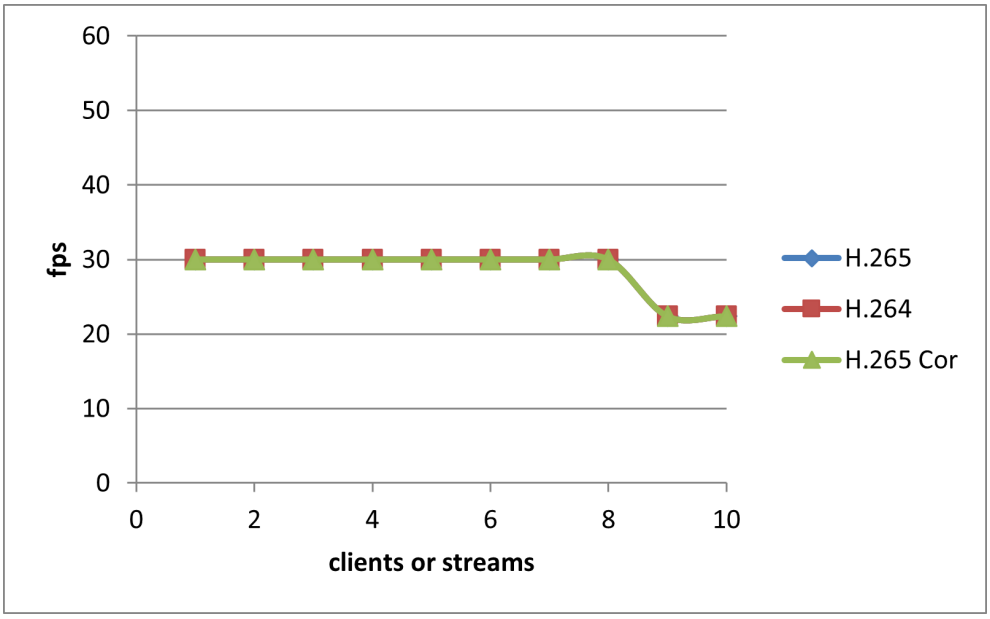

Figure 4. HDTV 1080P (1920x1080) resolution, realistic scene, max fps: 30. The tested product had the normal ARTPEC-8 hardware configuration. For H.265, both standard format and corridor format were tested.

4.5 4MP (2688x1512), max 60 fps, limited configuration

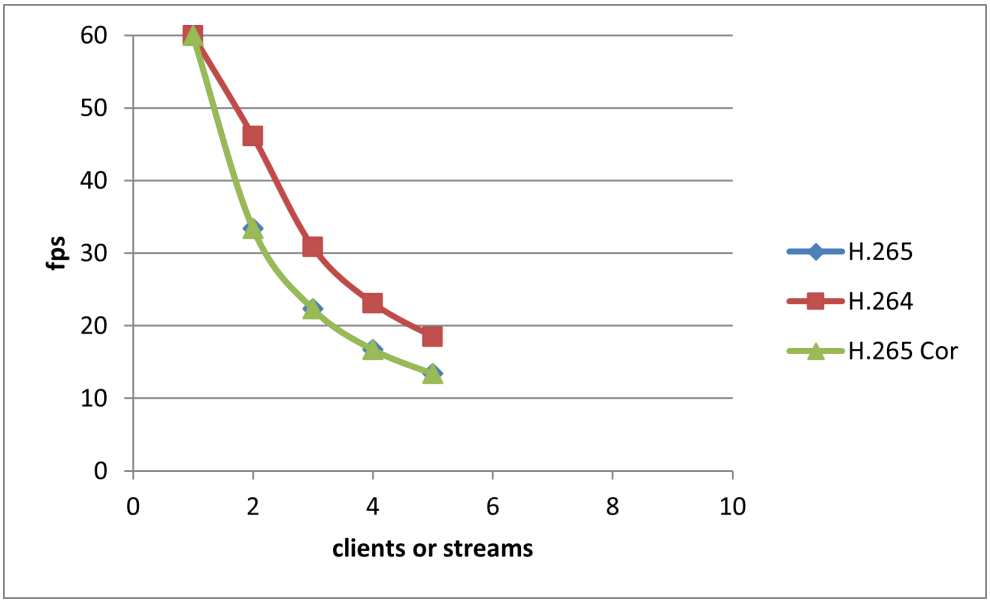

Figure 5. 4MP (2688x1512) resolution, realistic scene, max fps: 60. The tested product had the limited ARTPEC-8 hardware configuration. For H.265, both standard format and corridor format were tested.

4.6 4MP (2688x1512), max 30 fps, limited configuration

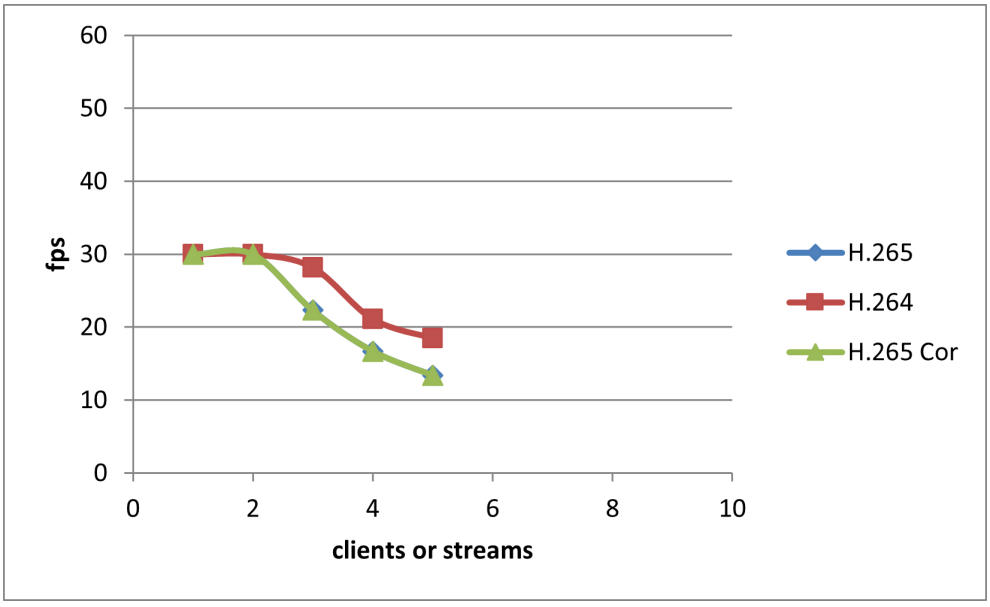

Figure 6. 4MP (2688x1512) resolution, realistic scene, max fps: 30. The tested product had the limited ARTPEC-8 hardware configuration. For H.265, both standard format and corridor format were tested.

4.7 HDTV 1080P (1920x1080), max 60 fps, limited configuration

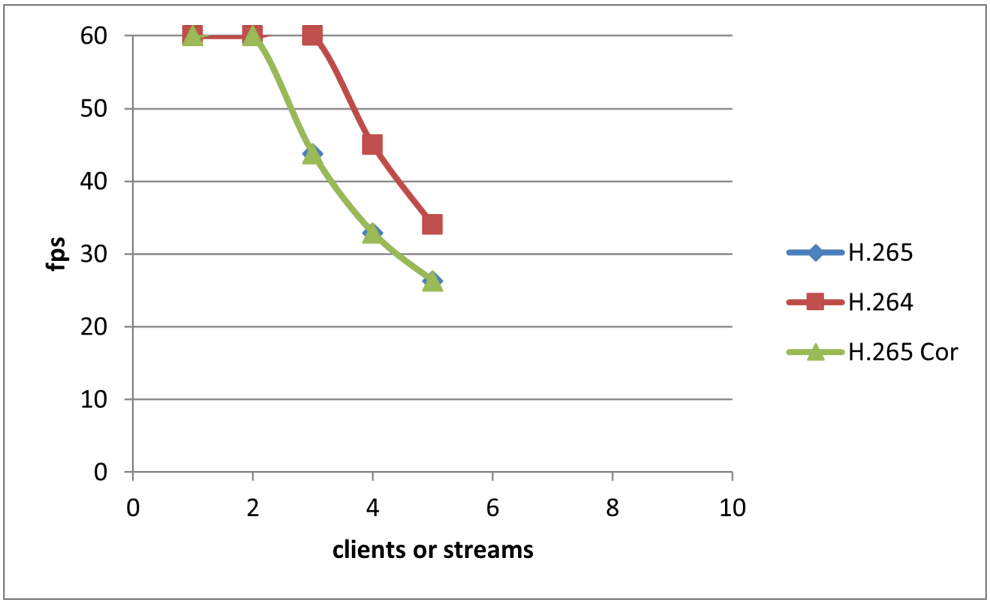

Figure 7. HDTV 1080P (1920x1080) resolution, realistic scene, max fps: 60. The tested product had the limited ARTPEC-8 hardware configuration. For H.265, both standard format and corridor format were tested.

4.8 HDTV 1080P (1920x1080), max 30 fps, limited configuration

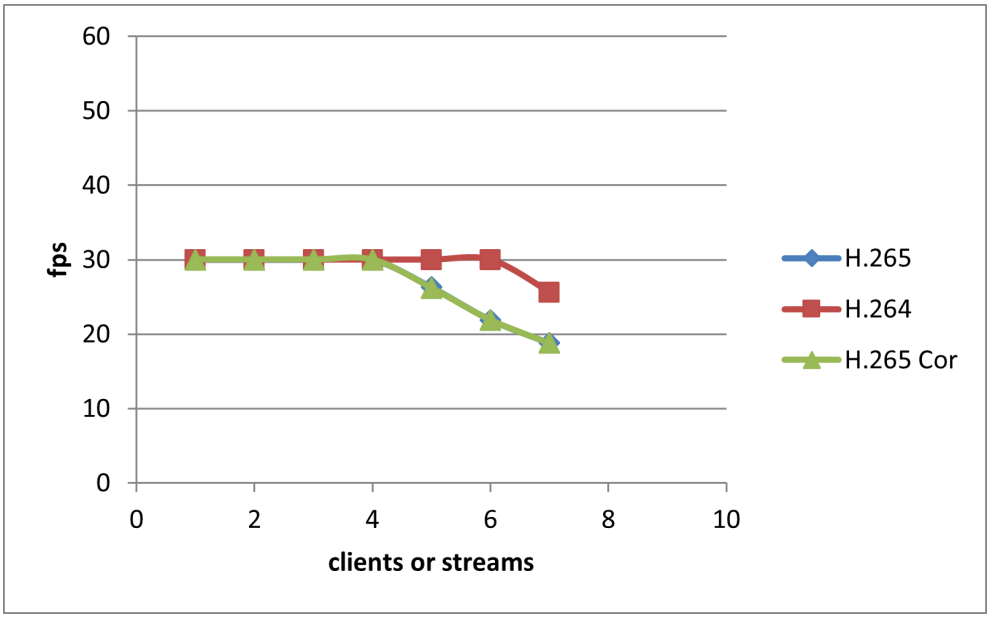

Figure 8. HDTV 1080P (1920x1080) resolution, realistic scene, max fps: 30. The tested product had the limited ARTPEC-8 hardware configuration. For H.265, both standard format and corridor format were tested.

5 Discussion

If the image scene, compression level, and compression method are kept constant, an increase in resolution will decrease the number of full frame rate streams or cause the frame rate per stream to decrease.

When the resolution is increased to, for example, 4K, the frame rate will be dropped as the number of streams is increased. However, ARTPEC-8 can still achieve one H.265 stream of 4K at 60 fps (Figure 1).

The test results also show that ARTPEC-8 can deliver two simultaneous H.265 streams in 4K at 30 fps (Figure 2) or four simultaneous H.265 streams in HDTV 1080P at 60 fps (Figure 3) or eight simultaneous H.265 streams in HDTV 1080P at 30 fps (Figure 4).

In terms of number of streams and frame rate, the performance with Axis H.264 encoder is about the same as with Axis H.265 encoder, or slightly better. The performance with corridor format is about the same as with the standard format.

The test results indicate that the processing power (P_{CPU}), or total throughput, of ARTPEC-8 can reach 498 megapixels/s for the normal configuration and 263 megapixels/s for the limited configuration, both for H.265. We find this by using the following formula:

P_{CPU} = Frame rate x Image resolution x Number of unique streams

Note that the formula is not valid for the cases in Figure 3 and Figure 4. There is a fps drop from the 4th stream to the 5th stream in Figure 3 and a fps drop between the 8th and 9th stream in Figure 4. This is caused by the limitation of the number of image source instances, which is four by design in ARTPEC. It is not only the total output throughput that has a limit, but also the total input from the image sources. The input size was 4K at 60 fps in Figure 3 and 4K at 30 fps in Figure 4.

6 Conclusion

ARTPEC-8 makes the new generation of Axis video products even more powerful. A typical Axis camera with ARTPEC-8 can deliver one stream of 4K at 60 fps by H.265. A typical Axis camera with the limited version of ARTPEC-8 can deliver one stream of 4MP at 60 fps by H.265.

The performance, in terms of number of streams and frame rate, is approximately the same with corridor format as with the standard format.

Please note that the product datasheets are the official specification documents for Axis products.

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About Axis Communications

Axis enables a smarter and safer world by creating network solutions that provide insights for improving security and new ways of doing business. As the industry leader in network video, Axis offers products and services for video surveillance and analytics, access control, intercom and audio systems. Axis has more than 3,800 dedicated employees in over 50 countries and collaborates with partners worldwide to deliver customer solutions. Axis was founded in 1984 and has its headquarters in Lund, Sweden.

For more information about Axis, please visit our website *axis.com*.