The Benefits of PCoIP versus H.264 Protocols

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INTRODUCTION

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The Tech Question of 2018: Will PCoIP retain its position as the dominant codec for interactive computer applications or do H.264-based protocols offer more promise in terms of deliverables?
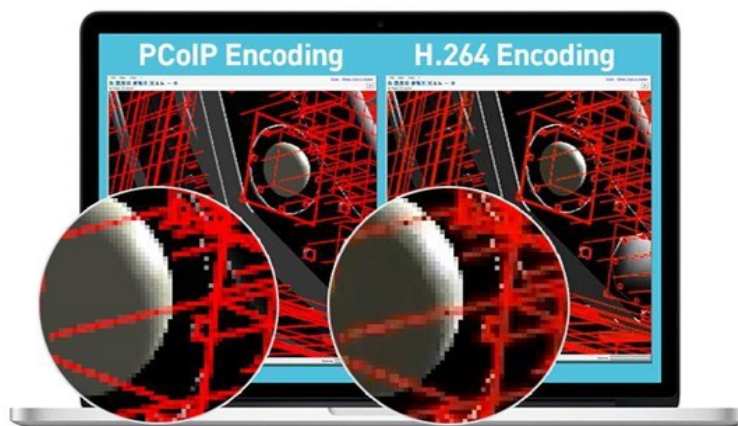
Before getting into the debate, let's explore the key difference that sets apart PCoIP and H.264. PCoIP is a groundbreaking remote display protocol technology that facilitates virtual desktops and delivers a high performance responsive computing experience. On the other hand, H.264 is a video encoding format that is frequently applied in the broadcast and video streaming industries. Since 2014, it has been popularly implemented by vendors for distributing HD video content in moderately low bitrates.

In this white paper, we will evaluate the advantages of using PCoIP against H.264-based protocols.
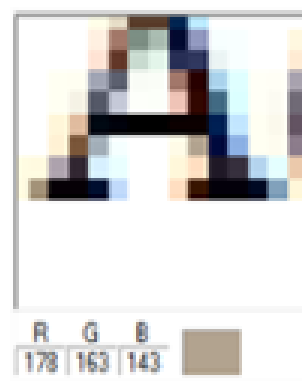
Encoding and Text Accuracy

PCoIP is renowned for its capacity to run graphic intensive applications and meet the heavy resource demands of multimedia. Owing to PCOIP's multi codec architecture that facilitates various displays including video, image and text, its encoding elements offer greater clarity and are more detail-oriented. However, using H.264, users would encounter distorted resolutions. This comparison is depicted in the diagram below.

With PCoIP, users also get to enjoy dynamic object compression and high resolution sessions. Considering PCoIP's ability to boost productivity by delivering superior display quality, speed and lossless spatial compression on text and related content, VDI users can get to enjoy images and fonts in their original CoolType formats. Conversely, H.264 supports a single codec and 4:2:0 Chroma subsampling which render inefficiencies in the form of lossy and grainy text compression and images. The result is similar to disabling the ClearType and CoolType software technologies that assist in enhancing text readability.
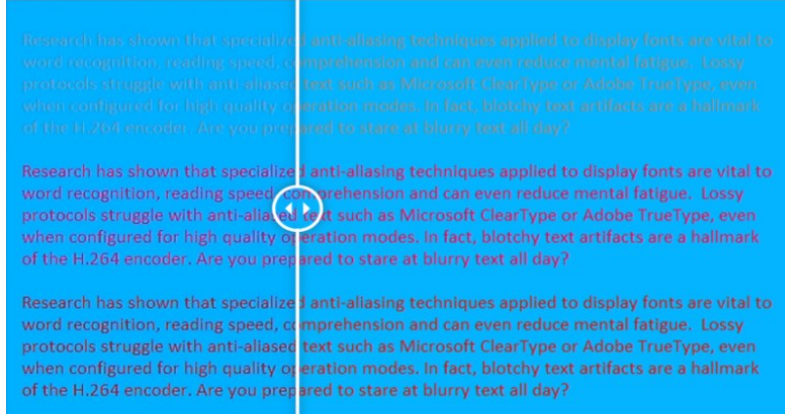

Original CoolType   Compressed with H.264

Additionally, by deploying PCoIP algorithms, the clearness of anti-aliased fonts is preserved, making them appear smoother and suitable for enlarged images. However, H.264-based protocols require thrice the bandwidth of PCoIP to convey flat images which lack depth, thereby producing substandard text and image clarity. Consequently, one limitation of H.264 is that it lacks the anti-aliasing capabilities of the PCoIP protocol. In this situation, users would experience slow reading speed and difficulties in word recognition and text comprehension.
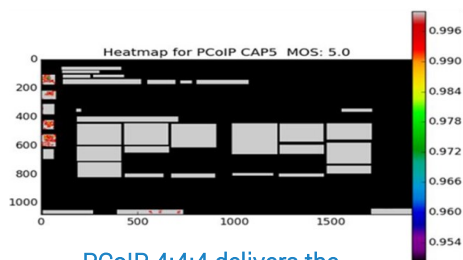

With PCoIP algorithms, anti-aliased text types remain crisp,
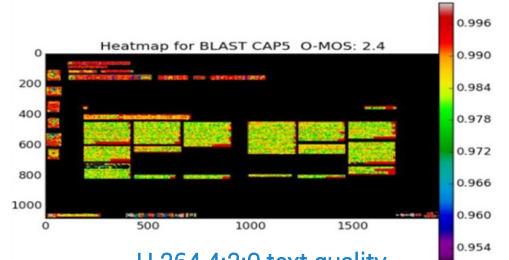*clear and always readable*

PCoIP and H.264 in SSIM Heat Map

The Structural Similarity (SSIM) index is a technique for reviewing the similarity between two structured images of the same quality in an identical workspace. Assessing the text quality of PCoIP 4:4:4* color mode against a reference image deploying the H.264 4:2:0* model, users can expect lossless and comprehensible text for PCoIP while the quality in H.264 is greatly compromised.

As we can see, the outcome of using SSIM with PCoIP results in a successfully compressed and interpretable image which would minimize bandwidth costs and boost website or application performance. In the same setting with H.264, the application of aggressive compression leads to a low quality result with rough color gradients and the 'color bleeding' problem, where the colors blur into one another's pixels.
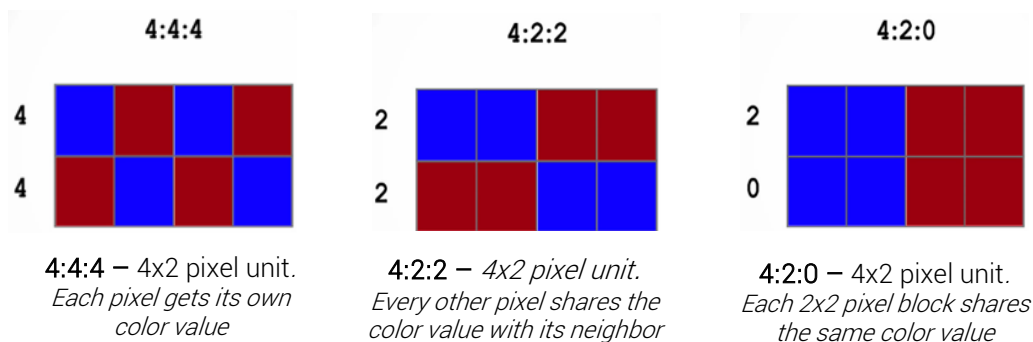

PCoIP 4:4:4 delivers the
text as lossless

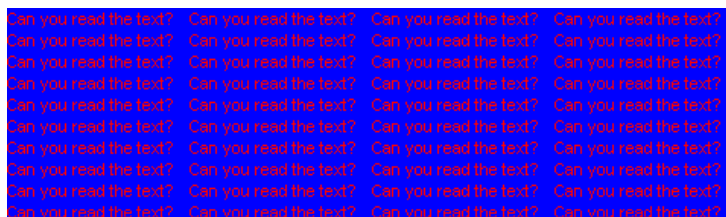H.264 4:2:0 text quality
has significant loss

Why Color Space Is Essential in PCoIP and H.264

Enhancing image quality at a professional level is an essential part of good user experience, particularly in graphically intensive industries. Clearly defined color spaces specifically detail how the available data must be mapped to colors. The YUV 4:4:4: color component subsampling indicates that all three Y, U and V have a similar sample rate. The 4:2:2 format has half the chroma of 4:4:4, meaning that U and V are sampled with half the rate of the Y component. Lastly, 4:2:0 will only consider the first row colors in half of the pixels.

4:4:4 – 4x2 pixel unit.
Each pixel gets its own color value

4:2:2 – *4x2 pixel unit.*
Every other pixel shares the color value with its neighbor

4:2:0 – 4x2 pixel unit.
Each 2x2 pixel block shares the same color value

PCoIP
YUV 4:4:4

H.264
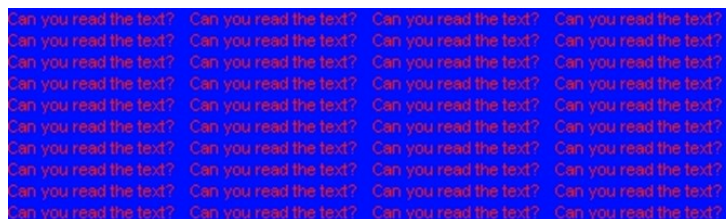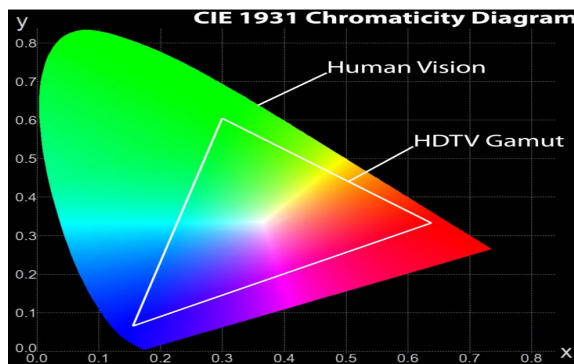**YUV 4:2:0**

The text in YUV 4:2:0 appears to be cluttered, indicating that although the quality would fare better in 4:2:2, these two color spaces still lack clarity and detail as opposed to 4:4:4.

Using PCoIP, users can expect the same high-contrast text and superior image quality as the YUV 4:4:4 color space while H.264 produces low-contrast text and image results along the lines YUV 4:2:2.

Color Accuracy in H.264

The H.264 protocol employs a reduced color palette that is leveraged for HDTV, a technology where the transmitted pictures are superior in terms of detail and quality. Even with H.264 integrating lossless 4:4:4 color format, it does not completely utilize all the colors in the palette and this codec lacks the ability to replicate the missing colors. This affects the overall image quality and leads to unalterable discrepancies.

H.264 starts with a reduced color palette that is optimized for HDTV

Color Accuracy Comparison

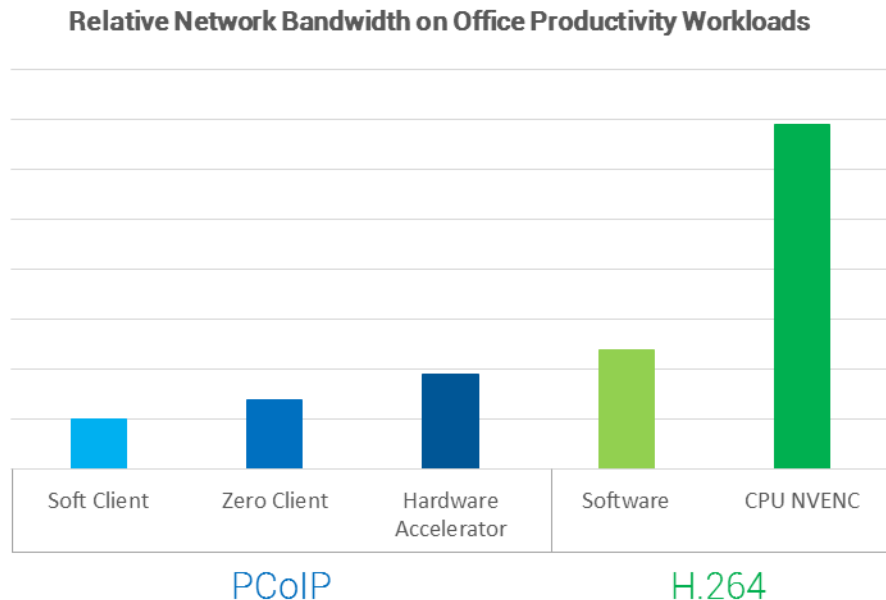| PCoIP	H.264
Uses a fully reversible color space conversion, resulting in remote reproduction of image colors precisely as intended by graphics applications	H.264 video encoder starts with a reduced color palette that is optimized for HDTV.
PCoIP lossless technology delivers accurate color and texture for any use case.	Even in H.264 "lossless" 4:4:4 color mode, the missing colors from the palette cannot be reproduced.
Dynamically chooses the appropriate codec to apply, depending on the type of content, so you don't need to sacrifice quality to achieve optimal results.	Attempting color accuracy via manual lossless modes, compromises frame rates and high CPU or bandwidth utilization.

In comparison, PCoIP effectively encodes and delivers rich and accurate content detail similar to that of the original image as shown below.

Benchmarking Workplace Productivity with Blast Performance

Designed with built-in H.264 video format coding, Blast Extreme essentially caters to mobile devices and network resources. It also delivers seamless performance in environments where servers come with GPUs that integrate the H.264-based protocol. H.264 works well for non-specialized hardware as it accelerates operations that leverage H.264 encoder hardware. Therefore, Blast promises satisfactory performance for organizations primarily focusing on NVIDIA GPU investment and where mobile users are abundant.

On the other hand, PCoIP offers optimum performance in multi-monitor environments with office productivity workloads as it leverages configurable server and bandwidth consumption. In this scenario, users can achieve superior network and server scalability with the core functionality of a soft client and PCoIP zero client. This is a competitive alternative against the H.264 functionality which necessitates GPUs for reinforcing the graphics rendering H.264 protocol. The software and NVENC encoding is also considerably higher with H.264 on routine productivity assignments minus 3D and video features, thereby affecting text quality.

Relative Network Bandwidth on Office Productivity Workloads

Generally, all this is also on account of PCoIP's capacity to consume lesser bandwidth which makes the H.264 protocol a less than ideal resource particularly for devices that regularly use high latency and congested networks.
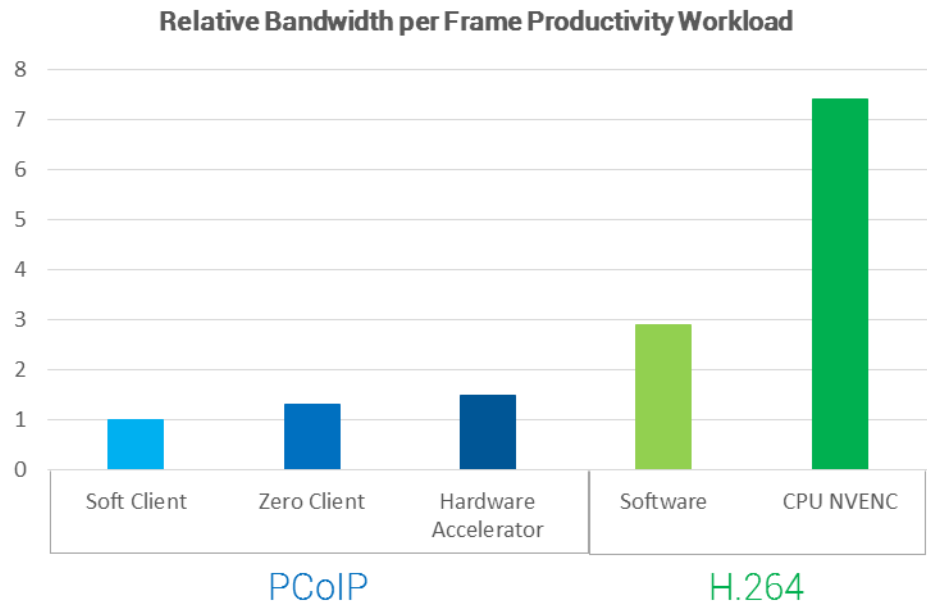
Normalized Bandwidth per Frame

In comparing PCoIP against Blast H.264 normalized bandwidth per frame, the former offers more bandwidth efficient capabilities because of its ability to support multiple codecs that help create crisp graphics and computer text.

In a standardized network bandwidth setting, Blast utilizes two times the network bandwidth of the PCoIP protocol during the software encoding process for the same productivity workload. While the PCoIP soft and zero clients utilize less bandwidth, an increase in this protocol's bandwidth usage for hardware accelerator only occurs when delivering rich image or text content. All this owes to the superior experience which users can gain in a high frame rate.

Nonetheless, there may be a significant rise in the Blast H.264 bandwidth during a minor FPS increase.

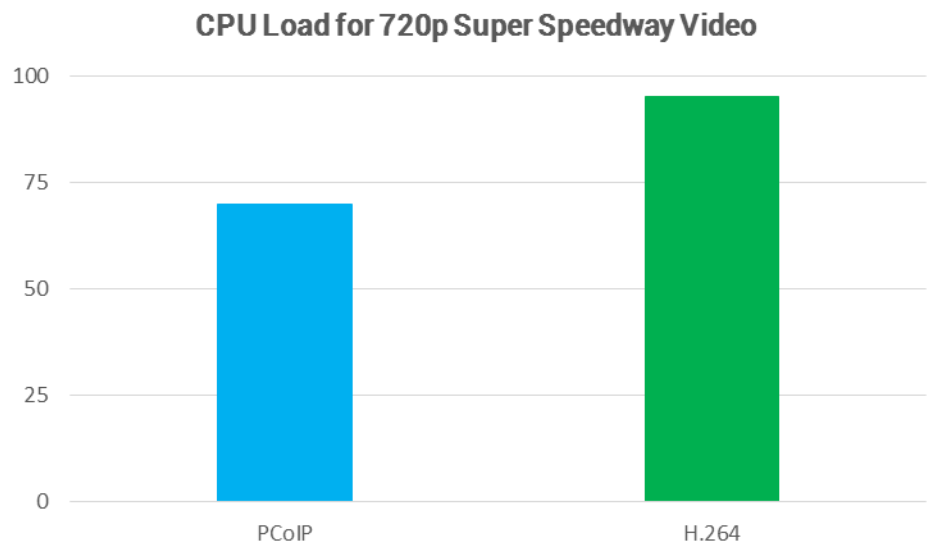**Relative Bandwidth per Frame Productivity Workload**

Relative CPU Loads

Although GPUs are important for creating rich user experiences in high-performance applications, PCoIP protocol is defined by its ability to deliver the same without a GPU while keeping network bandwidth usage at a minimum, therefore pointing towards optimal performance even in high latencies.

Consider a scenario where CPU load of PCoIP and H.264 is measured against the 720p Super Speed video format in a setting minus GPU. The lack of Blast GPU offload indicates that each server can accommodate a lesser quantity of users.

In this scenario, H.264's single codec cannot support the extensive and dynamic nature of content rich desktop applications, videos, text and other graphic-intensive workload, thus resulting in extra CPU consumption. These lead to server choke and reduced functionality in a H.264-based environment.

CPU Load for 720p Super Speedway Video

CONCLUSION

PCoIP versus H.264 – The Verdict

Summarizing the findings, one can safely verify the superior color correctness, image quality, resourceful bandwidth and CPU usage of PCoIP codecs over H.264.

Depending on what your VDI needs are, PCoIP gives you the flexibility to cater to different types of users in simple as well as complex environments while being more efficient on your IT infrastructure.