

High-quality JPEG2000* software with enhanced server platform

The Intel® Xeon® processor E5 v2 family provides higher efficiency and performance for the Kakadu Software Development Kit* for JPEG2000*, offering a highly optimized software toolkit for digital cinema rendering and other applications



Kakadu Software, a business of New South Innovations based at the University of New South Wales in Sydney, Australia, provides a broad and solid foundation for applications using JPEG2000*. The Kakadu Software Development Kit (SDK)* is a comprehensive, heavily optimized, fully compliant software toolkit offered to JPEG2000 developers through Kakadu customers, who are independent software vendors (ISVs). Through this software framework, which provides a solid foundation for a range of both commercial and non-commercial applications, Kakadu aims to encourage the widespread adoption of JPEG2000 through consistent and efficient implementation of the standard, which is widely available for both academic and commercial applications. Kakadu collaborated with Intel to build and enhance this software to provide a more efficient and high-performance toolkit for JPEG2000 developers.

Challenges

- **Improve Kakadu software's memory efficiency and execution speed.** Ensure Kakadu software has enhanced memory and faster performance execution.
- **Increase throughput.** Enable higher throughput for the Kakadu software for faster, highly efficient performance to enable 100 percent utilization of all computational resources for digital cinema rendering workloads.

Solutions

- **Deploy servers based on Intel® Xeon® processor E5 v2 family.** Provide a highly scalable software architecture to optimize the performance and speed of the Kakadu software, increasing its advantage over other compression methods.
- **Harness multiple features of the new platform.** The platform based on the Intel Xeon processor E5 v2 family allows Kakadu to take advantage of improved multi-threading support, additional multiple cores and cache that not only enhance performance, but also enable the creation of new products and applications for the software.

Technology Result

- **Improve IT infrastructure for the Kakadu software.** The Intel Xeon processor E5 v2 family provides multiple cores, SIMD capabilities in every core, and new, improved microarchitecture features to optimize the Kakadu software's speed and performance.
- **Enhance multi-threading support.** Improved multi-threading support for the Kakadu software delivers up to a 1.29x performance increase for 2K digital cinema rendering workloads compared to the previous-generation Intel Xeon processor E5 family.

Business Value

- **Deliver optimized solution to customers.** Using the Intel Xeon processor E5 v2 family optimized the JPEG2000 SDK for delivery to Kakadu's customers, providing them value through an improved performance of the new JPEG2000 SDK version.
- **Achieve an edge over competitors.** The Kakadu software aims to provide the fastest JPEG2000 implementation environment for its customers, with the lowest memory utilization and broadest range of features. Optimizing the software for the Intel Xeon processor E5 v2 family has contributed to the achievement of these objectives.

"Under test lab conditions, the latest version of the Kakadu Software library with improved multi-threading support was able to deliver up to a 1.29x performance increase on the platform based on Intel® Xeon® processor E5 v2 family for 2K digital cinema rendering workloads, compared to the previous-generation Intel Xeon processor E5 family."

– Daniel Gronowski
Sales Manager
Kakadu Software

As the world's leading JPEG2000 developer toolkit, the Kakadu software is a complete implementation of the JPEG2000 standard, part 1 (ISO/IEC 15444-1). This image compression standard is substantially more complex than the existing JPEG standard, from both computational and conceptual perspectives. Kakadu also provides a comprehensive implementation for several of the most useful features from part 2 of the JPEG2000 standard, including general multi-component transforms and arbitrary wavelet transform kernels, as well as much of parts 3 and 9.

The Kakadu software was written specifically for a variety of different types of applications, including image and volume compression, image and volume decompression/rendering, transcoding between related representations, interactive rendering applications, client/server applications, and digital cinema applications.

Efficient and faithful implementation of the JPEG2000 standard is a challenging task that can consume years of a competent individual's time. The industries that use the JPEG2000 application are always on the lookout for higher throughput.



Harnessing the multi-core, multi-featured Intel® Xeon® processor E5 v2 family-based platform provides Kakadu Software faster performance and high-quality rendering for JPEG2000 applications

To make the application highly efficient in terms of performance, underlying hardware capabilities should be harnessed to boost the performance and efficiency of the application. Kakadu addresses this challenge by adopting a new server platform that runs its JPEG2000 software.

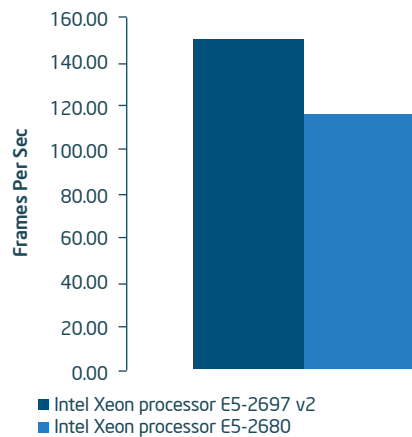
Addressing JPEG2000 standard complexities

Kakadu software is an implementation of the JPEG2000 suite of standards, including parts 1, 2, 3 and 9. JPEG2000 brings numerous advantages over other image compression standards, including compression efficiency, scalability, highly efficient interactive remote browsing, management and incremental dissemination of metadata, rich transcoding options, volumetric compression, and the capability to represent content with almost unlimited precision and spatial extent. In exchange for this flexibility and coding efficiency, however, there are a number of challenges presented by the computational and memory complexity of the JPEG2000 algorithms.

Kakadu addressed these challenges through careful implementation of the core coding technologies and management of processor cache resources, as well as extensive use of available SIMD processing instructions, and a highly sophisticated multi-threading environment that is almost free from critical sections. Unlike most other compression standards, JPEG2000 possesses enormous potential for parallelism; however, load balancing and synchronization within the hierarchical processing environment of the JPEG2000 algorithm can become a daunting challenge. Kakadu has been evaluated and optimized to take advantage of the rich multi-processing and SIMD capabilities of the Intel Xeon processor E5 v2 family.

The culmination of this effort is that Kakadu SDK is able to fully exploit the resources of all 48 hardware threads offered by server platforms based on Xeon E5 family v2 CPUs. This means that the software is able to deliver 1.29x increased performance for 2K digital cinema rendering workloads compared to the previous-generation Intel Xeon processor E5. Moreover, this is achieved not by processing cinema frames independently (a very high latency, high memory approach) but by deploying the

entire pool of hardware threads to work on only a handful of frames at a time. In the case of very large individual images, the Kakadu SDK is able to deploy all 48 hardware threads of a Xeon E5 v2 based server platform to cooperatively process the image, without relying on tiles or any other mechanisms for artificially partitioning the work load; moreover this can be done with close to 100% utilization of all available CPU resources.



Comparison between the throughput performance of the Kakadu software on Intel Xeon processor E5-2697 v2 vs. the previous-generation Intel Xeon processor E5-2680

Optimizing the JPEG2000 software

The Kakadu software optimized on Intel Xeon processor E5 v2 family provides extensive and convenient support for Java* native interfaces and now automatically builds bindings for C#* and Visual Basic* programmers. The multi-threaded processing it offers fully utilizes parallel processing resources, such as multiple CPUs, multi-core CPUs, or hyperthreading. This means JPEG2000 developers can select the single-threaded processing model from v5.0 and before, or a new multi-threaded processing model, which requires only a few extra lines of code in the application.

“Kakadu software also provides a carefully engineered thread scheduler, so once developers have created a multi-threaded environment and populated it with one thread for each physical/virtual processor on their system, close to 100 percent utilization of all computational resources can be achieved,” explained Gronowski.

Lessons Learned

- Kakadu software, optimized on the Intel Xeon processor E5 v2 family-based platform, provides approximately 100 percent utilization of all 48 hardware threads, processing a single large image (terapixels and up), providing highly efficient utilization through the additional cores and cache available. This bodes well for the deployment of Kakadu software on extremely intensive workloads. Thus, the Intel Xeon processor E5 v2 family is a launching point for Kakadu into addressing even more challenging arenas.

Kakadu software is also the only implementation which supports all compositing, animation and metadata features of the JPX file format, in addition to other JPEG2000 sources such as raw codestreams, JP2 files and MJ2 files. Several hundred organizations have taken out full commercial licenses to build and sell applications based on Kakadu software, including many of the world’s best-known imaging and entertainment corporations, together with companies that operate with highly demanding novel media types.

Providing business edge over competitors

For licensees and end users of the Kakadu SDK, the latest versions of the software work together with the features of Intel Xeon processors E5 family v2 to provide unprecedented levels of performance and efficiency. This allows these businesses to enter new market segments and bring their products to market more quickly -- far more quickly than can be achieved using hardware-based solutions. The Kakadu software provides a solid foundation for the consistent and efficient use and widespread adoption of JPEG2000.

More importantly, the Kakadu software has advantages over other compression methods and allows new features to be included in the SDK, which could be useful for Kakadu-based applications, while allowing the creation of new products and applications for the software.

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