Siemens Digital Industries Software

Siemens, AMD, and Microsoft collaborate on EDA in the cloud

Executive summary

Moving some or all of your electronic design automation (EDA) computing to the cloud enables your company to reduce time-to-market and innovate faster, simply by taking advantage of flexible resources and economies of scale. Siemens Digital Industries Software teamed up with Advanced Micro Devices, Inc. (AMD) and Microsoft Azure (Azure) to demonstrate how the use of the Calibre nmPlatform with cloud computing can dramatically reduce your design closure times by employing more compute resources to get your design to market faster. Using a production 7nm design, we achieved a 2.5X speed up in physical verification cycle time.

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Calibre computing in the cloud

Cloud processing provides integrated circuit (IC) design companies an opportunity to reduce time-to-market and speed up innovation by accessing vastly more compute resources than are typically available when rolling into a design tapeout crunch. High-scaling tools like those in the Calibre platform can scale to thousands of cores to reduce runtimes...but who has a couple of thousand cores sitting around idle? The cloud gives you access to significantly more hardware for those times when you are under the greatest schedule pressure, such as block or full chip verification.

Core Calibre technology has been cloud-ready for years[1,2], and with recent improvements in cloud security mitigating the industry's concern over intellectual property (IP) protection, the biggest barrier hindering the implementation and use of Calibre technology in the cloud processing model has been removed.

Siemens EDA, a part of Siemens Digital Industries Software works closely with foundries, IC companies, and cloud service providers to ensure a smooth transition from on-site grid systems to off-site cloud processing. Identifying and defining best practices enables companies to achieve maximum benefit from their transition to a "Calibre in the cloud" processing model. As IC companies increasingly look to leverage cloud capacity for faster turnaround times on advanced process node designs, they can be confident that running Calibre in the cloud will provide the same sign-off verification results they know and trust, while enabling them to adjust their resource usage to best fit their business requirements and market demands.

Calibre and cloud server efficiency

To ensure Calibre users can employ cloud resources in the most cost-efficient manner, we developed cloud usage guidelines and suggested best practices for running Calibre operations in the cloud. To develop and test these guidelines and practices, we engaged in a joint project with AMD and Azure, using AMD EPYC™ servers running on the Azure cloud service. The results highlight the capabilities of EPYC servers and the Calibre nmPlatform in the Azure cloud.

Foundry rule decks

Design companies should always use the most recent foundry-qualified rule deck to ensure that the most up-to-date best practices for coding are implemented.

Calibre software versions

Because Siemens EDA has long been committed to optimizing the Calibre engines for every Calibre release, using the most current version of your Calibre software ensures optimized runtimes and memory consumption, as shown in figure 1[3].

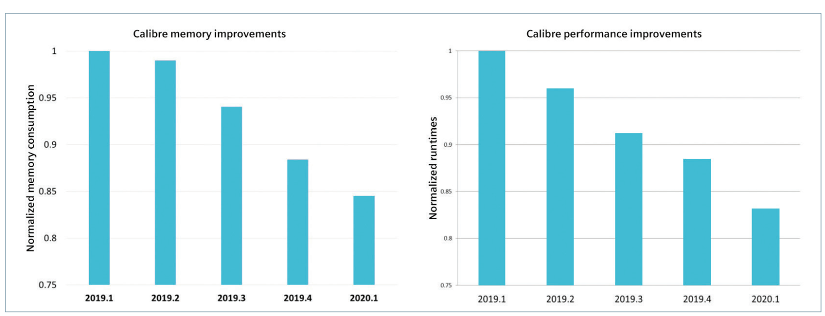

Figure 1. Normalized memory vs. Calibre release versions (left), normalized runtime vs. Calibre release versions (right).

Cloud servers

The market offers a variety of server types for cloud operations, with the "best" selection dependent on the customer's needs and applications. For our collaborative project, we selected AMD EPYC servers available for the Microsoft Azure public cloud. Each EPYC server type has different core, memory, interface, and performance characteristics, enabling cloud users to select the EPYC server best suited for their applications.

The AMD EPYC architecture (figure 2) provides an excellent medium for massive parallelism, due to its 32 core/64 threads per socket, which supports computationally-heavy runs. The 8 DDR4 channels add another dimension to the server, further optimizing its ability to handle machineintensive computation runs. Finally, the hierarchical design of an 8MB L3 memory cache per 4 cores boosts the computational speed even more.

These cloud servers are used to create virtual machines (instances) in the cloud service. We determined the two most appropriate Azure instances for Calibre applications are the HB60rs and the L80s v2. Both the HB60rs and L80s v2 run on EPYC 7551 processors, but with different configurations and functionality.

For example, the HB60rs instance has the same EPYC 7551 processor as the Lv2 instances, but only 60 of the 64 cores in the two socket machine are accessible to the instance, and hyper-threading is turned off. The Lv2 instances are designed to support customers with demanding workloads that are storage-intensive and require high levels of I/O, while the HB series instances are optimized for applications driven by memory bandwidth, such as fluid dynamics and explicit finite element analysis. Table 1 provides a summary comparison of the attributes for each server type.

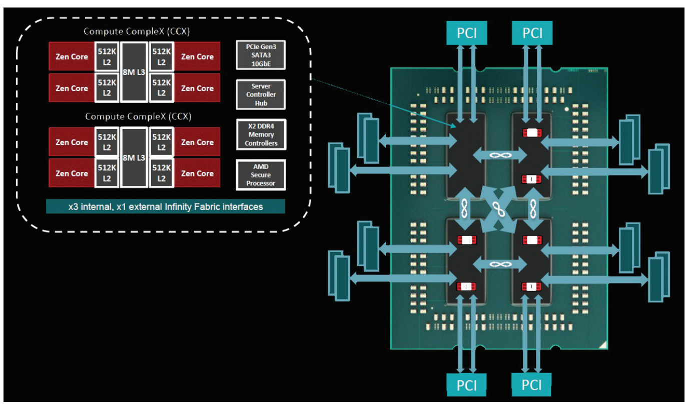

Figure 2. AMD EPYC server architecture (source: AMD. Used by permission).

Resource	HBR60rs	L80s v2
Cores	60 AMD64 AMD EPYC 7551 Cores at 2.55 GHz all-core boost	80 AMD64 AMD EPYC 7551 vCores (SMT pairs) at 2.55 GHz all-core boost
Cache	15 x 8MB L3 cache (120 MB total L3)	10 x 8MB L3 cache (80 MB total L3)
Memory	240 GB total memory (4 GB per core)	640 GB total memory (8 GB per vCPU)
Network	40 Gbps	16 Gbps+

Table 1. AMD EPYC server attributes.

Calibre computing in the cloud

For the joint project, we used the final metal tape-out database of a production 7nm Radeon Instinct™ Vega20 – AMD's largest 7nm chip design, containing over 13 billion transistors.

Initial setup

The Calibre 2019.2 release was used with a production version of the foundry deck for the 7nm technology node to perform design rule checking (DRC) on the design. For the Calibre nmDRC™ run, we used Calibre hyper-remote distributed computing capability[3], which can support up to 4,000 cores (figure 3).

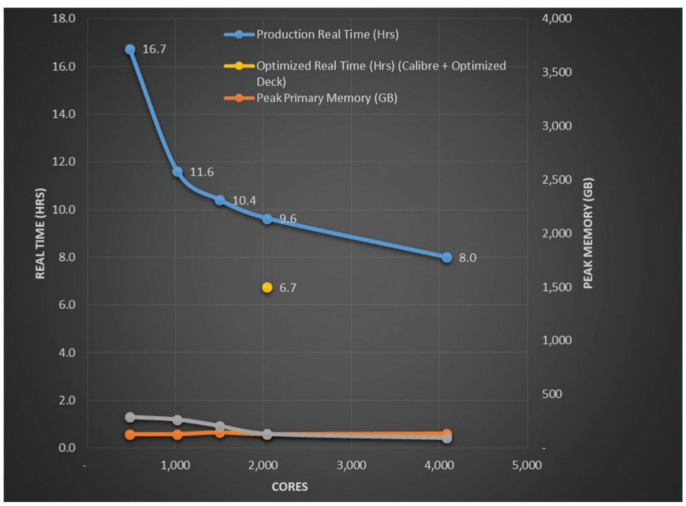

Figure 3. Calibre nmDRC runtime versus number of cores (source: AMD. Used by permission).

As in all Calibre distributed computing runs, a primary server was assigned to manage all other resources used in the run. For the purposes of our collaboration, both the designated primary server and the remote servers were AMD EPYC 7551 servers with a 32 CPU core and 256 GB RAM memory.

Cloud setup

Siemens EDA ran all experiments using the AMD EPYC servers for both the primary and remote servers, using the following hardware configuration:

- Microsoft Azure HB60rs instances. For a single HB60rs, a primary server was run in conjunction with 17, 25, 34, and 68 remote HB60rs instances, each dedicated entirely to running Calibre jobs, using the Azure CycleCloud interface to invoke and manage the jobs.
- Geographically close servers. All cloud servers used were running in the region of the Azure Cloud closest to the physical location of the hardware used to initiate and control the cloud usage.
- To minimize the latency between initiating a job and actual execution, the design was assembled in the cloud as blocks were ready.

Results

Our results demonstrated the following performance metrics:

- The speed of the Calibre nmDRC run continued to increase all the way up to 4K cores.
  - There is always a “knee” in this scaling curve where the “best value for money” is achieved. For this design and node, the knee was reached between 1.5K and 2K cores.
- Peak cumulative memory used on the primary and remote servers was less than 500GB.
- Peak remote server memory actually decreased as more cores were added.

In an on-premise Calibre nmDRC run, Siemens normally uses 256 cores for full chip DRC—because that is the amount of on-site resources most design teams will typically have access to during a tape-out. The turn-around time using 256 cores might be as long as 24 hours for a large, complex 7nm design like the AMD Radeon VII/MI60 GPU. In turn, that means a team will typically only complete one design iteration per day, which is far slower than what most time-to-market schedules require.

By increasing that number to 2K cores, we can reduce runtime to 12 hours, allowing two iterations per day, while going up all the way to 4K cores results in sub-8 hour runtimes and three iterations per day. This experiment clearly demonstrates that combining the power and efficiency of Calibre scaling with a significant increase in the number of available cores enables companies using Calibre software in the cloud to dramatically improve their rate of design closure simply by reducing runtimes.

As previously discussed, Siemens EDA continuously works to improve Calibre performance, and collaborate with foundries to identify and deploy performance-focused deck optimizations (while ensuring the same or better accuracy). In figure 2, we ran an additional experiment to see if there was any benefit from using the latest version of Calibre and the latest optimized deck. The results, shown by the yellow dot, demonstrated that an additional three hours could be saved at the knee of the scaling curve, at about 2K cores.

Minimizing cloud costs

Large system-on-chip (SOC) designs consume a lot of RAM during verification, and RAM is expensive. Even on the cloud, large RAM instances are expensive. The solution is reduce the RAM requirement per remote core by increasing the total number of remote cores, as shown in figure 4. Because the Calibre platform provides a proven hyper-remote distributed processing model[3], users can take advantage of this capability to lower the cost of cloud resources, while also enabling faster processing speeds on lower RAM CPUs.

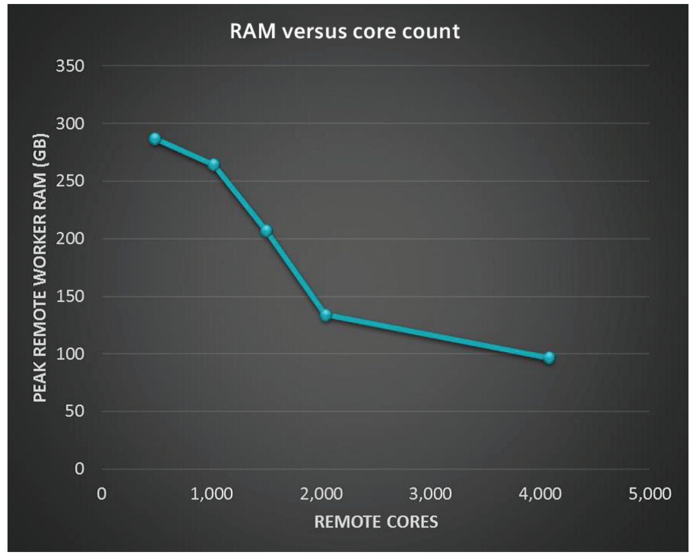

Figure 4. Peak memory (RAM) consumption versus remote core usage.

Conclusion

The collaboration between Siemens EDA, AMD, and Azure highlights the reduction in time and costs of cloud usage that can be achieved by implementing best practices and usage guidelines for EDA cloud computing. Companies can use these results as guidance for their own "Calibre in the cloud" implementations. By implementing these strategies and practices, companies can achieve faster overall runtimes, enabling them to reduce their time to market and speed up design innovation, while maintaining or lowering operating costs.

References

1. Omar El-Sewefy. "Calibre in the cloud: unlocking massive scaling and cost efficiencies," Siemens Digital Industries Software, July 2019. https://resources.sw.siemens.com/en-US/white-paper-calibre-in-the-cloud-unlocking-massive-scaling-and-cost-efficiencies
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