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Calibre in the cloud: Unlocking massive scaling and cost efficiencies

Design to silicon

As companies look to leverage cloud capacity for faster turnaround times on advanced process node designs, they can be confident that running Calibre in the cloud provides 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.

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Cloud computing is here

Cloud computing is the delivery of computing services–servers, storage, databases, networking, software, analytics, intelligence, and more–over the Internet ("the cloud") to offer faster innovation, flexible resource usage, and economies of scale. Companies typically pay only for cloud services they use, helping to lower your operating costs, run infrastructure more efficiently, and scale quickly as business needs change. Clouds may be limited to a single organization (enterprise clouds), be available to many organizations (public cloud), or a combination of both (hybrid cloud).

The most common applications for cloud service are:

- Infrastructure as a Service (IaaS), where infrastructure is hosted by the cloud provider and supplied to various users,
- Platform as a Service (PaaS), which provides a platform that allows users to develop, run, and manage applications without the complexity of putting together and maintaining an on-site grid,
- Software as a Service (SaaS), an "on-demand" software licensing and delivery model that enables users to access software without having to have it installed on their hardware.

Cloud computing for EDA

The electronic design automation (EDA) industry adopted a cloud services model somewhat later than other businesses, due primarily to concerns about the protection and control of intellectual property (IP). Cloud providers responded by enhancing and extending security, and today IP providers (most importantly, the foundries) have embraced the use of cloud technology. The most common form of cloud technology in the semiconductor industry is PaaS, in which EDA companies enable their customers to develop and run their process design kits (PDKs) on a cloud platform.

Running EDA tools on the cloud does not require any special treatment for the software executed by the user. Any software that can run locally can be installed and run on the cloud. However, as advantageous as hosting software on the cloud can be, it actually does not make sense for all jobs. The two leading reasons to use cloud services are costs and latencies. From the cost perspective, using PaaS allows companies to avoid the capital investment of buying servers, along with the running cost of maintaining and supporting them. For companies who experience latency issues during high demand periods in which multiple users need to access the server's limited resources, PaaS can provide seamless transitions between low and high demand intervals.

Calibre and cloud: Together at last

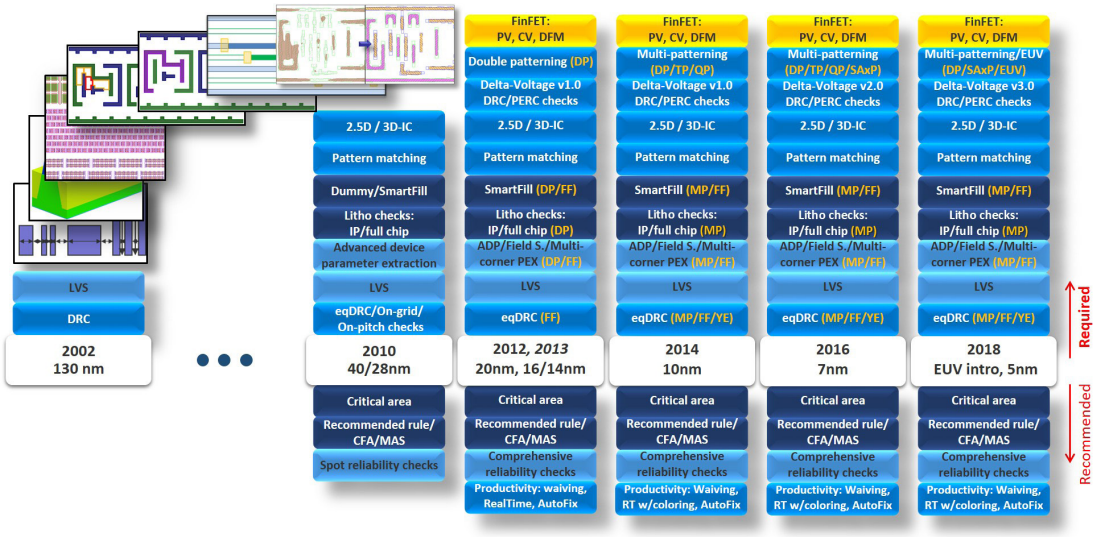

Figure 1: Industry trends for physical verification requirements per node.

With 2x more transistors being added node over node, and ever-larger and more complex foundry rule decks, the amount of computing required for today's integrated circuit (IC) designs makes it challenging to obtain and support the requisite amount of computing resources needed to maintain fast design rule checking (DRC) runtimes on premise (figure 1).

Since the first introduction of Calibre® hyper-remote capability in 2006, the Calibre architecture has supported scaling to large numbers of CPUs/cores (figure 2). However, increasing the number of CPUs on-site is not a simple task–hardware acquisition, grid installation, and maintenance all consume time and money. More importantly, on-site grids lack immediate additional resource availability.

Cloud computing provides an opportunity to accelerate the time to market for designs, particularly when you consider the growth in computing at advanced nodes. By removing cost and latency barriers to resource usage, cloud computing allows companies to leverage the Calibre platform's inherent scaling capability by obtaining instant access to the CPU resources needed to achieve their physical verification turnaround time goals (e.g., overnight runtimes), even in the face of the exponential compute growth at the newest technology nodes.

Having access to Calibre technology in the cloud can also provide a fast, cost-effective means of dealing with emergent situations in which all internal resources are committed, but a critical issue requiring immediate resolution arises.

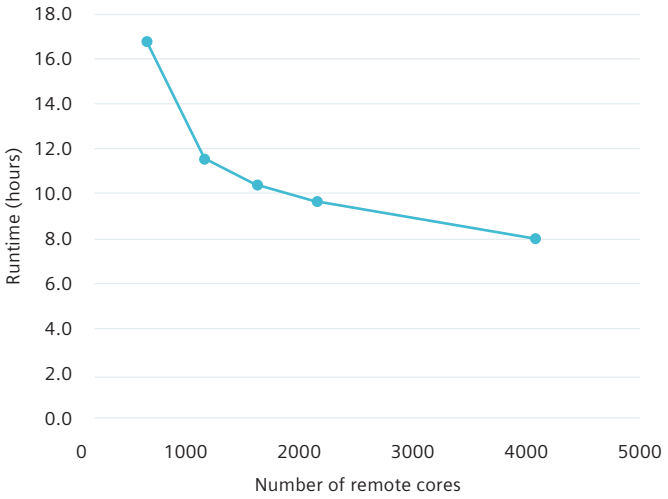

Figure 2: Calibre nmDRC™ runtime vs. number of CPUs. (source: AMD. Used by permission)

Making the cloud more cost-effective

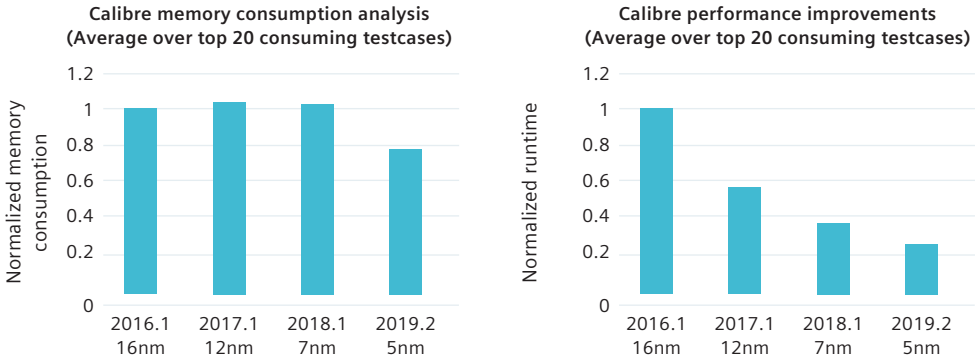

Figure 3: (left) Normalized memory vs. Calibre release versions, (right) Normalized runtime vs. Calibre release versions.

The good news is that the effort required to perform Calibre verification in the cloud is in the cloud setup itself–nothing needs to change in the process of running Calibre core technology. The adoption effort is in choosing the cloud provider and setting up the cloud environment.

Of course, there is a cost to using cloud resources. To ensure Calibre users can employ cloud resources in the most cost-efficient manner, we provide cloud usage guidelines and suggested best practices.

Foundry rule decks

First and foremost is the recommendation to use the most recent foundry-qualified rule deck. Doing so ensures that the most recent coding best practices are adopted. In addition, because of our commitment to Calibre engine optimizations with every release, users are assured of optimized runtimes and memory consumption, as shown in figure 3.

Hierarchical filing

Implementing a hierarchical filing methodology, in which a design is sorted into cells that are later referred to in the top levels of the design, significantly reduces data size and enables a significant reduction in final sign-off runtimes.

Hierarchical construction mode

Historically, creating a hierarchical database (HDB) with the Calibre HDB construction mode meant the construction process (in which the layout is read into the Calibre engine and an internal database is created) first connected to the master and all of the remotes, then began the HDB construction. However, due to the nature of the HDB construction process, only the master was utilized during HDB construction, leaving the remote cores connected, but idle.

Using the Calibre HDBflex process instead allows you to connect to the master hardware only during HDB construction. This sequence eliminates idle resource time by ensuring that the majority of the HDB construction takes place in the multi-threading (MT) only mode, and does not connect to remotes until the later stages of construction. Using the Calibre HDBflex construction mode substantially reduces the real time that Calibre MTflex™ remotes are idle during the creation of the HDB (figure 4).

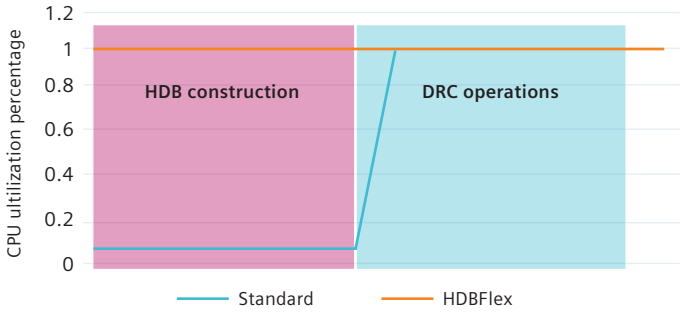

Figure 4: CPU utilization as a percentage of total acquired CPUs. Using the Calibre HDBflex process, which connects only to the master during HDB construction, ensures that CPU utilization is sustained at 100% throughout the entire flow.

Calibre cloud workflow efficiency

By choosing geographically close cloud servers, you can reduce network latency time. Cache-based systems will also improve machine performance.

To minimize upload time, upload each block separately as it is available, along with standard cells and IPs, then upload the routing. By uploading in stages, you avoid any bottlenecks. You can then use the Calibre DESIGNrev™ interface in the cloud to assemble all the data (figure 5).

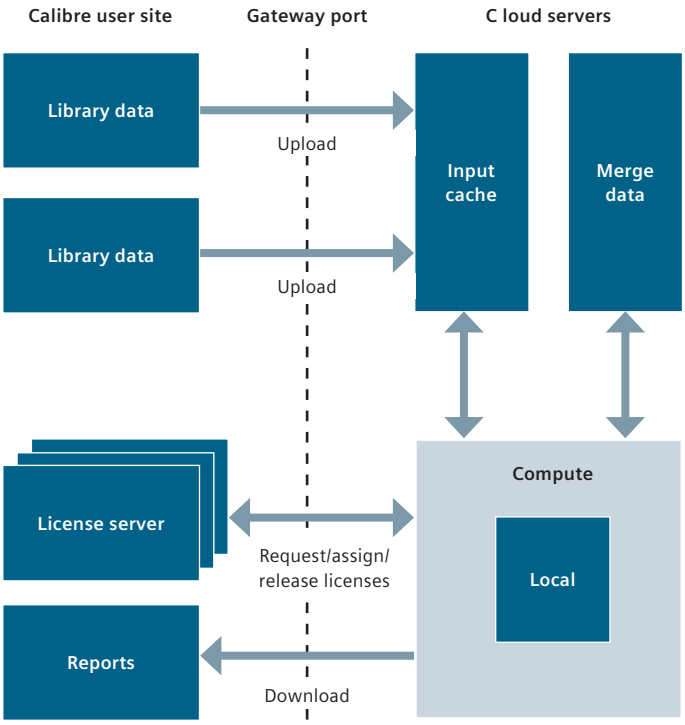

Figure 5: Uploading blocks and routing separately, and combining the data in the cloud server, minimizes both upload time and potential bottlenecks.

Conclusion

Cloud processing provides companies an opportunity to reduce time to market and speed up innovation while maintaining or lowering operating costs. Core Calibre technology has been cloud-ready for years; with improvements in cloud security eliminating the industry concern over IP protection, the only barrier hindering the implementation of Calibre technology in the cloud processing model has been removed.

Siemens EDA, a part of Siemens Digital Industries Software, worked closely with foundries, design companies, and cloud service providers to ensure a smooth transition from on-site grid systems to off-site cloud processing. Best practices enable 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.

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