DesignWare IP for Cloud Computing SoCs
Overview

Hyperscale cloud data centers continue to evolve due to tremendous Internet traffic growth from smartphones, media applications, video streaming, and connected AI devices. This is driving the need for new architectures for compute, storage, and networking such as AI accelerators, Software Defined Networks (SDNs), communications network processors, and solid state drives (SSDs) storage to improve cloud data center efficiency and performance. Re-architecting the cloud data center to support these latest applications is driving the next generation of semiconductor SoCs supporting new high-speed protocols to optimize data processing, networking, and storage in the cloud.

Designers building SoCs for these cloud computing applications need a combination of high-performance and low-latency IP solutions to help deliver total system throughput. Synopsys provides a comprehensive portfolio of high-quality, silicon-proven IP that enables designers to develop SoCs for high-end cloud computing AI accelerators, networking, communications network processors, and storage applications. Synopsys’ DesignWare® Interface IP, Processor IP, and Foundation IP are optimized for high-performance, low-latency, and low-power, while supporting advanced process technologies from 16-nm to 5-nm FinFET.

Artificial Intelligence (AI) Accelerators

AI accelerators process tremendous amounts of data for deep learning workloads including training and inference which require a large memory capacity, high bandwidths, and cache coherency within the overall system.

AI accelerator system-on-chip (SoC) designs have myriad requirements: high performance; low power; need for cache coherency; integrating high bandwidth interfaces that are scalable to many cores; implementing heterogeneous processing hardware accelerators; addressing Reliability- Availability-Serviceability (RAS); and massively parallel deep learning neural network processing. Synopsys offers a portfolio of DesignWare IP in advanced FinFET processes that address the specialized processing, acceleration, and memory performance requirements of AI accelerators.

Benefits of Synopsys DesignWare IP for AI Accelerators

- Industry’s widest selection of high-performance interface IP, including DDR, USB, PCI Express, CXL, CCIX, Ethernet, and HBM2/2E, offers high bandwidth, low latency to meet the high-performance requirements of AI servers
- Highly integrated, standards-based security IP solutions enable the most efficient silicon design and highest levels of security encryption
- Low latency embedded memories with standard and ultra-low leakage libraries, optimized for a range of cloud processors, provide a power- and performance-efficient foundation for SoCs

Figure 1: IP for AI Accelerator
Benefits of Synopsys DesignWare IP for Cloud Computing Networking

- Synopsys’ portfolio of IP in advanced foundry processes, supporting high-speed protocols such as DDR, HBM2/2E, Ethernet, USB, CCIX, CXL, and PCI Express are optimized to meet the high-throughput, low-latency connectivity needs of hyperscale data center networking applications.
- Low latency embedded memories with standard and ultra-low leakage libraries, optimized for a range of cloud processors, provide a power- and performance-efficient foundation for SoCs.
- Configurable AMBA interconnects with a library of peripheral components deliver SoC design flexibility and minimize design complexity.

Figure 2a: IP for cloud computing networking (smart NIC)

Figure 2b: IP for cloud computing networking (Network Switch)
Communications Network Processors

Communication service providers are turning towards server virtualization to increase efficiency, flexibility, and agility to optimize network packet processing. The latest communications architecture uses Open vSwitch Offloads (OVS), OVS over Data Plane Development Kits (DPDK), network overlay virtualization, SR-IOV, and RDMA to enable software defined data center and Network Function Virtualization (NFV), accelerating communications infrastructure. To achieve higher performance, communications network processors can accelerate OVS offloads for efficiency and security. Synopsys provides a portfolio of high-speed interface IP including DDR, HBM2/2E, 112G Ethernet for up to 800G links, CXL for cache coherency, and PCI Express for up to 32GT/s data rates. DesignWare Security IP enables the highest levels of security encryption, and embedded ARC processors offer fast, energy-efficient solutions to meet throughput and QoS requirements. Synopsys’ foundation IP delivers low-latency embedded memories with standard and ultra-low leakage libraries for a range of cloud processors.

Storage

NVMe-based Solid-State Drives (SSDs) storage can utilize a PCI Express (PCIe) interface to directly connect to the server CPU and function as a cache accelerator allowing frequently accessed data, or "hot" data, to be cached extremely fast. High-performance PCIe-based NVMe SSDs with extremely efficient input/output operation and low-read latency improves server efficiency and avoids having to access the data through an external storage device. NVMe SSD server acceleration is ideal for high transaction applications such as AI acceleration or database queries. Synopsys’ portfolio of DesignWare interface IP for advanced foundry processes, supporting high-speed protocols such as PCI Express, USB, and DDR, are optimized to help designers meet their high-throughput, low-power, and low-latency connectivity for cloud computing storage applications. Synopsys’ foundation IP offers configurable embedded memories for performance, power, and area, as well as high-speed logic libraries for all processor cores. Synopsys also provides processor IP ideally suited for flash SSDs.

Benefits of Synopsys DesignWare IP for Communications Network Processors

- Synopsys’ portfolio of IP, supporting high-speed protocols such as DDR, HBM2/2E, Ethernet, USB, PCI Express, CXL, and CCIX, are designed to meet the high-throughput interface needs of cloud communications Network Processors applications
- Highly integrated, standards-based security IP solutions enable the most efficient silicon design and highest levels of security encryption
- ARC processors, supported by a broad spectrum of 3rd-party tools, operating systems and middleware from leading industry vendors, offer high-speed, energy-efficient IP to meet throughput and QoS requirements

Benefits of Synopsys DesignWare IP for Cloud Computing Storage

- High-performance, low-latency PCI Express controllers and PHYs supporting data rates up to 32GT/s enable NVMe-based SSDs
- High-performance, low-power ARC processors support fast read/write speeds for NVMe-based SSDs
- Portfolio of interface IP including Ethernet, USB, PCI Express, and DDR provides low latency and fast read/write operations
### Interface IP

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<tr>
<th>Device</th>
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<tr>
<td>Ethernet Controller and PHY</td>
<td>NRZ and PAM-4 112G and 56G Ethernet PHYs for up to 800G hyperscale data center SoCs and configurable controllers compliant with IEEE standards</td>
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<tr>
<td>DDR5/4 Controller and PHY</td>
<td>DDR memory interface controllers and PHYs supporting system performance up to 5200 Mbps, share main memory with compute offload engines plus network and storage I/O resources</td>
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<tr>
<td>HBM2/2E PHY</td>
<td>HBM2/2E IP allows high memory throughput with minimal power consumption</td>
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<tr>
<td>USB Controller and PHY</td>
<td>Complete USB IP solution reduces engineering effort while reducing area</td>
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<tr>
<td>PCI Express Controller and PHY</td>
<td>High-performance, low-latency PCI Express controllers and PHYs supporting data rates up to 32GT/s enables real-time data connectivity and NVMe SSDs and SD Express cards</td>
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<tr>
<td>Compute Express Link (CXL) Controller and PCIe 5.0 PHY</td>
<td>Very high-bandwidth with extremely low latency IP supporting all three CXL protocols (CXL.io, CXL.cache, CXL.mem) and device types</td>
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<tr>
<td>CCIX Controller and PHY</td>
<td>CCIX IP solutions support data transfer speeds up to 32 Gbps (ready for 32 Gbps) and cache coherency for faster data access</td>
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### Security IP

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### Foundation IP

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<td>Embedded Memories and Logic Libraries</td>
<td>Low latency embedded memories with standard and ultra-low leakage libraries provide a power- and performance-efficient foundation for SoCs</td>
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### About DesignWare IP

Synopsys is a leading provider of high-quality, silicon-proven IP solutions for SoC designs. The broad DesignWare IP portfolio includes logic libraries, embedded memories, embedded test, analog IP, wired and wireless interface IP, security IP, embedded processors, and subsystems. To accelerate prototyping, software development and integration of IP into SoCs, Synopsys’ IP Accelerated initiative offers IP prototyping kits, IP software development kits, and IP subsystems. Synopsys’ extensive investment in IP quality, comprehensive technical support and robust IP development methodology enable designers to reduce integration risk and accelerate time-to-market.

For more information on DesignWare IP, visit [synopsys.com/designware](http://synopsys.com/designware).