



cādence®



# Design IP

Accelerating the deployment of advanced  
SoCs in leading-edge processes

## Overview

Cadence is a leader in semiconductor IP addressing hyperscale computing, enterprise, data center, automotive, and artificial intelligence/machine learning (AI/ML) applications. Our IP are available in advanced-process nodes ranging from 28nm to 3nm—all silicon verified in leading-edge foundry processes. Our memory IP portfolio spans DDR, LPDDR, and GDDR. The Cadence® IP family for PCI Express® (PCIe®) includes support for PCIe 6.0/5.0/4.0/3.1/2.1/1.1 as well as Computer Express Link (CXL). Our high-speed PAM4 SerDes in 112G and 56G address the needs of hyperscaler designing products for 400G and 800G networks as well as 5G applications. Our UCle and UltraLink die-to-die (D2D) connectivity products address chiplets, multi-chip, and multi-die implementation in 2D standard packages or 2.5D advanced packages, and are ideally suited for disaggregated CPUs, GPUs, and complex heterogenous SoCs that are pushing the limits of Moore's Law.

		Enterprise	Hyperscale	Comms	Aerospace/ Defense	Automotive	Mobile	Industrial	Consumer
Ethernet/PCIe/CXL/CPRI/D2D	224G-LR (200G/400G/800G/1.6T)	•	•	•	•			•	
	112G-ELR (100G/200G/400G/800G)	•	•	•	•			•	
	56G-LR (100G/200G/400G)	•	•	•	•				
	25G-KR (25G/100G)	•	•	•					
	16G UCle™	•	•		•				
	40G UltraLink™ D2D	•	•		•				
	10GBase-KR	•		•	•	•		•	•
	USXGMII/QSGMII/SGMII	•		•	•	•		•	•
	PCIe 6.0/CXL	•	•	•	•	•		•	•
	PCIe 5.0/CXL	•	•	•	•	•	•	•	•
	PCIe 4.0	•	•	•	•	•	•	•	•
	PCIe 3.1	•	•	•	•	•	•	•	•
	USB/MIPI/SATA/DP	USB4	•	•	•	•	•	•	•
USB3.0/3.1/3.2		•	•	•	•	•	•	•	•
USB2.0/eUSB		•	•	•	•	•	•	•	•
MIPI®D-PHY <sup>sm</sup>						•	•	•	•
MIPI®C/D-PHY <sup>sm</sup>						•	•	•	•
MIPI SoundWire®							•		•
MIPI I3C®		•	•	•	•	•	•	•	•
SATA		•						•	•
DP						•	•	•	•
DDR/LPDDR/GDDR	DDR5	•	•	•	•			•	•
	DDR4	•	•	•	•		•	•	•
	DDR3						•	•	•
	LPDDR5/5X	•	•	•	•	•	•	•	•
	LPDDR4/4X	•	•	•	•	•	•	•	•
	GDDR6	•	•			•			
Storage	xSPI				•	•	•	•	•
	SD/eMMC					•	•	•	•
	ONFi/Toggle	•				•	•	•	•

Table 1: Apps versus IP titles

## Advanced SerDes

We offer various complete, configurable, and production-proven interface protocols, such as Ethernet, PCIe, CXL, D2D, USB, SATA, DP, and MIPI. All these solutions are designed with your SoC in mind, eliminating the need for you to design around our IP. Moreover, our IP can be delivered with a complement of Cadence Verification IP (VIP) and models. Pre-verified solutions save time and effort and allow you to focus on your innovative designs.

	Protocol	Data Rate	TSMC									Samsung				Global Foundries		UMC		SMIC	Ctrl	
			22ULP/ 28HPC+	16/12 FFC	N7	N6	N5	N5A	N4P	N3E	10	8	7	5	12		28	14/12 nm				
											LPP	LPE	LP	LP+	HPC	HPC+						
Ethernet	224G-LR (200G/400G/ 800G/1.6T)	212.5 Gbps																			○	
	112G-ELR (100G/200G/ 400G/800G)	106.25 Gbps			●	●	●		●	○				○							●	
	56G-LR (100G/200G/400G)	53.125 Gbps			●	●															●	
	25G-KR (25G/100G)	25.78125 Gbps			●	●	●		○	○											●	
	10GBase-KR	10.3125 Gbps	●	●	●	●				●	○										●	
	USXGMII	10.3125 Gbps		●	●	●	●		○	○											●	●
	QSGMII	5Gbps	●	●	●	●	●		○	○											●	●
	SGMII	1.25Gbps	●	●	●	●	●		○	○											●	●
	Multi-Speed Ethernet Controller (soft IP)	10M/ 100M/1G																				●
PCIe and CXL	PCIe 6.0/CXL	64Gbps					○		○					○							●	
	PCIe 5.0/CXL	32Gbps			●	●	●	○	○	○											○	●
	PCIe 4.0	16Gbps		●	●	●				●				●	○					○	●	
	PCIe 3.1	8Gbps	●	●	●	●	●		○	○		●	○			●	●	●	●	●	●	
	PCIe 2.1	5Gbps	●	●	●	●	●		○	○	●	○	●	●	●	○	●	●	●	●	●	
	PCIe 1.1	2.5Gbps	●	●	●	●	●		○	○	●	○	●	●	●	○	●	●	●	●	●	
CPRI/ eCPRI	CPRI Option10	24.33 Gbps			●	●															○	
D2D	40G UltraLink D2D	40Gbps			●	●	●					●			●						○	●
	UCle	16Gbps			○		○			○												○

Table 2: IP for Ethernet, PCIe and CXL, and D2D connectivity

● Ready for design  
○ In progress

	Protocol	Data Rate	TSMC						Samsung					SMIC	Ctrl		
			16	12	N7	N6	N5	N5A	N4P	28	10	8	7	5		14	
			FFC							FD-SOI	LPP		LPE	nm			
USB	USB4	20Gbps	○	○	○	○	○	○									
	USB 3.0	5Gbps	●	●	●	●	●	○	●	●	○	●	●	●			xHCI Host
	USB 3.0	5Gbps	●	●	●	●	●	○	●	●	○	●	●	●	●		DRD
	USB 3.1	10Gbps	●	●	●	●	●	○	○	●	○	●	●	●	●	●	
	USB 2.0	480Mbps	●	●	●	●			○	●	○	●	○	●	●		Device
	USB 3.0	5Gbps	●	●	●	●	●		○	●	○	●	●	●	●	●	
	USB 3.1	10Gbps	●	●	●	●	●	○	○	●	○	●	●	●	●	●	
	USB 2.0	480Mbps	●	●	●	●	●		○	●	○	●	○	●	●	●	OTG
MIPI	D-PHY v1.2	2.5Gbps	●	●	●											●	CSI2 DSI
	C/D PHY 1.0/1.2	3.5Gbps/2.5Gbps	○	○												●	
	C/D PHY 1.1/2.1	6Gbps/4.5Gbps			○	○	○		○							●	
	SoundWire v1.2	12MHz				●										●	
	I3C	Soft IP														●	CSI2 DSI
DP/ SATA	SATA 3.0 Host	6.0Gbps	●	●	●	●	●		○					●			
DP/ eDP	DP 1.4 TX	8.1Gbps	●	●	●	●	●		○					●			

Table 3: IP for USB, MIPI, SATA, and DP

● Ready for design  
○ In progress

## Advanced Memory

We offer the broadest and most configurable portfolio of the industry's widely used memory and storage protocols. The Cadence Denali® Memory IP gives you the added value of multi-standard DDR support by providing controller IP that supports DDR5, DDR4, DDR3, DDR3L, LPDDR5X/5, LPDDR4X/4, and LPDDR3 as a single IP solution, as well as GDDR6. We also offer advanced memory IP solutions created by the best experts in the field to provide you with the controller, PHY, and VIP you need for your design.

	Protocols	Perf. (Mbps)	TSMC							Samsung					Global Foundries	SMIC	Ctrl			
			22	28	16	12	N7	N6	N5/N4P	N3E	14	10	8	7	4	5		12		14/12 nm
			ULP	HPC+	FFC						LPP		LPE		LP	LP+				
DDR/LPDDR	DDR5/4	8,800+							○	○									○	
		6,400+							○	○									○	
		5,600							●						●				●	
		4,800			●	●	●	●	●				●				●	●	●	
	DDR5/4, LPDDR5/4X combo	5,600					○	○	●				○						●	
	LPDDR5/4X	6,400					●	●	○										●	
	LPDDR5X/5	8,533+							○	○									○	
	LPDDR4/3/DDR4/3[L]	4,266	●	●	●	●	●	●										●	●	
	LPDDR4/4X/3/DDR4	4,266			●		●	●											●	●
	DDR4/3[L]	3,200	●	●	●	●	●	●											●	●
GDDR	GDDR6 PHY	16G					●	●	○		●		●	●	○	○			●	
		20G+						●											●	

Table 4: IP for DDR, LPDDR, GDDR, and HBM

● Ready for design  
○ In progress

## Storage IP

Cadence storage IP solutions consist of three popular technologies: NAND Flash, SD/eMMC, and xSPI. These memory technologies address the needs of a broad range of market requirements. The Cadence NAND Flash Controller IP supports all major NAND Flash manufacturers handling asynchronous devices and meets standards such as ONFI5.x, ONFI4.x, ONFI 3.x, ONFI 2, ONFI 1, Toggle 1, or Toggle 2. The Cadence NAND Flash PHY IP supports speeds up to DDR3600 for most process nodes, and is available as soft IP with a delay-locked loop (DLL), a firm PHY, or a hard PHY for your specific process and library. Ask your Cadence representative about hard PHYs at higher speeds. The Cadence SD/eMMC IP is compliant with the latest versions of Secure Digital and Embedded Multimedia Memory Card standards, which makes our IP the perfect choice for both high-performance and low-power solutions. The Cadence xSPI IP is compliant with a range of serial standards, including xSPI, Octal SPI (OSPI), Quad SPI (QSPI), NOR Flash, and some RAM, NAND, and novel NVM technologies.

	Protocol	Soft PHY	TSMC 16/12 FFC	TSMC N7	TSMC N5	Ctrl
xSPI	xSPI – Supports multiple serial standards including OSPI and QSPI	•				•
SD/eMMC	SD 4.0/eMMC5.1	•				•
	SD 6.0/eMMC5.1	•				•
NAND	ONFI4.x/Toggle 2	•				•
	ONFi 5.x Firm PHY and I/O / Hard PHY		•	○	○	
Combo	Multistandard PHY supporting NAND, SD/eMMC, and xSPI	•				

\* Information provided in this brochure is for planning purposes only. Contact Cadence to confirm availability and specifications.

Table 5: IP for storage

- Ready for design
- In progress



Cadence is a pivotal leader in electronic systems design and computational expertise, using its Intelligent System Design strategy to turn design concepts into reality. Cadence customers are the world's most creative and innovative companies, delivering extraordinary electronic products from chips to boards to complete systems for the most dynamic applications. [www.cadence.com](http://www.cadence.com)

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