

US Semiconductors

Cloud capex tracker: Raising '24 view to up 24% vs 20% prior

Industry Overview

'24 cloud capex tracking +24% YoY, directionally bullish

Our consensus cloud capex tracker now shows CY24 spend of \$201bn vs. \$196bn, suggesting +24% YoY growth versus +20% prior. As a reminder, our Global cloud capex tracker assesses spending trends across major US and China cloud/internet service providers (CSP). Aggregate Q4 capex across major US hyperscalers – Amazon, Google, Meta, Microsoft – came in slightly below expected (\$42.9bn vs. \$43.8bn expected). Google outperformance (+12% vs. Street) more than offset weaker results from other companies (3%-10% below Street). However, AI has created more positive sentiment around spend: 1) Street Q1 cloud capex outlook for US + China co's now \$48.4bn (vs. \$46.9bn prior), up 28% YoY, 2) Net-net, CY24 cloud capex outlook now ~\$5bn/2% above prior, and 3) CY24 Cloud capex intensity to reach 12.2% (levels seen pre-'23 downcycle). Upward revisions positive read throughs for top pick NVDA (see [preview](#)), MRVL, AMD, and AVGO. Also positive for EDA (SNPS/CDNS), ARM, memory (MU), and semicap.

Hyperscaler comments, accounting adjustments positive

Comments from hyperscalers: 1) **Google:** Q4 capex step-up (\$3bn QoQ) driven largely by servers followed by data centers, 2024 capex to be “notably larger” than CY23; 2)

Microsoft: Capex to be up materially in MarQ, ramp in capex spending going largely towards servers and data center footprint; 3) **Amazon:** CY23 capex declines (down ~\$10bn YoY) largely based on lower fulfillment/transportation costs, expected CY24 capex growth driven by AWS, support for genAI/LLMs; 4) **Meta:** Raised high-end of capex guide (\$30bn-\$37bn vs. \$30-\$35bn prior), growth driven by both AI and non-AI hardware. We also note Amazon raised the useful life of its servers (from 5 to 6 years), potentially indicating intentions to extend use of non-AI hardware assets. This follows adjustments in Jan '22 (extended useful life of servers from 4 to 5 yrs), and changes by Google/Microsoft/Oracle (extended equipment useful life 1-2yr in last 12-18 months).

Semis AI opportunity extends beyond Tier-1 hyperscalers

CY24 capex across the top 7 US/China hyperscalers expected to grow ~\$40bn, which often creates questions around ability for all semis vendors to achieve “AI” rev forecasts. We note several non Tier-1 hyperscalers add upside to our model not captured. Some key examples: 1) Tier 2/3 data center operators (CoreWeave, Vultr, Lambda Labs, Yotta, ByteDance) are placing multi-\$bn investments in aggregate into accelerators/servers, 2) HPC (High performance compute) systems launching with accelerators, accounting for multi-hundred \$mn in accelerator sales (AMD supplied El Capitan with est. ~\$350mn of GPUs in Q4); 3) Enterprises becoming active in purchasing GPUs; and 4) Government nations placing AI infra orders (NVDA CEO Jensen Huang recently highlighted traction).

5G cycle highlights tech cycles driving capex intensity

We believe capex intensity can grow/hold above historical levels in the “AI cycle,” remaining above 12% (CY22 levels). Indeed, the rolling 3yr capex intensity across cloud hyperscalers has increased from ~8% to >11% over the last decade. Using the 5G cycle as a proxy, Verizon + AT&T capex averaged ~15% from '21-'23 versus 12% from '18-'20, highlighting importance infra companies place on investment during tech cycles.

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Refer to important disclosures on page 6 to 9. Analyst Certification on page 4. Price Objective Basis/Risk on page 3.

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Glossary

AI: Artificial Intelligence
AMD: Advanced Micro
ARM: arm Holdings
ASP: Average Selling Price
AVGO: Broadcom
CDNS: Cadence
EDA: Electronic Design Automation
GPU: Graphics Processor
LLM: Large Language Model
MRVL: Marvell
MU: Micron
NVDA: Nvidia
PC: Personal Computer
SNPS: Synopsys

Cloud Capex Details

Exhibit 1: Summary of cloud capex expectations

Consensus is now forecasting cloud capex to grow nearly 25% in '24E

CapEx (\$mn)	C1Q23	C2Q23	C3Q23	C4Q23E	C1Q24E	C2Q24E	C3Q24E	C4Q24E	C1Q25E	C2Q25E	C3Q25E	C4Q25E	2022	2023E	2024E	2025E
Total US	36,573	35,415	38,308	44,087	45,658	46,123	46,146	49,962	49,073	49,355	50,839	56,897	157,932	154,383	187,889	206,165
Google	6,289	6,888	8,055	11,019	9,040	9,265	9,490	10,037	9,800	9,995	10,440	11,522	31,485	32,251	37,833	41,758
Microsoft	6,607	8,943	9,917	9,735	11,176	11,623	11,233	11,522	11,667	12,144	12,210	12,590	24,768	35,202	45,553	48,610
Amazon	14,207	11,455	12,479	14,588	14,661	14,021	14,779	17,020	16,246	15,642	16,664	20,289	63,645	52,729	60,480	68,841
Meta	6,842	6,216	6,543	7,665	8,210	8,340	8,532	9,240	9,098	9,124	9,354	10,273	31,356	27,266	34,322	37,849
Oracle	2,628	1,913	1,314	1,080	2,571	2,874	2,112	2,144	2,263	2,450	2,172	2,222	6,678	6,935	9,701	9,107
Total China	1,197	1,746	2,145	3,031	2,743	3,324	3,624	3,616	2,889	3,604	3,756	4,012	9,410	8,119	13,307	14,261
Alibaba	366	828	564	1,106	1,198	1,972	2,037	1,459	1,267	2,142	2,084	1,609	5,490	2,864	6,665	7,102
Tencent	642	545	1,097	1,516	1,195	991	1,170	1,682	1,345	1,087	1,218	1,861	2,703	3,800	5,038	5,511
Baidu	189	373	484	409	350	361	418	475	277	375	454	542	1,217	1,455	1,604	1,649
Total	37,770	37,161	40,453	47,118	48,401	49,447	49,770	53,578	51,962	52,959	54,596	60,909	167,342	162,502	201,196	220,426
YoY %																
Total US	(0.1%)	(7.8%)	(6.6%)	5.3%	24.8%	30.2%	20.5%	13.3%	7.5%	7.0%	10.2%	13.9%	20.9%	(2.2%)	21.7%	9.7%
Google	(35.7%)	0.9%	10.7%	45.1%	43.7%	34.5%	17.8%	(8.9%)	8.4%	7.9%	10.0%	14.8%	27.8%	2.4%	17.3%	10.4%
Microsoft	23.7%	30.2%	57.8%	55.2%	69.2%	30.0%	13.3%	18.4%	4.4%	4.5%	8.7%	9.3%	6.7%	42.1%	29.4%	6.7%
Amazon	(5.0%)	(27.1%)	(23.8%)	(12.1%)	3.2%	22.4%	18.4%	16.7%	10.8%	11.6%	12.8%	19.2%	4.2%	(17.2%)	14.7%	13.8%
Meta	25.7%	(17.9%)	(30.1%)	(14.7%)	20.0%	34.2%	30.4%	20.5%	10.8%	9.4%	9.6%	11.2%	68.3%	(13.0%)	25.9%	10.3%
Oracle	138.7%	34.4%	(23.6%)	(55.6%)	(2.2%)	50.2%	60.8%	98.5%	(12.0%)	(14.8%)	2.8%	3.7%	114.2%	3.8%	39.9%	(6.1%)
Total China	(58.2%)	(28.0%)	(1.7%)	56.4%	129.3%	90.4%	68.9%	19.3%	5.3%	8.4%	3.7%	11.0%	(27.2%)	(13.7%)	63.9%	7.2%
Alibaba	(74.8%)	(50.1%)	(63.4%)	31.7%	227.3%	138.2%	261.0%	31.9%	5.8%	8.6%	2.3%	10.3%	(9.0%)	(47.8%)	132.8%	6.6%
Tencent	(41.6%)	21.1%	228.4%	85.1%	86.1%	81.9%	6.6%	10.9%	12.5%	9.6%	4.1%	10.7%	(48.0%)	40.6%	32.6%	9.4%
Baidu	(39.6%)	17.7%	57.1%	46.3%	85.8%	(3.3%)	(13.7%)	16.1%	(20.8%)	3.9%	8.8%	14.0%	(28.1%)	19.6%	10.3%	2.8%
Total	(4.3%)	(9.0%)	(6.3%)	7.5%	28.1%	33.1%	23.0%	13.7%	7.4%	7.1%	9.7%	13.7%	16.6%	(2.9%)	23.8%	9.6%
Cap. intensity (%)																
Total US	12.6%	11.4%	11.9%	11.9%	14.4%	13.7%	13.2%	12.6%	13.9%	13.2%	13.1%	12.9%	13.6%	11.9%	13.4%	13.2%
Google	9.0%	9.2%	10.5%	12.8%	13.7%	13.1%	13.1%	12.3%	13.5%	13.0%	13.2%	13.1%	11.1%	10.5%	13.0%	13.2%
Microsoft	12.5%	15.9%	17.5%	15.7%	18.4%	18.0%	17.3%	16.5%	16.9%	16.6%	16.7%	16.1%	12.1%	15.5%	17.5%	16.6%
Amazon	11.2%	8.5%	8.7%	8.6%	10.3%	9.3%	9.3%	9.0%	10.3%	9.4%	9.4%	9.8%	12.4%	9.2%	9.4%	9.7%
Meta	23.9%	19.4%	19.2%	19.1%	23.0%	22.0%	21.9%	20.7%	22.6%	21.5%	21.3%	20.6%	26.9%	20.2%	21.8%	21.4%
Oracle	21.2%	13.8%	10.6%	8.3%	19.4%	19.5%	15.7%	15.3%	15.7%	15.4%	14.7%	14.5%	14.5%	13.4%	17.5%	15.1%
Total China	2.1%	2.9%	3.8%	4.8%	4.7%	5.3%	5.8%	5.3%	4.5%	5.2%	5.4%	5.4%	4.2%	3.4%	5.3%	5.2%
Alibaba	1.2%	2.5%	1.8%	3.0%	3.9%	5.7%	6.0%	3.7%	3.8%	5.8%	5.7%	3.9%	4.4%	2.2%	4.8%	4.8%
Tencent	2.9%	2.6%	5.1%	6.9%	5.3%	4.4%	5.0%	7.0%	5.3%	4.2%	4.5%	6.8%	3.3%	4.4%	5.4%	5.2%
Baidu	4.2%	7.7%	10.2%	8.3%	7.7%	7.1%	8.0%	8.8%	5.5%	6.7%	7.7%	9.1%	6.9%	7.6%	7.9%	7.3%
Total	10.9%	10.0%	10.6%	10.8%	12.9%	12.4%	12.1%	11.5%	12.4%	11.9%	11.9%	11.9%	12.1%	10.6%	12.2%	12.0%

Source: Bloomberg, company reports

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Exhibit 2: Summary of stocks mentioned

Prices and ratings summary

Ticker	Price	Rating
ARM	\$73.27	C-1-9
AVGO	\$1,243.10	B-1-7
INTC	\$42.77	B-2-8
MRVL	\$67.02	C-1-7
NVDA	\$693.32	C-1-7
SNPS	\$559.14	B-1-9
CDNS	\$296.65	B-1-9
MU	\$86.98	B-1-7

Source: BofA Global Research, Bloomberg

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Price objective basis & risk

Arm Holdings (ARM)

We assign a \$80 PO, which is based on 44x our CY25E non-GAAP EPS. This is at the high end of peers trading at 30x-36x and is justified, in our view, given Arm's superior growth profile.

Downside risks: 1) historically cyclical nature of semiconductor units, 2) high exposure to mature smartphone market, 3) competition against established x86 in the data center, 4) emerging competition from RISC-V in low-end consumer markets, 5) rising geopolitical tensions and deterioration of Arm China relationship, 6) ongoing Qualcomm/Nuvia litigation, 7) small trading float

Broadcom Inc (AVGO)

Our \$1250 price objective for Broadcom is based on 22x CY25E P/E, the upper end of its 8x-23x historical range, though justified given double-digit EPS growth and best-in-semis profitability, FCF generation, and returns.

Downside risks to our price objective are 1) semiconductor cycle risks, including sensitivity to US/China trade relations, 2) high exposure to Apple and Google with potential design out risks, 3) competitive risks in networking, smartphone, storage, enterprise software markets, 4) frequent acquirer of assets, which increases financial and integration risks, and 5) recent strategy towards moving into non-core software businesses creates execution risks.

Cadence (CDNS)

Our \$315 PO is based on 46x FY25E P/E, at upper end historical 22x-52x trading range and justified in our view given the strategic importance of EDA in an increasingly fragmented global electronics supply chain.

Downside risks are: (1) Share loss in existing markets to primary competitors, (2) a broader economic downturn dampens semis R&D spending and corresponding spend on EDA tools and services, (3) escalation of US-China trade war limits CDNS' ability to sell to key customers, (4) semiconductor industry consolidation accelerates which could diminish customer spending power, (5) venture into adjacent system analysis market fails to meaningfully accelerate revenue growth and incremental investments suppress margin expansion.

Intel (INTC)

Our \$50 price objective is based on 26x our 2025E pf-EPS ex-stock comp expense, in the middle of compute peers (15x-40x), which we view as appropriate given manufacturing uncertainties and risks of new foundry strategy.

Upside risks to our price objective are 1) clarity or breakthrough on yields for 7nm process technology, 2) new products allowing Intel to limit share loss, 3) improving product mix which can drive upside to gross margins, 4) manufacturing slip up at key foundry competitors.

Downside risks to our price objective are 1) weaker-than-expected trends in a mature PC market, which is largest revenue generator for Intel, 2) further delays in 7nm process technology and roadmap, 3) accelerated share loss to AMD, 4) more competition in profitable data center market.

Marvell Technology Group Ltd. (MRVL)

Our \$80 PO is based on a 32x FY26E/CY25E pf-EPS, which is well-supported by the 20%-30%+ longer-term compounded annual EPS growth potential, and within the



normal 1x-2x range for high growth semi peers.

Downside risks: 1) Integration risks in recent deals, 2) Financial risks related to going to net debt from net cash position, and in achieving expected cost synergies in a timely manner, and 3) Cyclical industry risks including potential slowdown in legacy hard disk drive, infrastructure spending, and storage assets, 4) Competitive risks against larger well resourced rivals.

Micron Technology, Inc (MU)

Our \$100 PO is based on 2.1x our CY25E P/B, which is within MU's long term range 0.8x-3.0x as we potentially enter the next memory upcycle.

Downside risks: (1) larger than expected memory ASP decline, (2) greater competition from China newcomers, (3) share loss to other large competitors like Samsung or SK Hynix, (4) softening of demand across major end markets such as data center, smartphones, or PCs.

NVIDIA Corporation (NVDA)

Our \$800 PO is based on 31x CY25E PE ex cash, within NVDA's historical 26x-69x forward year PE range, justified given stronger growth opportunities ahead as gaming cycle troughs and data center demand potentially faces strong, long-term demand dynamics.

Downside risks to our price objective are: 1) weakness in consumer driven gaming market, 2) Competition with major public firms, internal cloud projects and other private companies in accelerated computing markets, 3) Larger than expected impact from restrictions on compute shipments to China, or additional restrictions placed on activity in the region, 4) Lumpy and unpredictable sales in new enterprise, data center, and autos markets, 5) Potential for decelerating capital returns.

Synopsys (SNPS)

Our \$650 PO is based on 40x 2025E P/E, at upper end of company's historical trading range (19x-49x), justified in our view as EDA investment accelerates as chip complexity rises.

Downside risks are (1) variability in IP/hardware sales creates issues in timing of revenue recognition, (2) competitors develop unique software capabilities displacing SNPS at core customers, (3) heightened geopolitical tensions lead to further restrictions on supplying firms in China with EDA technology.

Upside risks are (1) share gains in existing markets versus primary competitors, (2) increased government investment in semiconductor R&D and development as nations develop internal ecosystems, (3) material M&A that enables consistent margin expansion or further accelerates sales CAGR, (4) faster-than-expected cost improvements driving higher operating margin.

Analyst Certification

I, Vivek Arya, hereby certify that the views expressed in this research report accurately reflect my personal views about the subject securities and issuers. I also certify that no part of my compensation was, is, or will be, directly or indirectly, related to the specific recommendations or view expressed in this research report.

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US - Semiconductors and Semiconductor Capital Equipment Coverage Cluster

Investment rating	Company	BofA Ticker	Bloomberg symbol	Analyst
BUY				
	Advanced Micro Devices, Inc	AMD	AMD US	Vivek Arya
	Analog Devices Inc.	ADI	ADI US	Vivek Arya
	Applied Materials, Inc.	AMAT	AMAT US	Vivek Arya
	Arm Holdings	ARM	ARM US	Vivek Arya
	Broadcom Inc	AVGO	AVGO US	Vivek Arya
	Cadence	CDNS	CDNS US	Vivek Arya
	Camtek	CAMT	CAMT US	Vivek Arya
	KLA Corporation	KLAC	KLAC US	Vivek Arya
	Lam Research Corp.	LRCX	LRCX US	Vivek Arya
	M/A-Com	MTSI	MTSI US	Vivek Arya
	Marvell Technology Group Ltd.	MRVL	MRVL US	Vivek Arya
	Microchip	MCHP	MCHP US	Vivek Arya
	Micron Technology, Inc	MU	MU US	Vivek Arya
	Nova	NVMI	NVMI US	Vivek Arya
	NVIDIA Corporation	NVDA	NVDA US	Vivek Arya
	NXP Semiconductors NV	NXPI	NXPI US	Vivek Arya
	onsemi	ON	ON US	Vivek Arya
	Synopsys	SNPS	SNPS US	Vivek Arya
NEUTRAL				
	Advanced Energy Industries	AEIS	AEIS US	Duksan Jang
	Allegro MicroSystems	ALGM	ALGM US	Blake Friedman
	Axcelis Technologies	ACLS	ACLS US	Duksan Jang
	Coherent Corp	COHR	COHR US	Vivek Arya
	GlobalFoundries	GFS	GFS US	Vivek Arya
	Intel	INTC	INTC US	Vivek Arya
	Lattice Semiconductor	LSCC	LSCC US	Blake Friedman
	Texas Instruments Inc.	TXN	TXN US	Vivek Arya
UNDERPERFORM				
	Ambarella	AMBA	AMBA US	Vivek Arya
	Credo Technology	CRDO	CRDO US	Vivek Arya
	Lumentum Holdings	LITE	LITE US	Vivek Arya
	Qorvo Inc.	QRVO	QRVO US	Vivek Arya
	Skyworks Solutions, Inc.	SWKS	SWKS US	Vivek Arya
	Teradyne	TER	TER US	Vivek Arya
	Wolfspeed Inc	WOLF	WOLF US	Vivek Arya

Disclosures

Important Disclosures

Equity Investment Rating Distribution: Technology Group (as of 31 Dec 2023)

Coverage Universe	Count	Percent	Inv. Banking Relationships ^{R1}	Count	Percent
Buy	215	53.09%	Buy	111	51.63%
Hold	97	23.95%	Hold	45	46.39%
Sell	93	22.96%	Sell	24	25.81%

Equity Investment Rating Distribution: Global Group (as of 31 Dec 2023)

Coverage Universe	Count	Percent	Inv. Banking Relationships ^{R1}	Count	Percent
Buy	1895	53.62%	Buy	1083	57.15%
Hold	832	23.54%	Hold	454	54.57%
Sell	807	22.84%	Sell	383	47.46%

^{R1} Issuers that were investment banking clients of BofA Securities or one of its affiliates within the past 12 months. For purposes of this Investment Rating Distribution, the coverage universe includes only stocks. A stock rated Neutral is included as a Hold, and a stock rated Underperform is included as a Sell.

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Investment rating	Total return expectation (within 12-month period of date of initial rating)	Ratings dispersion guidelines for coverage cluster ^{R2}
Buy	≥ 10%	≤ 70%
Neutral	≥ 0%	≤ 30%
Underperform	N/A	≥ 20%

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