IT Hardware Industry

Artificial Intelligence set be a key driver for server market growth

Price Objective Change

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Equity
United States
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Modeling double-digit CAGR for revs, high-single for units

In the 17-years from 2006 to 2023, the server market grew revenues at mid-single digit CAGR (5.4%), and units at low-single digit CAGR (2.8). We see Artificial Intelligence (AI) driving most of the future growth in server revenues over the next 4-years. We model the overall server market growing revenues double-digits (about 23% CAGR) between 2023-2027, while server units grow at high-single digits (8.6% CAGR) in the same timeframe. Within our coverage universe, we see Super Micro, DELL, and HPE directly benefiting from higher AI server demand, while NTAP, PSTG, WDC and STX benefit from increased demand for storage driven by increased AI workloads.

AI servers to grow much faster than the overall market

Figure 2 shows our estimate of AI versus non-AI server growth 2023-27. While we expect the overall server market to grow revenues at 23% CAGR, in that timeframe we expect AI server revenues to grow much faster at about 50% CAGR. Non-AI server revenues grow much slower at low-single digits (about 2.5% CAGR). We expect AI server units to grow at 58% CAGR 2023-27, while non-AI server units grow at mid-single digit CAGR (6.3%). This leads to total server market unit growth at 8.6% CAGR 2023-27. Within AI servers, we expect both Training servers and Inference servers to grow revenues double digits, with Training server revenues growing at about 36% CAGR 2023-27, while inference server revenues grow faster at about 66% CAGR.

Dell, Super Micro, HPE, Lenovo are the top server OEMs

In C4Q23 Dell, Super Micro, HPE, Lenovo and were the top server vendors by revenue. In terms of market share by revenues, Dell had 11.5% share, Super Micro 8.1%, HPE 6.9%, and Lenovo and IBM each with 4.0%. In terms of unit share, Dell had 11.7% share, HPE 6.7%, Super Micro 6.0%, Lenovo 4.8% and Cisco 1.2%.

Adjusting estimates and price objectives

We reiterate our Buy rating on Dell and adjust our revenue/EPS estimates. Our PO moves to $130 (from $116) on 15x (prior 14x) C25E EPS of $8.46 (prior $8.26). We apply a slightly higher multiple on expected higher revenue growth related to AI server demand. We reiterate our Neutral rating on HPE and our PO moves to $19 (from $17) on 8x C25E EPS of $2.26 (prior 9x C24E EPS of $1.94). We roll-over to a C25E based valuation. For NTAP, we reiterate our Underperform rating. Our PO moves to $85 (from $78) on 13x C25E EPS of $6.51. We roll-over to a C25E based valuation. For PSTG, we reiterate our Neutral rating. Our PO moves to $57 (from $50) on 5x (prior 4x) C25E EV/sales on better-than-expected revenue growth and profitability. For WDC, we reiterate our Buy rating. WDC recently positively pre-announced its F3Q24 quarter. We adjust our estimates, and our PO moves to $75 from $70 on 9x (unchanged) C25E EPS of $8.31 (prior $8.16). For STX, we reiterate our Buy rating. STX also recently pre-announced its F3Q24 quarter to the mid-point of prior guidance. We adjust our revenue and EPS estimates. Our PO moves to $110 from $100 on 13x (prior 12x) C25E EPS of $8.34 (prior $8.36). We use a higher multiple as growth and margins are rerating higher.

Ticker	Rating	PO (previous)	PO (revised)
DELL	BUY	$116	$130
HPE	NEUTRAL	$17	$19
NTAP	UNDERPERFORM	$78	$85
PSTG	NEUTRAL	$50	$57
WDC	BUY	$70	$75
STX	BUY	$100	$110

See inside for revenue and EPS estimate changes

AI: Artificial Intelligence
FCF: Free Cash Flow
n-t: near-term
l-t: long-term
PO: Price Objective

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AI workloads set to drive Server market growth above historical rate

Figure 1 shows our model for server revenue, unit and average sell price (ASP) growth for the 4-years from 2023 to 2027. We model server industry revenues to grow at 23% CAGR 2022-2027, primarily driven by growth in artificial intelligence (AI) servers which have much higher ASP vs. general purpose servers. We model server units growing at 9% CAGR, while average ASP grows 13% CAGR in the same timeframe. Most of the AI related demand in the initial years will be in training servers (mid-range and high-end servers) while latter years will see higher inference related server demand (mostly mid-range servers).

While we expect volume servers (which are typically less than $10K in ASP and are used for non-AI applications) to grow units at high single digit (7% 4-year CAGR), we expect mid-range servers to grow units at strong double-digits (31% 4-year CAGR) driven by the demand for both training and inference. We also expect high-end server units to grow double-digits (15% 4-year CAGR) driven by the demand for training AI models.

Figure 1: BofA server industry model

Between 2023 and 2027, we model server industry revenues growing at 23% CAGR with units growing at 9% CAGR and ASP growing at 13% CAGR

	2023				2024E				2025E									
	3/23	6/23	9/23	12/23	3/24E	6/24E	9/24E	12/24E	3/25E	6/25E	9/25E	12/25E	2022	2023	2024E	2025E	2026E	2027E
Server Analysis By Class				-										-				
Revenue ($M)	**$28,089**	**$30,862**	**$32,041**	**$39,863**	**$36,346**	**$44,347**	**$47,605**	**$56,526**	**$44,403**	**$53,551**	**$57,962**	**$69,610**	**$117,984**	**$130,854**	**$184,823**	**$225,526**	**$260,964**	**$298,666**
Volume Server	$19,788	$19,960	$19,745	$21,648	$18,914	$21,454	$21,783	$21,344	$19,505	$22,320	$22,703	$21,923	$101,039	$81,141	$83,495	$86,451	$87,508	$87,803
Midrange Enterprise Server	$7,309	$9,325	$10,600	$15,128	$15,348	$19,582	$22,260	$29,303	$22,397	$27,259	$30,985	$40,632	$11,676	$42,361	$86,493	$121,273	$156,661	$194,349
High-End Enterprise Server	$992	$1,576	$1,696	$3,087	$2,084	$3,310	$3,562	$5,879	$2,501	$3,972	$4,274	$7,055	$5,268	$7,352	$14,835	$17,802	$16,795	$16,515
Y/Y Growth (Revenue)	**13%**	**5%**	**2%**	**23%**	**29%**	**44%**	**49%**	**42%**	**22%**	**21%**	**22%**	**23%**	**20%**	**11%**	**41%**	**22%**	**16%**	**14%**
Volume Server	(8%)	(20%)	(28%)	(21%)	(4%)	7%	10%	(1%)	3%	4%	4%	3%	21%	(20%)	3%	4%	1%	0%
Midrange Enterprise Server	190%	233%	245%	361%	110%	110%	110%	94%	46%	39%	39%	39%	12%	263%	104%	40%	29%	24%
High-End Enterprise Server	19%	(12%)	80%	80%	110%	110%	110%	90%	20%	20%	20%	20%	24%	40%	102%	20%	(6%)	(2%)
Units	**2,896,791**	**2,963,643**	**2,985,465**	**3,128,387**	**2,916,579**	**3,360,940**	**3,439,059**	**3,286,177**	**3,167,966**	**3,674,050**	**3,765,298**	**3,565,100**	**14,851,549**	**11,974,286**	**13,002,754**	**14,172,414**	**15,504,497**	**16,681,039**
Volume Server	2,773,861	2,784,967	2,801,191	2,867,901	2,732,182	3,092,926	3,162,648	2,925,489	2,936,124	3,352,434	3,433,604	3,132,274	14,590,909	11,227,918	11,913,245	12,854,437	13,719,155	14,471,774
Midrange Enterprise Server	121,449	176,301	180,581	254,792	182,173	264,452	270,872	352,887	229,174	317,342	325,046	423,464	254,109	733,123	1,070,384	1,295,027	1,762,222	2,186,117
High-End Enterprise Server	1,482	2,374	3,693	5,695	2,223	3,561	5,539	7,802	2,668	4,274	6,647	9,362	6,531	13,244	19,125	22,951	23,120	23,148
Y/Y Growth (Units)	**(14%)**	**(22%)**	**(24%)**	**(17%)**	**1%**	**13%**	**15%**	**5%**	**9%**	**9%**	**9%**	**8%**	**10%**	**(19%)**	**9%**	**9%**	**9%**	**8%**
Volume Server	(16%)	(26%)	(27%)	(22%)	(2%)	11%	13%	2%	7%	8%	9%	7%	10%	(23%)	6%	8%	7%	5%
Midrange Enterprise Server	115%	196%	169%	258%	50%	50%	50%	39%	26%	20%	20%	20%	6%	189%	46%	21%	36%	24%
High-End Enterprise Server	20%	8%	204%	202%	50%	50%	50%	37%	20%	20%	20%	20%	5%	103%	44%	20%	1%	0%
ASP	**$9,696**	**$10,413**	**$10,732**	**$12,742**	**$12,462**	**$13,195**	**$13,842**	**$17,201**	**$14,016**	**$14,575**	**$15,394**	**$19,525**	**$7,944**	**$10,928**	**$14,214**	**$15,913**	**$16,832**	**$17,905**
Volume Server	$7,134	$7,167	$7,049	$7,548	$6,923	$6,936	$6,888	$7,296	$6,643	$6,658	$6,612	$6,999	$6,925	$7,227	$7,009	$6,725	$6,379	$6,067
Midrange Enterprise Server	$60,178	$52,892	$58,699	$59,372	$84,249	$74,049	$82,178	$83,038	$97,729	$85,897	$95,326	$95,951	$45,949	$57,782	$80,806	$93,645	$88,900	$88,901
High-End Enterprise Server	$669,628	$663,849	$459,290	$542,155	$937,479	$929,389	$643,005	$753,595	$937,479	$929,389	$643,005	$753,595	$806,616	$555,132	$775,676	$775,676	$726,414	$713,449
Y/Y Growth (ASP)	**31%**	**35%**	**34%**	**48%**	**29%**	**27%**	**29%**	**35%**	**12%**	**10%**	**11%**	**14%**	**10%**	**38%**	**30%**	**12%**	**6%**	**6%**
Volume Server	10%	8%	(1%)	2%	(3%)	(3%)	(2%)	(3%)	(4%)	(4%)	(4%)	(4%)	10%	4%	(3%)	(4%)	(5%)	(5%)
Midrange Enterprise Server	35%	12%	28%	29%	40%	40%	40%	40%	16%	16%	16%	16%	5%	26%	40%	16%	(5%)	0%
High-End Enterprise Server	(1%)	(18%)	(41%)	(40%)	40%	40%	40%	39%	0%	0%	0%	0%	18%	(31%)	40%	0%	(6%)	(2%)

Source: IDC, Gartner, BofA Global Research estimates

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Figure 2 shows our estimate of AI versus non-AI server growth 2023-27. While we expect the overall server market to grow revenue at 23% CAGR in that timeframe, we expect AI server revenues to grow much faster at about 50% CAGR. Non-AI server revenues grow much slower at low-single digits (about 2.5% CAGR).

We expect AI server units to grow at 58% CAGR 2023-27, while non-AI server units grow at mid-single digits (6.3% CAGR 2023-27). This leads to total server market unit growth of 8.6% CAGR 2023-27.

Within AI servers, we expect both Training servers and Inference servers to grow revenues double digits. We model Training server revenues growing at about 36% CAGR 2023-27, while inference server revenues grow faster at about 66% CAGR in the same timeframe. After the initial years of strong y/y revenue growth for training servers, as Enterprises apply AI models to specific use cases, inference revenues should see strong growth.

Figure 2: We expect AI servers to see higher revenue and unit growth vs. non-AI servers. Within AI servers, we expect about equal revenue growth CAGR for both training and inference servers

We model AI server revenues and units growing at 50% CAGR and 58% CAGR, respectively, in the 4-year period between 2023 and 2027

	2022	2023E	2024E	2025E	2026E	2027E
Server TAM forecast						
AI server rev ($mn)	$7,206	$38,801	$89,087	$126,917	$160,385	$197,080
y/y		438%	130%	42%	26%	23%
non-Ai server rev ($mn)	$110,778	$92,053	$95,735	$98,607	$100,580	$101,585
y/y		(17%)	4%	3%	2%	1%
total server rev ($mn)	$117,984	$130,854	$184,823	$225,525	$260,964	$298,666
y/y		11%	41%	22%	16%	14%
Split between Training and Inference						
Training rev ($mn)	$14,058	$23,280	$53,452	$63,459	$64,154	$78,832
y/y		66%	130%	19%	1%	23%
Training as percent of total AI (%)		60%	60%	50%	40%	40%
Inference rev ($mn)	($6,852)	$15,520	$35,635	$63,459	$96,231	$118,248
y/y		-327%	130%	78%	52%	23%
Inference as percent of total AI (%)		40%	40%	50%	60%	60%
Total AI server rev ($mn)	$7,206	$38,801	$89,087	$126,917	$160,385	$197,080
y/y		438%	130%	42%	26%	23%
Server unit forecast						
AI server units (K)	51	277	670	1,004	1,336	1,728
y/y		438%	142%	50%	33%	29%
Non AI server units (K)	14,800	11,697	12,332	13,167	14,168	14,953
y/y		(21.0%)	5.4%	6.8%	7.6%	5.5%
Total server units (K)	14,852	11,974	13,002	14,172	15,504	16,681
y/y	9.6%	(19.4%)	8.6%	9.0%	9.4%	7.6%
% AI Server units	0.3%	2.3%	5.2%	7.1%	8.6%	10.4%
Server ASP forecast						
AI server ASP ($)	$140,000	$140,000	$133,000	$126,350	$120,033	$114,031
y/y		0.0%	(5.0%)	(5.0%)	(5.0%)	(5.0%)
Non-AI server ASP ($)	$7,485	$7,870	$7,763	$7,489	$7,099	$6,794
y/y		5.1%	(1.4%)	(3.5%)	(5.2%)	(4.3%)
Avg Server ASP ($)	$7,944	$10,928	$14,215	$15,914	$16,832	$17,904

Source: IDC, Gartner, BofA Global Research estimates

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Vendor market shares as of C4Q23

Figure 3 shows server vendor market share, by revenue, for C4Q23. We see that Dell, Super Micro, HPE, Lenovo and IBM made up the top 5 server OEMs with 11.5%, 8.1%, 6.9%, 4.0% and 4.0% market share, respectively. ODM Direct refers to servers sold by all Taiwanese ODMs combined, and they had 35.9% share of the server market.

Figure 3: Server market share, by revenue, for C4Q23

DELL had the highest server market share by revenue at 11.5%

% Market share	Dell	HPE	Lenovo	IBM	Cisco	Inspur	Super Micro	Huawei	Fujitsu	ODM Direct	Others	Total
Volume	14.5%	6.6%	5.0%	0.0%	1.6%	0.0%	6.1%	2.6%	0.7%	29.9%	32.9%	100.0%
Midrange Enterprise	9.3%	5.9%	3.4%	1.2%	3.2%	0.0%	12.0%	0.1%	0.4%	49.4%	15.0%	100.0%
High-End Enterprise	1.9%	13.8%	0.0%	46.1%	0.4%	0.3%	2.9%	0.0%	0.6%	11.6%	22.4%	100.0%
Total Server	**11.5%**	**6.9%**	**4.0%**	**4.0%**	**2.1%**	**0.0%**	**8.1%**	**1.4%**	**0.6%**	**35.9%**	**25.3%**	**100.0%**
% market share gain/loss	**Dell**	**HPE**	**Lenovo**	**IBM**	**Cisco**	**Inspur**	**Super Micro**	**Huawei**	**Fujitsu**	**ODM Direct**	**Others**	
Volume	-1.6%	-2.9%	-1.4%	0.0%	0.6%	-0.1%	0.5%	2.4%	-0.3%	-3.2%	6.0%	
Midrange Enterprise	-0.5%	-29.8%	-11.8%	-4.3%	-9.6%	-0.5%	9.7%	0.1%	-0.8%	48.9%	-1.5%	
High-End Enterprise	0.4%	12.2%	-0.1%	-32.2%	0.0%	-0.3%	2.9%	0.0%	0.2%	11.6%	5.3%	
Total Server	**-3.2%**	**-4.8%**	**-3.0%**	**-0.7%**	**-0.1%**	**-0.1%**	**3.1%**	**1.3%**	**-0.4%**	**7.8%**	**0.0%**	
% vendor exposure to market	**Dell**	**HPE**	**Lenovo**	**IBM**	**Cisco**	**Inspur**	**Super Micro**	**Huawei**	**Fujitsu**	**ODM Direct**	**Others**	**Total**
Volume	68.1%	51.8%	67.7%	0.3%	41.0%	10.9%	41.2%	97.1%	67.2%	45.3%	70.6%	54.3%
Midrange Enterprise	30.6%	32.7%	32.3%	11.0%	57.6%	33.7%	56.0%	2.9%	24.9%	52.2%	22.5%	37.9%
High-End Enterprise	1.3%	15.4%	0.0%	88.7%	1.4%	55.4%	2.8%	0.0%	7.9%	2.5%	6.8%	7.7%
Total Server	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: IDC

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We also look at market share on a rolling 4-quarter basis. Figure 4 shows vendor market share, by revenue, for the 4-quarters ending C4Q23. We see that Dell, HPE, Super Micro, Lenovo and IBM made up the top 5 server OEMs with 11.5%, 7.8%, 6.2%, 4.6% and 3.1% market share, respectively. ODM Direct refers to servers sold by all Taiwanese ODMs combined, and they had 37.4% share of the global server market by revenue.

Figure 4: Server market share, by revenue, for the 4-quarters ending C4Q23

DELL had the highest server market share, by revenue, on a rolling 4-quarter basis at 11.5%

% Market share	Dell	HPE	Lenovo	IBM	Cisco	Inspur	Super Micro	Huawei	Fujitsu	ODM Direct	Others	Total
Volume	14.5%	7.7%	5.7%	0.0%	1.5%	0.0%	4.9%	1.0%	1.0%	34.1%	29.6%	100.0%
Midrange Enterprise	7.3%	7.7%	3.4%	1.2%	4.1%	0.1%	9.5%	0.1%	0.4%	48.9%	17.2%	100.0%
High-End Enterprise	2.0%	9.6%	0.1%	47.6%	0.4%	1.0%	2.0%	0.0%	0.7%	7.1%	29.5%	100.0%
Total Server	**11.5%**	**7.8%**	**4.6%**	**3.1%**	**2.3%**	**0.1%**	**6.2%**	**0.7%**	**0.8%**	**37.4%**	**25.6%**	**100.0%**
% market share gain/loss	**Dell**	**HPE**	**Lenovo**	**IBM**	**Cisco**	**Inspur**	**Super Micro**	**Huawei**	**Fujitsu**	**ODM Direct**	**Others**	
Volume	-3.0%	-0.6%	-0.6%	0.0%	0.0%	0.0%	-0.6%	0.8%	0.1%	0.3%	3.6%	
Midrange Enterprise	-3.7%	-24.1%	-7.5%	-4.1%	-10.5%	-0.6%	7.5%	0.1%	-0.7%	47.6%	-4.0%	
High-End Enterprise	0.4%	6.8%	0.1%	-22.1%	-0.1%	-0.5%	2.0%	0.0%	-2.5%	7.1%	9.0%	
Total Server	**-4.7%**	**-2.6%**	**-1.8%**	**-0.6%**	**-0.5%**	**-0.1%**	**1.3%**	**0.5%**	**-0.2%**	**8.3%**	**0.3%**	
% vendor exposure to market	**Dell**	**HPE**	**Lenovo**	**IBM**	**Cisco**	**Inspur**	**Super Micro**	**Huawei**	**Fujitsu**	**ODM Direct**	**Others**	**Total**
Volume	78.4%	61.0%	76.3%	0.7%	40.5%	12.7%	48.8%	94.1%	76.6%	56.6%	71.7%	62.0%
Midrange Enterprise	20.6%	32.1%	23.6%	12.7%	58.4%	28.9%	49.4%	5.9%	18.1%	42.4%	21.8%	32.4%
High-End Enterprise	1.0%	6.9%	0.2%	86.6%	1.1%	58.4%	1.8%	0.0%	5.3%	1.1%	6.5%	5.6%
Total Server	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: IDC

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Figure 5 shows server vendor market share, by units, for C4Q23. We see that Dell, HPE, Super Micro, Lenovo and Cisco make up the top 5 server OEMs with 11.7%, 6.7%, 6.0%, 4.8% and 1.2% unit market share, respectively. ODM Direct refers to servers sold by all Taiwanese ODMs combined, and they had 32.5% share of the server market units.

Figure 5: Server market share, by units, for C4Q23
In C4Q23, DELL had the highest server market share by units at 11.7%

% Market share	Dell	HPE	Lenovo	IBM	Cisco	Inspur	Super Micro	Huawei	Fujitsu	ODM Direct	Others	Total
Volume	11.7%	6.6%	4.8%	0.0%	0.9%	0.0%	4.9%	1.7%	0.8%	32.3%	36.3%	100.0%
Midrange Enterprise	11.9%	7.5%	5.0%	0.9%	4.9%	0.0%	17.5%	0.2%	0.7%	35.7%	15.6%	100.0%
High-End Enterprise	3.0%	22.0%	0.0%	24.2%	0.8%	0.2%	5.0%	0.0%	0.4%	19.2%	25.3%	100.0%
Total Server	**11.7%**	**6.7%**	**4.8%**	**0.1%**	**1.2%**	**0.0%**	**6.0%**	**1.6%**	**0.8%**	**32.5%**	**34.6%**	**100.0%**
% market share gain/loss	**Dell**	**HPE**	**Lenovo**	**IBM**	**Cisco**	**Inspur**	**Super Micro**	**Huawei**	**Fujitsu**	**ODM Direct**	**Others**	
Volume	-1.1%	-2.0%	-0.8%	0.0%	0.3%	0.0%	-1.1%	1.5%	-0.2%	-1.4%	4.9%	
Midrange Enterprise	-0.7%	-27.2%	-8.4%	-2.3%	-9.7%	-0.2%	14.7%	0.2%	-0.9%	35.0%	-0.5%	
High-End Enterprise	1.3%	18.5%	-0.2%	-43.5%	-0.6%	-0.7%	5.0%	0.0%	-0.2%	19.2%	1.1%	
Total Server	**-1.1%**	**-2.3%**	**-0.9%**	**0.0%**	**0.4%**	**0.0%**	**0.0%**	**1.4%**	**-0.2%**	**-0.5%**	**3.4%**	
% vendor exposure to market	**Dell**	**HPE**	**Lenovo**	**IBM**	**Cisco**	**Inspur**	**Super Micro**	**Huawei**	**Fujitsu**	**ODM Direct**	**Others**	**Total**
Volume	91.7%	90.2%	91.4%	5.8%	66.2%	63.9%	75.9%	99.1%	92.6%	91.0%	96.2%	91.7%
Midrange Enterprise	8.3%	9.2%	8.6%	59.0%	33.6%	31.5%	23.9%	0.9%	7.3%	8.9%	3.7%	8.1%
High-End Enterprise	0.0%	0.6%	0.0%	35.2%	0.1%	4.6%	0.2%	0.0%	0.1%	0.1%	0.1%	0.2%
Total Server	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: IDC

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We also look at market share on a rolling 4-quarter basis. Figure 6 shows vendor market share, by units, for the 4-quarters ending C4Q23. We see that Dell, HPE, Lenovo, Super Micro and Cisco make up the top 5 server OEMs with 12.0%, 7.1%, 5.3%, 4.6% and 1.1% market share, respectively. ODM Direct refers to servers sold by all Taiwanese ODMs combined, and they had 35.6% share of the global server market by units.

Figure 6: Server market share, by units, for the 4-quarters ending C4Q23
For the rolling 4-quarters ended C4Q23, DELL had the highest market share by units at 12%

% Market share	Dell	HPE	Lenovo	IBM	Cisco	Inspur	Super Micro	Huawei	Fujitsu	ODM Direct	Others	Total
Volume	12.2%	6.9%	5.4%	0.0%	0.8%	0.0%	3.9%	0.7%	1.0%	35.5%	33.6%	100.0%
Midrange Enterprise	9.2%	9.7%	4.1%	1.0%	6.3%	0.1%	14.0%	0.2%	0.7%	38.0%	16.9%	100.0%
High-End Enterprise	3.3%	15.6%	0.3%	28.2%	0.9%	1.0%	3.6%	0.0%	0.5%	11.2%	35.4%	100.0%
Total Server	**12.0%**	**7.1%**	**5.3%**	**0.1%**	**1.1%**	**0.0%**	**4.6%**	**0.6%**	**1.0%**	**35.6%**	**32.6%**	**100.0%**
% market share gain/loss	**Dell**	**HPE**	**Lenovo**	**IBM**	**Cisco**	**Inspur**	**Super Micro**	**Huawei**	**Fujitsu**	**ODM Direct**	**Others**	
Volume	-1.6%	-0.5%	0.2%	0.0%	0.0%	0.0%	-2.0%	0.5%	0.1%	-2.5%	5.8%	
Midrange Enterprise	-4.2%	-21.2%	-5.0%	-2.2%	-11.8%	-0.3%	11.6%	0.2%	-0.4%	36.5%	-3.1%	
High-End Enterprise	2.1%	9.7%	0.2%	-32.3%	-0.8%	-0.7%	3.6%	0.0%	-1.8%	11.2%	8.8%	
Total Server	**-1.8%**	**-0.8%**	**0.1%**	**0.0%**	**0.1%**	**0.0%**	**-1.3%**	**0.4%**	**0.1%**	**-1.8%**	**4.9%**	
% vendor exposure to market	**Dell**	**HPE**	**Lenovo**	**IBM**	**Cisco**	**Inspur**	**Super Micro**	**Huawei**	**Fujitsu**	**ODM Direct**	**Others**	**Total**
Volume	95.3%	91.3%	95.3%	12.2%	66.2%	60.8%	81.1%	98.2%	95.7%	93.4%	96.7%	93.8%
Midrange Enterprise	4.7%	8.4%	4.7%	58.0%	33.7%	31.3%	18.8%	1.8%	4.3%	6.5%	3.2%	6.1%
High-End Enterprise	0.0%	0.2%	0.0%	29.8%	0.1%	8.0%	0.1%	0.0%	0.1%	0.0%	0.1%	0.1%
Total Server	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: IDC

BofA GLOBAL RESEARCH

Key beneficiaries of AI server growth

Dell Technologies (ticker: DELL, rating: Buy)

In F4Q24, Dell shipped $800mn of AI optimized servers in the qtr with backlog nearly doubled q/q to $2.9bn vs. $1.6bn exiting the prior qtr. AI optimized server orders grew +40% q/q with most AI servers shipped skewed toward training servers. Dell's AI server production is constrained by GPU availabilities. Mgmt. noted that once the company obtain the GPUs, they will be able to ship out the AI server in a relatively short amount of time. As of now, H100 GPU lead time is improving, but market demand continues to outpace GPU supply. Dell has already started taking in orders for H200 GPU. We reiterate Buy on higher capital returns, AI tailwinds, and improving FCF benefiting from negative cash conversion cycle as PC rev continues to grow.

Our F25E rev/EPS moves to $93.0bn/$7.78 from $92.3bn/$7.60. Our PO moves to $130 (from $116) on 15x (prior 14x) C25E EPS of $8.47 (prior $8.27). We apply a slightly higher multiple on expected higher revenue growth related to AI server demand.

Hewlett Packard Enterprise (ticker: HPE, rating: Neutral)

As a manufacturer of AI servers, HPE is a strong beneficiary of AI demand. However, AI server revenue in F1Q24 came lower than expected due to a lack of GPU supply. AI server delivery time was further negatively impacted by the increasing amount of time customers required to set up the data center space and the power and cooling requirements needed to run their systems. APU (accelerated processing unit) backlog declined to $3bn from $3.6bn at the end of FY23. We believe that half of the $3bn backlog relates to Services, while the other half relates to hardware. We reiterate Neutral on risk/reward balance as long-term mix shift to higher margin software and as-a-Service revenue is balanced by the near-term weaker Enterprise spend environment. PO moves to $19 (from $17) on 8x C25E EPS of $2.26 (prior 9x C24E EPS of $1.94). We roll-over to a C25E based valuation.

We believe that revenue related to AI servers have been split between two segments: (1) Compute and (2) HPC & AI. However, moving forward, HPE will combine the Compute and HPC & AI segments into a new “Server” segment, thereby integrating the general purpose computing, high-performance computing, supercomputing, and AI systems into one segment.

NetApp (ticker: NTAP, rating: Underperform)

NetApp will benefit from growth of storage demand related to increased AI workloads. NTAP’s CloudOps solutions offers AI-optimized data infrastructure that is unified, scalable, and high-performance. The company has been benefiting from AI demand with proven use cases in predictive AI for the last 5+ years, according to the management team. Looking ahead, the company is also well positioned to benefit from new AI demand such as from the Generative AI opportunity. In F3Q24, All Flash Arrays (AFA) revenue grew 21% y/y to annualized revenue run rate of $3.4bn. NTAP saw strong demand for the C-series all flash arrays. In the past quarter, the company introduced its SAN-optimized AFA which outperformed company’s expectations. Mgmt. noted opportunity to grow in the ~$20bn SAN market. NTAP had dozens of customer wins in the last quarter that were AI-related, including several large 8-figure deals of NVIDIA SuperPOD and BasePOD deployments.

We reiterate Underperform as we see potential macro and execution risk to estimates but acknowledge that margins are indeed holding up better than our prior forecast. PO moves to $85 (from $78) on 13x C25E EPS of $6.51. We roll-over to a C25E based valuation.

Pure Storage (ticker: PSTG, rating: Neutral)

As a supplier of high performance storage systems, PSTG is positioned to benefit from AI demand. As per management, current data storage environments inhibit AI deployments in two ways. First, existing data storage arrays were selected to provide just enough performance for their primary function, leaving little performance left for AI access. Second, existing storage arrays are not networked, limiting access to AI apps not provisioned directly on their primary compute stack. PSTG’s E//Family delivers flash reliability and efficiency at prices comparable to traditional hard disk systems and with sufficient performance to spare for AI access. Furthermore, the energy demands of AI is outstripping the availability of power in many data center environments. As per management, Pure’s flash solutions can reduce data center power usage, space, and e-waste by approximately 20%

Last quarter, PSTG won an 8-figure deal with one of the largest cloud GPU providers. Mgmt. noted that there could be more AI-related deals as customers will be able to leverage the company's Evergreen//One subscription model to maintain capital flexibility.

We reiterate Neutral on risk/reward balance as higher mix of Software-as-Service (SaaS) revenue and next-generation Flash product is balanced by risk from weaker macro & potential competitive threats. PO moves to $57 (from $50) on 5x (from 4x) C25E EV/sales on better-than-expected revenue growth and profitability. We use a slightly higher multiple on expected stronger revenues related to AI, which could lead to higher mix and higher margins.

Western Digital (ticker: WDC, rating: Buy)

WDC pre-announced positively last week at a competitor conference. The company pre-announced revenue at the high-end of guidance, gross margin above the guided range, and EPS also above the guided range. We moved our F3Q rev/EPS estimate to $3.4bn/ $0.26 from $3.3bn/ $0.14. We also raised our F4Q rev/EPS to $3.6bn/ $1.18 from $3.4bn/ $1.14. We reiterate our Buy rating on WDC on being close to the bottom of the cycle. The company remains on track to split the HDD and NAND business in 2H CY24.

WDC management expects in F3Q to see flash bit shipments decline sequentially in the March quarter and then remain flat sequentially in the June quarter. So the recovery in flash revenues will be predominantly driven by ASP. We expect HDD exabytes and ASPs to grow sequentially driven by growth in Cloud.

WDC also announced this week that David Goeckeler, the current WDC CEO, will become the CEO of the Flash business. Mgmt also noted that Irving Tan will become the CEO of the standalone HDD company. In our opinion, Mr. Goeckeler has strong relationships with the Japanese government and banks which will help maintain continuity and help run the standalone Flash business.

Adjusting estimates; PO moves to $75 from $70 on 9x (unchanged) C25E EPS of $8.31 (prior $8.16).

Seagate Technology (ticker: STX, rating: Buy)

Seagate (STX) pre-announced earnings last week at a competitor conference. STX management pre-announced to the mid-point of its previous guidance which is slightly lower than where our estimates were, but we believe STX is still positioned well to capture Cloud demand for HDDs, especially as Heat Assisted Magnetic Recording (HAMR) drives ramps. We model gross margins to grow 160bps sequentially in both the March and June quarters. STX is benefiting from prior price increases and we expect further price increases, especially as HAMR gets qualified at customers. We reiterate Buy on secular demand trends from Cloud, revenue and margin recovery from trough levels and path to higher capacity HAMR HDDs.

STX is nearing the end of the qualification process for HAMR drives with 1 major cloud customer and 1 major non-Cloud customer. Management noted that they expect this process to be completed in the next few weeks. We expect 1mn HAMR drives to be shipped in C1H24 and possibly 2mn drive in C2H24. We model stronger FY25E EPS than FY24E, driven partly by increasing HAMR sales. We expect HAMR to be margin accretive for the company. Over time, we expect HAMR to help gross margins surpass the previous long-term range of 30-33%.

We model positive FCF for STX in FY24E and FY25E. FCF can lag profitability for STX as the company needs to unwind working capital. We model $212mn of capex in FY24E, down from the $316mn in FY23. The FY24E figure is front loaded with $140mn already completed in F1H24. We expect lower capex in future years.

We adjust our revenue and EPS estimates. Our PO moves to $110 from $100 on 13x (prior 12x) C25E EPS of $8.34 (prior $8.36). We use a higher multiple as growth and margins are rerating higher. Management's focus is to maintain the dividend and debt levels to less than $5bn. After the $5bn level has been reached, the company may consider restarting share repurchases.

Figure 7: BofA price objected (PO) and estimates changes
We adjusted our PO and estimates for DELL, HPE, NTAP, PSTG, WDC, and STX

Company name	Ticker	(US$)	Previous	Current
Dell Technologies Inc.	DELL	Price Obj.	116	130
Dell Technologies Inc.	DELL	2024E Rev (mn)	92,335	93,009
Dell Technologies Inc.	DELL	2025E Rev (mn)	96,182	97,000
Dell Technologies Inc.	DELL	2026E Rev (mn)	102,787	103,653
Dell Technologies Inc.	DELL	2024E EPS	$7.60	$7.78
Dell Technologies Inc.	DELL	2025E EPS	$8.26	$8.46
Dell Technologies Inc.	DELL	2026E EPS	$9.04	$9.36
Hewlett Packard Enterprise	HPE	Price Obj.	17	19
NetApp	NTAP	Price Obj.	78	85
Pure Storage	PSTG	Price Obj.	50	57
Western Digital	WDC	Price Obj.	70	75
Western Digital	WDC	2024E Rev (mn)	12,594	12,731
Western Digital	WDC	2025E Rev (mn)	15,530	15,781
Western Digital	WDC	2026E Rev (mn)	18,059	18,347
Western Digital	WDC	2024E EPS	($1.10)	($0.92)
Western Digital	WDC	2025E EPS	$6.88	$7.04
Western Digital	WDC	2026E EPS	$9.21	$9.36
Seagate	STX	Price Obj.	100	110
Seagate	STX	2024E Rev (m)	6,716	6,630
Seagate	STX	2025E Rev (m)	9,024	9,017
Seagate	STX	2026E Rev (m)	11,321	11,314
Seagate	STX	2024E EPS	$0.99	$0.90
Seagate	STX	2025E EPS	$6.14	$6.13
Seagate	STX	2026E EPS	$10.52	$10.51

Source: BofA Global Research estimates

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Stocks mentioned

Prices and ratings for stocks mentioned in this report

BofA Ticker	Bloomberg ticker	Company name	Price	Rating
DELL	DELL US	Dell Inc.	US$ 113.55	B-1-7
HPE	HPE US	Hewlett-Packard	US$ 18.05	B-2-7
NTAP	NTAP US	NetApp	US$ 102.53	B-3-7
PSTG	PSTG US	Pure Storage	US$ 52.36	C-2-9
STX	STX US	Seagate	US$ 91.11	B-1-8
WDC	WDC US	Western Digital	US$ 62.97	C-1-9

Source: BofA Global Research

Price objective basis & risk

Dell Technologies Inc. (DELL)

Our PO of $130 is based on approximately 15x our C25 EPS estimate of $8.47. Our target multiple compares to median 5x of historical range 3x-8x for Dell since it returned to the public markets in 2019. Dell went private in 2013 and prior to that the company had a very different structure. As such, we do not believe earlier historical trading multiples are meaningful. In our opinion, a multiple higher than the historical range is warranted given improved storage portfolio, lower financial leverage and it balances opportunities to invest in core areas of growth, with ongoing weak macro and component shortages.

Downside risks: faster-than-expected slowdown in the global economy, which could prove to be a headwind to revenue growth, faster-than-expected strengthening of the U.S. dollar, trade war with China, and higher-than-expected tariffs, Dell not being able to source needed processors from Intel, new sales teams not being able to ramp as expected, and unexpected share loss to competitors.

Upside risks: faster-than-expected revenue growth and market share gain, faster mix shift to storage and premium PC and server configurations, which can drive upside to margins, faster-than-expected ramp of new sales teams, and component shortages normalizing more quickly than expected, which can drive upside to cash flow.

Hewlett-Packard Enterprise (HPE)
Our PO is $19 based on 8x our C25E EPS of $2.26. Our target multiple is just slightly lower than the median (9x) of the historical range (6x-13.0x). In our opinion, this multiple is justified as it balances positives including that HPE now has a better growth profile, and lower Tier-1 server sales and free cash flow is more in-line with normalized values, vs. near-term macro headwinds and risk from high backlog and slower customer acceptances.

Downside risks to our PO are larger than expected economic slowdown due to inflation and rising interest rates, on-going component availability concerns, COVID19 related shutdowns in China, more aggressive server pricing from competitor Dell, a faster than expected adoption of As-a-Service offerings which can pressure revenues in the near-term, unexpected share loss and slower than expected mix shift to higher margin products and services, FX headwinds, restructuring and execution challenges.

Upside risks are share gains, steady margin improvement and lower than expected restructuring costs and better free cash flow.

NetApp Inc. (NTAP)
Our price objective (PO) of $85 is based on 13x C25E EPS of $6.51. This multiple is in the lower half of the historical range of 10-18x. We believe this multiple balances the benefit of potential revenue growth in All Flash Arrays against the long-term risk from data-center migration to the Cloud, and technological pressure from emerging competitors.

Upside risks are faster-than-expected growth in public cloud revenues and lower drag from investments, unexpected share gain from competitors, unanticipated large M&A, which drives revenue growth faster than expected, and faster-than-expected penetration of Flash into the existing NetApp installed base.

Downside risks are extended component shortage, an unexpected slowdown in the economy, higher-than-expected inflation, stall in the installed base refresh, material share loss in the Flash and Converged technology space, including Hyper Converged to competitors, acceleration of storage moving to the public cloud, and decline in penetration and success beyond the top enterprise accounts.

Pure Storage (PSTG)
Our PO of $57 is based on 5x C2025E EV/Sales. This multiple compares to median 3x of historical range 1x-5x. Given Pure's strong revenue growth relative to other storage peers, we view 5x as appropriate (premium based on faster growth relative to peers).

Upside risks to our PO are faster recovery in the commercial segment, lower flash costs, sooner than expected recovery in the supply chain, and unexpected share gains.

Downside risks to our PO are an extended economic slowdown, rising costs, competition from well-established vendors like NetApp, Dell-EMC and HP that control vast distribution networks and have the ability to deeply discount products for certain customers, competition from private companies, enterprise movement to the public cloud, execution-related issues due to the high-growth nature of the company, and erosion of its competitive advantage in operating software over time.

Seagate Technology (STX)
Our PO of $110 is based on 13x our C2025E EPS estimate of $8.34. This multiple is towards the higher end of the historical P/E range of 7x-13x, and is warranted in our view as earnings momentum turns positive and peak earnings can be higher than historical peaks. Earnings are at a cyclically historic low and hence we look out to C25 for a more normalized earnings power of the company. The multiple balances near-term headwinds against the return of a more rational HDD industry and back to revenue and EPS growth.

Downside risks to our price objective are: (1) further unit declines in desktops and notebooks, (2) worse than expected industry pricing, (3) increased usage of NAND flash, (4) share loss to WDC in the enterprise HDD market, and (5) degradation of cash position and potential violation of credit facility covenants. Upside risks are: (1) significant pickup in high capacity/nearline HDDs, which could drive ASPs and gross margin higher, (2) improved technological advantage over NAND flash so as to reduce SSD penetration, (3) consumer PC refresh cycle, and (4) improved free cash flow generation.

Western Digital Corporation (WDC)
Our PO of $75 is based on 9x C25E EPS of $8.31. This multiple is inline with the HDD/SSD historical average of 9x, which we view as justified as it balances near-term sluggish end markets offset by longer-term improving trajectory of the business both in HDDs and in NAND. WD is a cyclical company. Near-term estimates are lower given lower demand from weaker macro.

Downside risks are: (1) unit declines in desktops and notebooks (2) worse than expected high-capacity HDD industry, (3) faster declines in NAND Flash pricing, (4) higher NAND manufacturing cost from either stronger Yen, or manufacturing yield issues, (5) lower royalty revenue from NAND licensing, (6) degradation of cash position and lower free cash flow and (7) failure of strategic actions to drive incremental value

Upside risks are: (1) significant pickup in high capacity/nearline HDDs, which could drive ASPs and gross margin higher, (2) share gains in enterprise NAND flash SSDs, (3) consumer PC refresh cycle, (4) improved free cash flow generation and faster debt pay down and (5) strategic options that drive the stock higher.

Analyst Certification

I, Wamsi Mohan, 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.

US - IT Hardware and Technology Supply Chain Coverage Cluster

Investment rating	Company	BofA Ticker	Bloomberg symbol	Analyst
BUY				
	Amphenol	APH	APH US	Wamsi Mohan
	Apple Inc.	AAPL	AAPL US	Wamsi Mohan
	Corning Inc.	GLW	GLW US	Wamsi Mohan
	Dell Technologies Inc.	DELL	DELL US	Wamsi Mohan
	Flex Ltd.	FLEX	FLEX US	Ruplu Bhattacharya
	HP Inc.	HPQ	HPQ US	Wamsi Mohan
	International Business Machines Corp.	IBM	IBM US	Wamsi Mohan
	Jabil Inc.	JBL	JBL US	Ruplu Bhattacharya
	Nutanix Inc	NTNX	NTNX US	Wamsi Mohan
	Roku, Inc.	ROKU	ROKU US	Ruplu Bhattacharya
	Seagate Technology	STX	STX US	Wamsi Mohan
	Super Micro Computer Inc.	SMCI	SMCI US	Ruplu Bhattacharya
	TD Synnex Corp	SNX	SNX US	Ruplu Bhattacharya
	TE Connectivity Ltd.	TEL	TEL US	Wamsi Mohan
	Western Digital Corporation	WDC	WDC US	Wamsi Mohan
NEUTRAL				
	Arrow Electronics Inc.	ARW	ARW US	Ruplu Bhattacharya
	Avnet Inc.	AVT	AVT US	Ruplu Bhattacharya
	CDW Corp	CDW	CDW US	Ruplu Bhattacharya
	Concentrix Corporation	CNXC	CNXC US	Ruplu Bhattacharya
	Hewlett-Packard Enterprise	HPE	HPE US	Wamsi Mohan
	Pure Storage	PSTG	PSTG US	Wamsi Mohan
	Sensata Technologies Holdings Plc	ST	ST US	Wamsi Mohan
	Teradata Corporation	TDC	TDC US	Wamsi Mohan
UNDERPERFORM				
	DigitalOcean	DOCN	DOCN US	Wamsi Mohan
	NetApp Inc.	NTAP	NTAP US	Wamsi Mohan
	Sanmina Corporation	SANM	SANM US	Ruplu Bhattacharya
	Vishay Intertechnology, Inc.	VSH	VSH US	Ruplu Bhattacharya

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%

[R2]Ratings dispersions may vary from time to time where BofA Global Research believes it better reflects the investment prospects of stocks in a Coverage Cluster.

INCOME RATINGS, indicators of potential cash dividends, are: 7 - same/higher (dividend considered to be secure), 8 - same/lower (dividend not considered to be secure) and 9 - pays no cash dividend. *Coverage Cluster* is comprised of stocks covered by a single analyst or two or more analysts sharing a common industry, sector, region or other classification(s). A stock's coverage cluster is included in the most recent BofA Global Research report referencing the stock.

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BofAS or an affiliate was a manager of a public offering of securities of this issuer within the last 12 months: Hewlett-Packard, Seagate Technology, Western Digital Corp.
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