

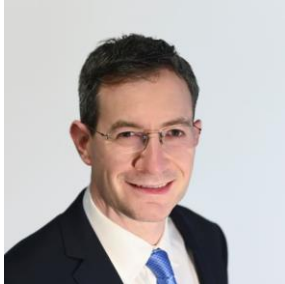


DSM CAPITAL
PARTNERS

**ARTIFICIAL
INTELLIGENCE**

March 2024

PRESENTED BY:



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Justin Burk joined Moody's Investor Services in 1998, moving to Carlyle High Yield Partners as an analyst in 1999. In 2001 he joined Aslan Capital Management, a high yield event-driven hedge fund, where he specialized in corporate structure analysis and asset valuation. Justin received an A.B. in Biochemical Sciences with Honors from Harvard University, and holds a Chartered Financial Analyst designation. Justin joined DSM in 2002 and is a member of the DSM Board of Managers.

CONTENTS/EXECUTIVE SUMMARY

- What is artificial intelligence?
 - Artificial intelligence isn't new, but generative AI is only now getting useful.
 - Important to keep the strengths and limitations in mind.
- Who are the immediate and medium term winners and losers from the ramp in AI?
 - How we think about it:
 - Winners
 - Users
 - Losers

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CONTENTS/EXECUTIVE SUMMARY

- What are the longer term implications for the economy and society?
 - Economic impact – don't fear change.
 - Societal impact – manageable, like all technologies.
- DSM's market view.
 - Positive growth/valuation.
- This is all early stage, a lot can change.



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BRIEF HISTORY OF ARTIFICIAL INTELLIGENCE

- What is artificial intelligence trying to achieve?
 - Replicating human abilities
 - Some earlier
 - Some later
- What changed over time?
 - Computing power, not algorithms.
 - Access to data.

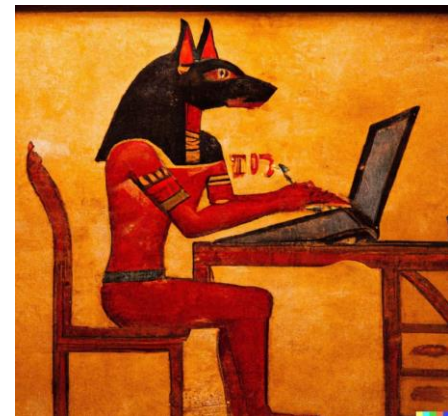


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BRIEF HISTORY OF ARTIFICIAL INTELLIGENCE

Recent successes?

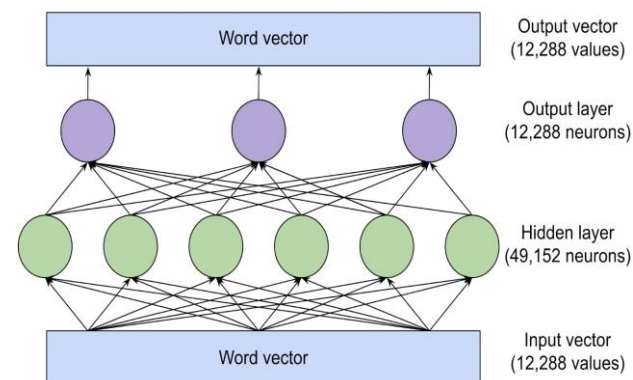
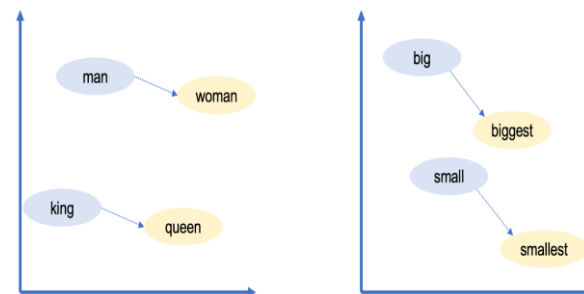
- AI has largely been discriminative so far
 - Financial data
 - Preference data
 - Visual data
- In the past two years, tremendous progress has been made in generative AI.
 - Write a cover letter
 - Create/explain code
 - Generate a novel image



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HOW DOES GENERATIVE AI WORK (FOR TEXT)?

- Why do we care?
 - Helps understand capabilities and limitations.
 - Some suppliers are better-positioned.
- How does it work?
 - High level... it is “autocomplete.”
 - Deeper level... Each word represents a series of numbers.
 - The numbers represent how “close” words are.
 - How does the LLM learn these weightings? They train themselves!



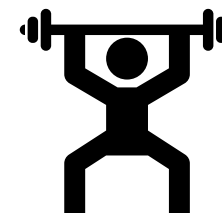
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HOW DOES GENERATIVE AI WORK (FOR TEXT)?

- How does it work?

Once the LLM is “trained”:

- Generate text with a prompt, this process is called “inference.”
- Make the process a little bit random...
- Refine the training with RLHF (reinforcement learning from human feedback).
- Prompt engineering.
- Further customization for specialized uses.
- Important to have clean, reliable datasets for this.
- But after all that – the capabilities are very, very powerful.



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HOW DOES GENERATIVE AI WORK (FOR TEXT)?

What is generative AI actually capable of?

Important to keep in mind - it's not actually "thinking."

Strengths

- Answering questions.
- Summarizing/analyzing data.
- Writing/analyzing computer code.



Weaknesses

- Hallucination.
- Potential bias/toxicity.
- General unreliability.



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HOW DOES GENERATIVE AI WORK (FOR TEXT)?

What is generative AI actually capable of?

Best immediate use cases:

- Coding.
- Simple customer or internal support.
- High level summaries of data.
- Customized marketing messages.
- Business specific applications.

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GENERATIVE AI USE CASES

Marketers using Adobe's Firefly or competitor Midjourney to create initial marketing and advertising slides.



HR department answering employee questions and reducing physical customer support agents.



Finance department finding anomalies in adherence to company travel policies.



Investment Analyst summarizing the last 4 earnings calls on Microsoft.



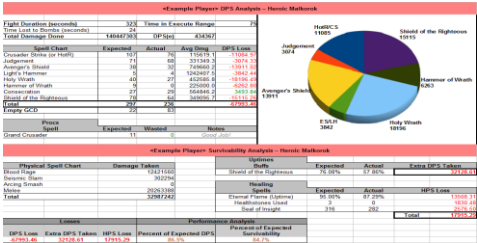
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GENERATIVE AI USE CASES

Small business identifying habitually late paying customers and finding ways to incentivize them to pay on-time.



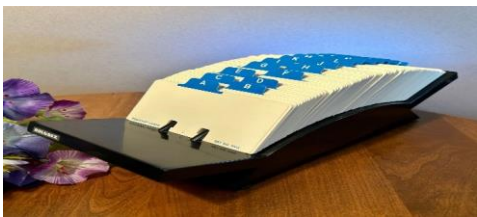
Salesperson analyzing sales trends by geography and summarizing in a colored pie graph.



Traveler seeking recommendations to key sights in Lisbon, Portugal but that might be closed over Christmas break.



Executive asking what contacts are CEOs of aerospace companies based in Los Angeles.



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HOW DOES GENERATIVE AI WORK (FOR TEXT)?

Are there material differences between the various LLM foundational models?

Unclear if there are any material differences but some possible differentiation:

- Reliability
- Safety
- Interfaces

Short-term, better established models will win. In the longer run, it's again, unclear...

- Open source has historically “won” many battles.
- But LLMs may be too customer-facing.

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HOW DOES GENERATIVE AI WORK (FOR TEXT)?

Can models be made smaller/”lighter?”

- To some extent, yes.
- AI for customer support doesn’t need to know medicine.
- In many roles, less knowledge might be preferable!
- But we may lose some of the models’ capabilities to “converse.”
- Github Copilot is a cut-down version of GPT-4.
- Mixtral – the “mix of experts” model.

Can models move to the “edge?”

- Theoretically, yes.
- But there are multiple problems to solve.
- Google’s Gemini Nano.
- Ultimately – every device is already online...

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HOW DOES GENERATIVE AI WORK (FOR TEXT)?

What does all this mean?

- LLMs are incredibly complex. We don't fully understand how they work!
- Can all problems be fixed?
- Will changing one behavior remove other competencies?
- Can't take for granted that they'll improve significantly.
- But they still have tremendous capabilities.



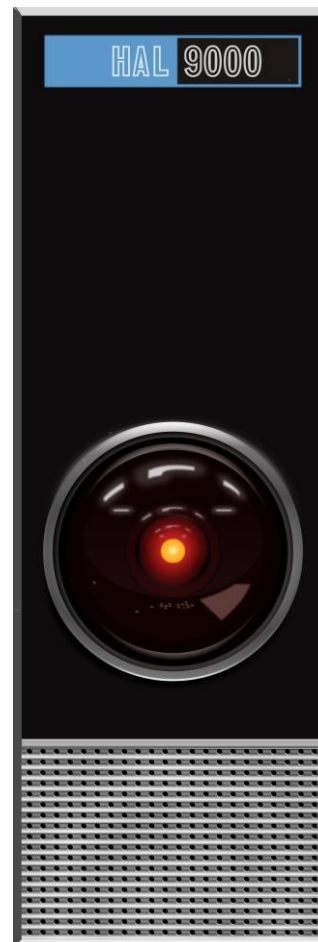
An actual "black box."

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HOW DOES GENERATIVE AI WORK (FOR TEXT)?

What does the future hold?

- GPT-1 and 2 were curiosities.
- GPT-3 was passable, but still detectably non-human.
- GPT-4 is pretty good at mimicking human conversation.
- No guarantee that the next generation will produce a further step-change.
- So is AGI (Artificial General Intelligence) likely to arise from this pathway?
- Will probably need new approaches for AGI.



Hal had goals

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HOW DOES GENERATIVE AI WORK (FOR TEXT)?

What does the future hold? (continued)

- LLMs are poor at “planning” (second-level thought).
- Could add planning emulation through iterative analysis of each portion of a response.
 - This has been referred to as the Q^* algorithm.
 - Currently focused on math problems.
 - Would require much more inference computing.
- Does this move us closer to AGI?
 - Possibly, planning is important for human thought.
 - Generally dangerous to over-extrapolate past successes – airspeed did not increase linearly from the first commercial flight.



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WHAT COMPANIES ARE BEST POSITIONED TO BENEFIT?

Winners, users, and losers.

- **Winners – Companies/Sectors with immediate benefit:**

Semiconductors

- Need to do tremendous amounts of parallel computations.
- Currently only two credible suppliers: NVDA/AMD.
- In theory, even more-specialized AI chips could be more efficient.
- ASML/ENTG – benefit on the semi production side.

Networking

- Massive numbers of chips need to be networked together.
- Networking requirements of an AI-focused datacenter are ~7x that of a traditional datacenter.
- ANET is the best-positioned supplier due to speed/flexibility/efficiency considerations.

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WHAT COMPANIES ARE BEST POSITIONED TO BENEFIT?

- **Winners – Companies/Sectors with immediate benefit:**

AI software layer (LLM or other)

- Foundational models can be used through multiple modalities.
- Companies are unlikely to use open-source LLMs in customer-facing applications.
- Also unlikely that they'll “roll their own.”

Cloud providers

- Building your own AI datacenter is cost prohibitive and not physically possible
- Customers more likely to use outsourced, “AlaaS” models.
- Favors large cloud providers with established AI capabilities (MSFT/GOOGL/AMZN).

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WHAT COMPANIES ARE BEST POSITIONED TO BENEFIT?

- **Winners – Companies/Sectors positioned to benefit in the future**

Consulting services

- Enterprises are rarely specialists in new technologies.
- IT consultants will be critical in enabling enterprises to implement generative AI.
- GLOB/ACN/EPAM/etc. – cleaning/labeling data, & implementing AI.

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WHAT COMPANIES ARE BEST POSITIONED TO BENEFIT?

- **Winners— Companies/Sectors that are positioned to immediately benefit:**

(Some) Software providers

- Software providers with text or image-heavy output.
- Also massive amounts of training data
- Two leading examples: MSFT's 365 Copilot & ADBE's Firefly.
- Features won't replace workers, but will make them more productive.
- Other providers with large scale data & strong share: INTU and FTNT

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WHAT COMPANIES ARE BEST POSITIONED TO BENEFIT?

Users – Companies/sectors that can leverage generative AI to create meaningful benefits in productivity for themselves:

Who can benefit from the early use cases:

- Coding
- Customer support costs, etc.
- Also good for analysis
- Robotic Process Automation may finally get meaningful traction.
- DUOL reduced its translator contractor base by 10%.
- Klarna's AI assistant does the equivalent work of 700 support agents.
- Long tail here
- Much depends on how efficient/reliable AI can get for certain use cases.

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WHAT COMPANIES ARE BEST POSITIONED TO BENEFIT?

Losers – Companies/Sectors whose business models are meaningfully disrupted

Education

- A lot of textbooks seem to have gone into GPT3/4's training data.
- Problematic for CHGG.
- LLMs will be great at creating curricula.



Contact centers?

- No, need to handle multiple modes of interaction.
- More productive, not displaced.

Coders or writers?

- No.....Jevons paradox.
- Tech sector unemployment rate is 3%.
- Writers, also no.
- Generally not a lot of examples... AI likely to be a substantial net positive for the economy.

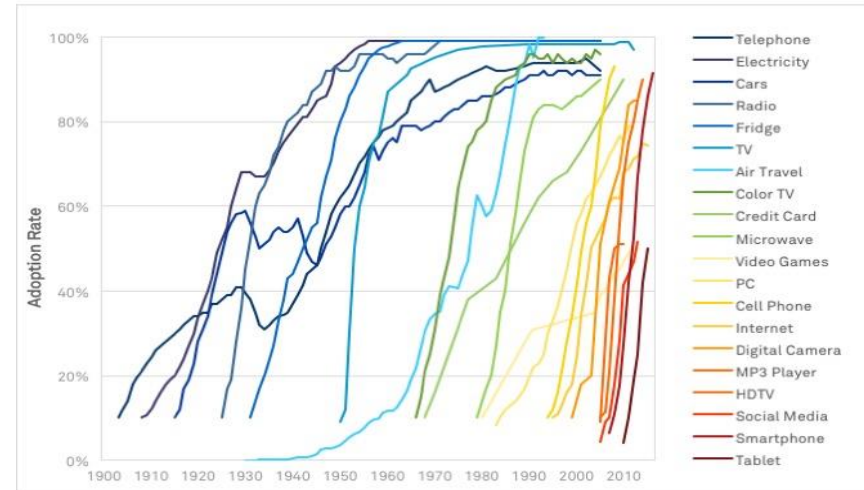


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BROADER IMPLICATIONS FOR THE ECONOMY & SOCIETY

How fast will this happen?

- Historically technological advancements took decades.
- Telephone/electricity, broadcast TV, cell phones, etc.
- As innovation has moved to software, the pace has picked up.



Source: Asymco

BLACKROCK

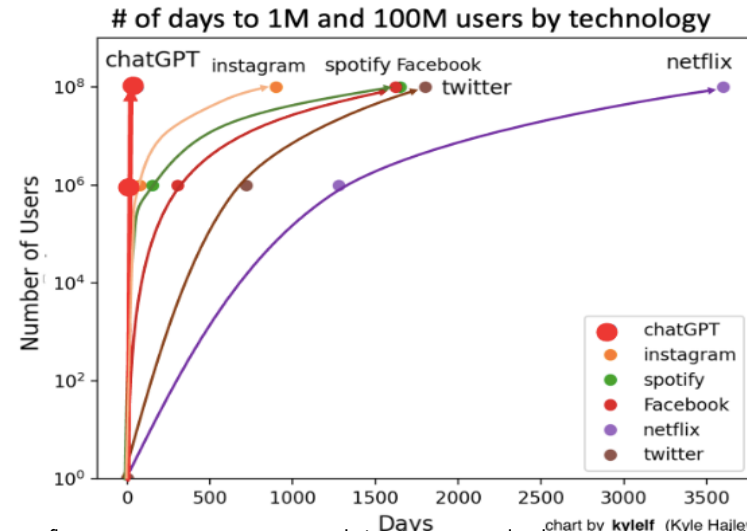


chart by kylelf (Kyle Hajley)

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GATING FACTORS

Physical deployment

- GPU availability still limited.
- AI-focused datacenters need concentrated power and cooling.
- Both are in relatively short supply currently.
- Not necessarily total power production, just challenges getting power to the right places.



Corporate deployment

- Data estate needs to be cleaned up before in-house training.
- Privacy concerns – ensure governance/security.
- Reliability.

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BROADER IMPLICATIONS FOR THE ECONOMY & SOCIETY

Will AI put everyone out of a job?

- 200 years ago, 90% of the population was in the agricultural field.
- Mechanization and nitrogen fertilizer eliminated a lot of jobs.
- Farmers still exist, just way more productive.
- Scrivener → typewriter → Microsoft Word
- Computer (human) → calculator → computer (machine)
- Likely that workers increase efficiency, and create incremental net demand.



Barge-hauling was a popular field in 19th century Russia

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BROADER IMPLICATIONS FOR THE ECONOMY & SOCIETY

Will AI destroy humanity?

- ChatGPT-4 not getting the nuclear launch codes.
- Spamming social networks.
- Generating fake images/audio/video to impersonate people.
- Sophisticated spam, phishing, hacking.
- Not new, but AI makes them easier and scalable.
- The good news is, AI is also likely to do a decent job “defending.”



ChatGPT finally realizes its true purpose

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BROADER IMPLICATIONS FOR THE ECONOMY & SOCIETY

Other ESG considerations:

- AI datacenters are energy-intensive.

However:

- Resource intensity/query likely to decline.
- Cloud providers increase green initiatives.
- AI displacement of existing processes = net positive.
- Privacy and Data – Increased costs due to fast evolving regulatory landscape.



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DSM'S MARKET VIEW

'92, not '99.

- Tech enablers poised to benefit
- Broad economic acceleration
- Still well below valuations of previous peaks.

Dominant companies today are not as expensive as those in previous 'bubble' periods in history

	Size		Valuation	
	Market weight	Market Cap (\$ Bn)	*24m fwd P/E	*24m fwd EV/Sales
Magnificent 7 (2024)				
Microsoft	7.1%	3084	27.6	9.9
Apple	6.1%	2643	23.0	6.4
NVIDIA	5.2%	2272	30.5	17.0
Amazon	4.2%	1834	30.9	2.6
Alphabet	3.7%	1622	17.3	1.9
Meta Platforms	2.5%	1090	20.7	5.9
Tesla	1.2%	540	39.2	3.8
Magnificent 7 (2024) Aggregate	30.2%	13085	25.1	4.8
Tech Bubble Leaders (2000)				
Microsoft	4.5%	581	53.2	19.2
Cisco Systems	4.2%	543	101.7	17.5
Intel	3.6%	465	42.1	11.5
Oracle	1.9%	245	84.6	19.0
IBM	1.7%	218	23.5	2.3
Lucent	1.6%	206	37.9	4.1
Nortel Networks	1.5%	199	86.4	6.4
Tech Bubble Leaders (2000) Aggregate	19.0%	2457	52.0	8.2
Japan Financial Bubble (1989)				
Nippon Telegraph and Telephone	6.9%	157	100.1	
Industrial Bank Of Japan	4.6%	105	154.2	
Sumitomo Mitsui Banking	3.4%	77	49.2	
Bank of Tokyo-Mitsubishi	3.3%	75	49.8	
Fuji Bank	3.1%	71	52.8	
Dai-ichi Kangyo Bank	2.9%	65	44.0	
Sakura Bank	2.8%	62	62.1	
Japan Financial Bubble (1989) Aggregate	27.0%	613	67.0	
Nifty 50 (1973)				
IBM	7.1%	48	35.5	
Eastman Kodak	3.6%	24	43.5	
Sears Roebuck	2.7%	18	29.2	
General Electric	2.0%	13	23.4	
Xerox	1.8%	12	45.8	
3M	1.4%	10	39.0	
Procter & Gamble	1.4%	9	29.8	
Nifty 50 (1973) Aggregate	19.9%	135	34.3	

Source: Goldman Sachs. Valuations as of 3/14/24

CONCLUSION

- **Gave Bing Chat a try at this one (still pretty wordy, bullet points are not its forte):**
 - Prompt: "Provide bullet points for the concluding slide of a presentation on LLMs that addresses strengths and limitations of the technology, their impact on society and the economy, and potential financial beneficiaries."
 - Response:
 - **Strengths of LLMs:**
 - LLMs are advanced AI algorithms trained on massive amounts of text data.
 - They can automate language-related tasks such as content generation, summarization, translation, classification, and sentiment analysis.
 - LLMs have the potential to revolutionize various industries, including customer service, finance, and scientific research.
 - They can understand natural language and produce human-like responses to inputs.
 - LLMs can increase efficiency and lower costs by automating financial transactions and data processing.
 - **Limitations of LLMs:**
 - LLMs have certain limitations and potential downsides that need to be considered.
 - The specific outcome of an LLM is not always predictable, and programming them is currently limited to writing prompts.
 - LLMs may generate responses that contain errors or biased language.
 - They require large amounts of computational resources and energy.
 - LLMs can also perpetuate misinformation if not properly trained and supervised.
- **Impact on Society and the Economy:**
 - LLMs have the potential to accelerate technological developments and innovation in conversational AI.
 - They can revolutionize fields such as medicine, finance, and customer service.
 - LLMs offer exciting possibilities for individuals to interact more easily with computers.
 - They can increase efficiency, cut costs, and automate language-related tasks, which can have a positive impact on businesses and the economy.
- **Potential Financial Beneficiaries:**
 - Companies that leverage LLMs for customer service, content creation, and translation can increase efficiency and reduce costs.
 - Financial institutions that automate financial transactions and data processing using LLMs can save time and resources.
 - Organizations involved in scientific research can benefit from LLMs' ability to analyze large amounts of text data and generate insights.

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ADOBE HAS SHOWN RAPID PACE OF INNOVATION IN ADOPTING GENERATIVE AI

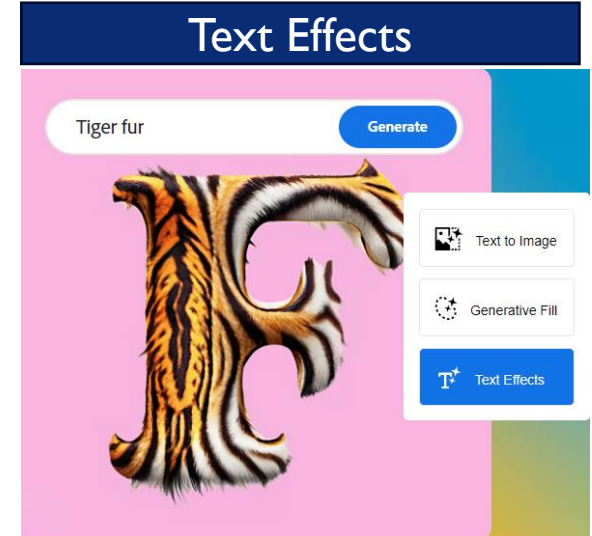
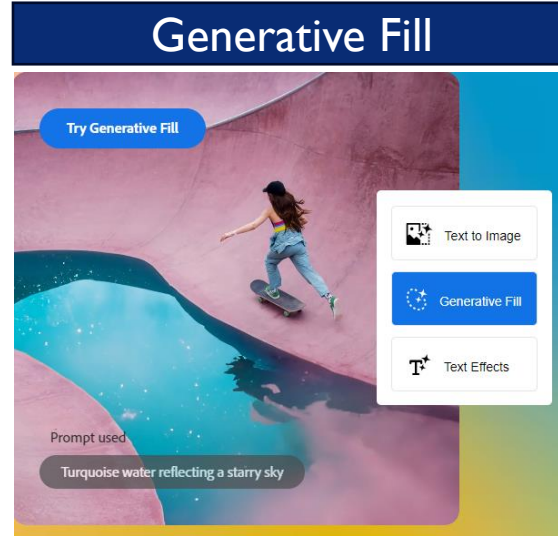
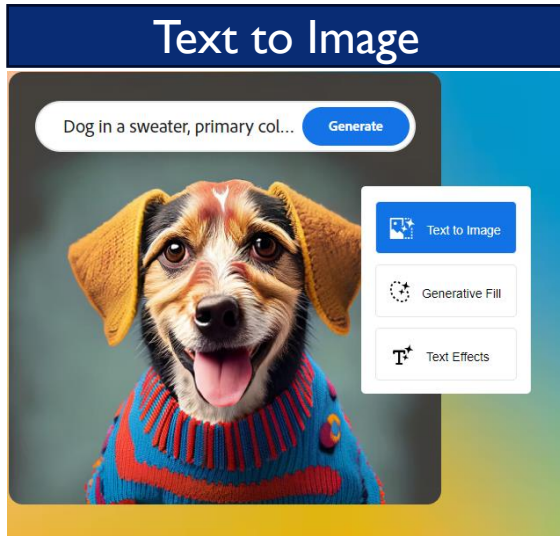
Timeline

- **2016:** Adobe first started talking about AI and machine learning to improve their software features.
- **November 2022:** ChatGPT released, reached viral adoption with 100MM MAUs in January 2023
- **March 2023:** ADBE announced Firefly – their generative AI platform – and partnership with NVDA at Adobe Summit Conference
- **May 2023:** announced that 70MM images were generated in first month of Firefly Beta
- **June 2023:** Adobe announced Firefly for Enterprise and discussed plans to monetize Firefly
- **September 2023:** Announced price raises on existing product suite (5-10%) and Firefly subscription plans / credit packs. Goal is to proliferate adoption and usage of generative AI across their products

Rapid innovation in 6 months

Quick execution and innovation in generative AI, built on the back of 7 years of broader AI / machine learnings investments

ADOBE FIREFLY



- Adobe's Firefly has done 2Bn generations with 3MM downloads in the beta window
- Features includes text to image (generate images from text), generative fill (use brush to remove and paint new objects from text), text effects, Image extender etc.
- Key advantages for creators: fixes the “blank page” problem, ease of use, integrated into existing tools and workflows (Photoshop, Illustrator, Express)

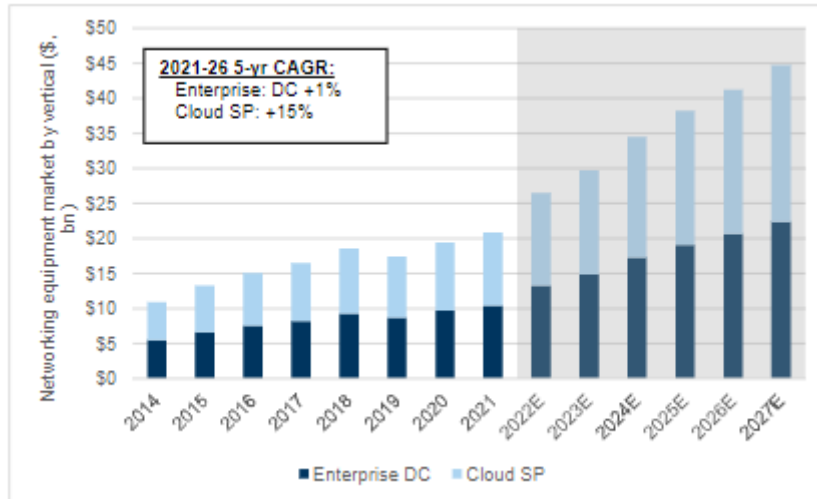
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ADOBE'S COMPETITIVE ADVANTAGES IN AI

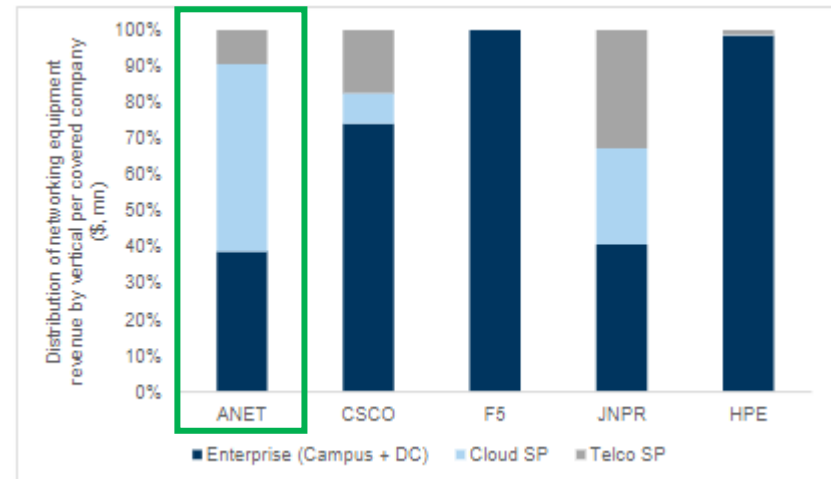
- **ADBE's Competitive Advantages in Generative AI**
 - **Quality of output** - they have been investing in AI for a decade and can merge their past work with generative AI to make an even better output
 - **Commercial safety** - large enterprises only want to use images they know is copyrighted etc, which theirs is (trained on Adobe Stock)
 - **Creator friendliness** - compensate the creators who contribute images to the Stock images data
 - **Workflow** - Generative AI helps with beginning of process but workflow will still need to be integrated into Adobe's tools – ie Photoshop, Illustrator
- **Benefits for ADBE's broader product suite**
 - **Opens up new potential user base:**
 - Firefly opens the user base to non-creative professionals – “everyone is a creator” – marketers, knowledge workers, etc. Synergies with Digital experience segment as well
 - **Increases ease of use, and drives increased adoption of Adobe Express**
 - Bring conversational interface to Photoshop so you can tell it how you want the photo changed
 - Integrated with Adobe Express where there is a share gain opportunity

ARISTA NETWORKS - NETWORK INFRASTRUCTURE WINNER

Networking Equipment Market: Cloud and Enterprise

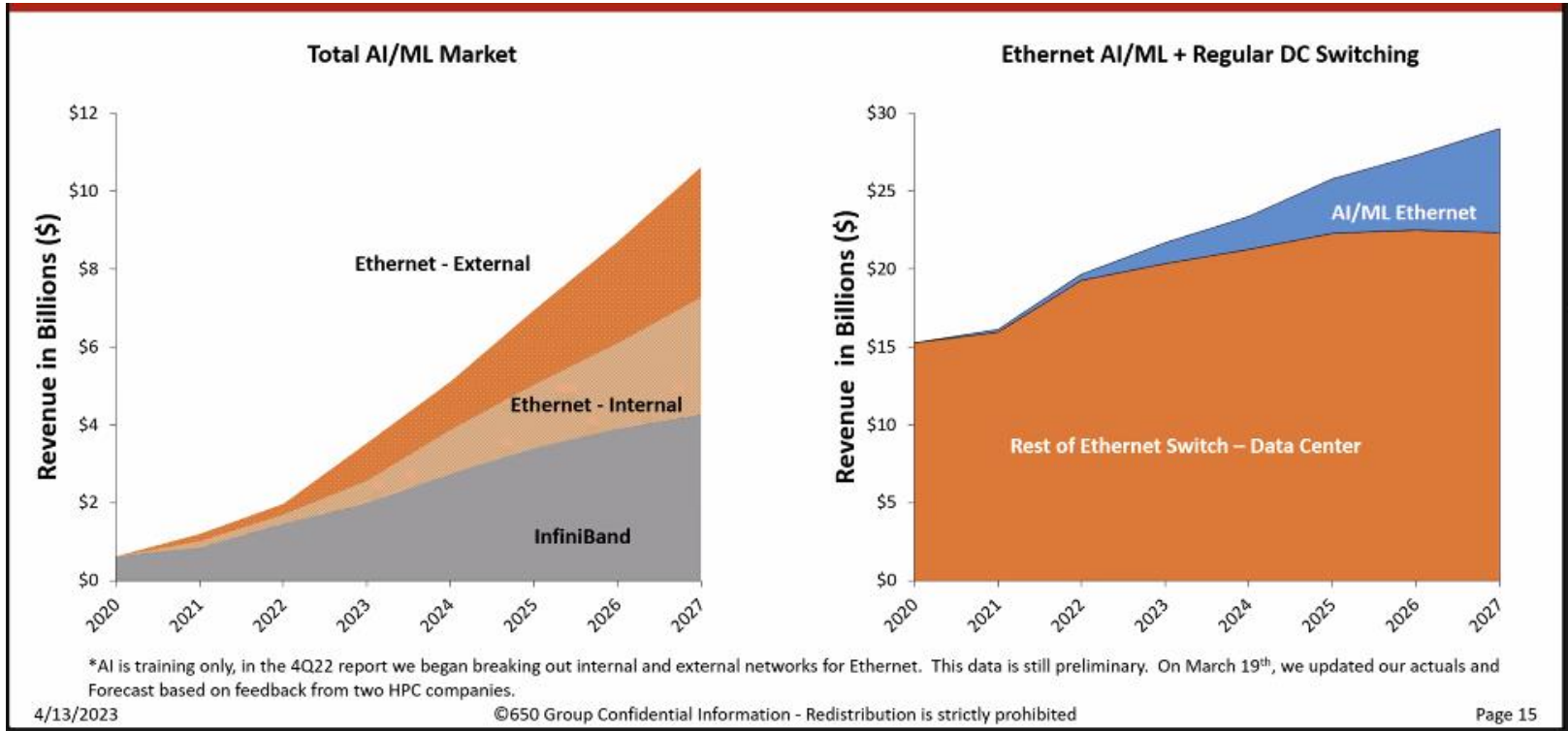


ANET has highest exposure to cloud among peers



- Cloud networking equipment spend continues to outgrow enterprise, with 15% 5-year CAGR vs 1% for the latter
- ANET is dominant in the cloud networking market, while also gaining share in enterprise vs incumbent Cisco.

AI / ML ETHERNET WILL BE A \$7-10BN MARKET BY 2027



Per Arista, timing for Ethernet is 2024 for pilots and 2025 for large scale deployments

Source: 650 Group

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ARISTA WILL BENEFIT FROM ETHERNET ADOPTION IN LARGE SCALE GPU CLUSTERS

Infiniband vs Ethernet

- Currently Infiniband is dominant in AI/ML workloads as vertically integrated with NVDA GPUs. Going forward and as clusters get larger, there will be a very meaningful opportunity for ethernet
- Ethernet is multi-sourced, multi-tenant, open standard, and better for larger clusters

Meta's InfiniBand vs. Ethernet-based LLM Training Clusters

	InfiniBand LLM Training Cluster	Ethernet LLM Training Cluster
# of Clusters / Nodes	4	8
Implied # of GPU Servers per Cluster / Node	1,024	504
Implied # of GPUs per Cluster / Node	8,192	4,032
- Total # of GPU Servers	4,096	4,032
- Total Implied GPUs	32,768	32,256
Networking Infrastructure:		
Total # of Leaf / Top-of-Rack (ToR) Switches per Cluster / Node	64	252
Total # of Spine / Cluster Switches per Cluster / Node	64	18
Total # of Super Spine / Aggregation Switches per Cluster / Node	16	n/a
- Implied Total # of Leaf / Top-of-Rack (ToR) Switches	256	2,016
- Implied Total # of Spine / Cluster Switches	256	144
- Implied Total # of Super Spine / Aggregation Switches	64	18
Total Implied # of Switches	576	2,178

Source: Meta; AI Hardware Summit

- Example: Meta's current AI cluster uses 16K NVIDIA A100 GPUs, and exclusively InfiniBand (as of May 2023)
- Their next gen deployment is a 32K GPU cluster by 2025, is being tested with both Infiniband and Ethernet

AI EXAMPLE: AUTODESK

- Still early stage
- Little training data available... yet.
- Spacemaker acquisition in 2020.
- Tremendous potential
- Automation of multiple points in design
 - Conceptual design
 - Site analysis
 - Environmental considerations
- More challenging journey, but greater reward.

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IMPACT ON THE INVESTMENT INDUSTRY

- Not a huge impact, mostly incremental points of efficiency
- Customer support and programming are the two areas most likely to see an immediate impact.
- Routine reports may be able to be automated to some extent.
- Could also be used for text analysis.
- Aspects of marketing could be automated.
- Analytical aspects of the industry are unlikely to be disrupted.
- Generally the industry is highly regulated and risk-averse.

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