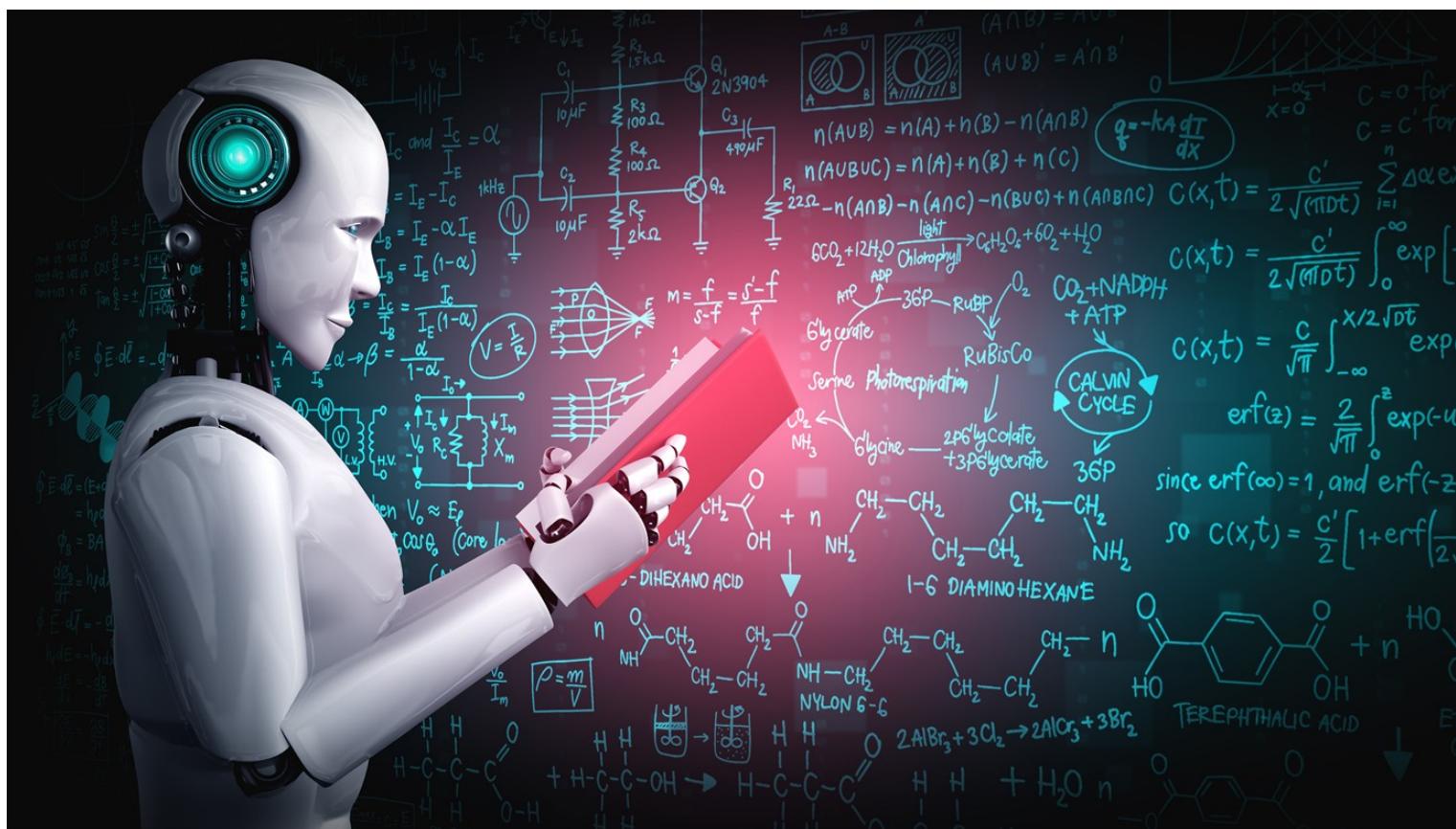


March 2, 2023 11:52 PM GMT

## Global Technology

# How is AI Set to Change the Tech Landscape...and What's NEXT?

We see ChatGPT and surging AI use cases akin to AI's "iPhone moment." We analyze the AI tech layers and players, from silicon to software. Our NEXT framework shows how AI could accelerate tech diffusion across the economy, with unique, scaled data and investment critical in the AI age ahead.



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# How is AI Set to Change the Tech Landscape...and What's NEXT?

**AI More Evolutionary than Revolutionary...** Our analysis of 25+ years of AI innovation (from GPUs, neural networks, transformers, and now generative AI) shows how the recent acceleration in AI applications is more evolutionary than revolutionary.

## INDUSTRY VIEW

### Internet | North America

#### In-Line

**...But the Evolution is Accelerating:** The breadth and adoption of AI consumer/business offerings is indeed accelerating – consider ChatGPT's adoption rate is 100X+ faster than the average of other consumer facing technologies. In effect, we see ChatGPT and the surging AI use cases akin to the 2007 iPhone introduction that expanded the mobile landscape and use cases for consumers and businesses.

## The AI Technology and Key Enablers... from Silicon to Software:

We discuss how the AI technology stack has evolved to bring us to this inflection point. We analyze how the tech companies are positioned down the stack and see leading platforms(GOOGL/MSFT/AMZN/AAPL/META) as being best positioned given the high capital/compute intensity of building/maintaining increasingly complex AI models and growing importance of scaled, unique data sets. We also discuss key data center enablers (NVDA/ANET) and 5 key private foundational AI companies.

**What's NEXT and The Tech Diffusion Ahead:** We detail how accelerating AI-driven innovation is set to drive changes in consumer behavior and new enterprise revenue and productivity enablers across the economy (from simple automation, to complex task assistance/completion, to robotics and more). Our NEXT framework analyzes the potential for AI to drive incremental (**N**ew Business Opportunities, (**E**)fficiencies, **E(X)**ternal Productivity and Con(**T**)ent

Creation across the economy. We believe combining this with our analysis of companies' data quality/scale and ability/willingness to invest will be important to assess relative AI beneficiaries across the economy (from healthcare to financials to energy to retail, logistics and more).

**What Are The Costs of Building The AI Age?** AI applications are more expensive and compute intensive than traditional applications. We discuss the cost implications for public cloud vendors and cloud customers. The primary driver of the AI cost uplift is the growing attach of accelerated nodes (GPUs, TPUs, Trainium, etc.), which can increase server prices 2-3x. Training is the most expensive process in AI model/application development, while Inference costs are more manageable. AI also requires more expensive storage and networking equipment. Operationally, we could see an increase in energy and bandwidth costs as AI workload penetration grows. Long term costs will depend on whether exponential improvements in semiconductor price/performance (combined with software optimization) offset exponential increases in AI model parameter counts.

**We Also Discuss 8 Unresolved Debates:** These key open questions could impact how and at what pace the AI ecosystem develops: **1)** Will the AI arms race be a zero-sum game due to network effects? What are the long term industry specific implications? **2)** What will differentiate AI models and how will the AI ecosystems evolve? **3)** The value of unique data is going up. Will new licensing business models emerge? **4)** How will regulation impact the AI ecosystem? **5)** Open source vs. proprietary offerings? **6)** Where will AI inference workloads run? **7)** What about Artificial General Intelligence? **8)** How does AI impact the long-term demand for AI silicon and infrastructure?

# Morgan Stanley

March 2, 2023

US INTERNET

## How is AI Changing the Tech Landscape...and What's NEXT?

MORGAN STANLEY RESEARCH  
North America

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## Executive Summary

## Executive Summary: AI at an Inflection Point

- **AI More Evolutionary than Revolutionary:** Our analysis of 25+ years of AI innovation (from GPUs, neural networks, transformers, and now generative AI) shows how the recent acceleration in AI applications is more evolutionary than revolutionary.
- **But the Evolution is Accelerating:** The breadth and adoption of AI consumer/business offerings is indeed accelerating – consider ChatGPT's adoption rate is 100X+ faster than the average of other consumer facing technologies.
- **As We See The Emergence of ChatGPT as AI's "iPhone Moment":** We see ChatGPT and its surging use cases akin to the 2007 iPhone introduction that changed and expanded the mobile landscape and use cases for consumers and enterprises. We see accelerating AI-driven tech innovation leading to changes in consumer behavior and new enterprise revenue and productivity enablers across the entire economy.

### How Did We Get Here & The Tech Diffusion Ahead

- We analyze how the AI technology stack (**from silicon to software**) has evolved/advanced over the past 25+ years...leading us to this inflection point. We also discuss the rapidly growing AI use cases and latest innovations (from simple automation, to more complex task productivity drivers, to robotics) set to be applicable across the entire economy (from healthcare to financials to energy to retail, logistics and more).

### Who are the AI ecosystem enablers?

- AI tool training/development is highly capital/compute intensive and requires large amounts of high-quality data. As such, we see the large platforms as the primary AI enablers. We analyze how each is positioned from compute power to consumer/business applications, the revenue opportunities and cost realities...as well as 5 key private foundational AI companies.



### What's NEXT?

- Our NEXT framework analyzes the potential for AI to drive incremental (N)ew Business Opportunities, (E)fficiencies, E(X)ternal Productivity and Con(T)ent Creation across the economy. We combine this with our analysis of companies' data quality/scale and ability/willingness to invest to assess relative AI beneficiaries..

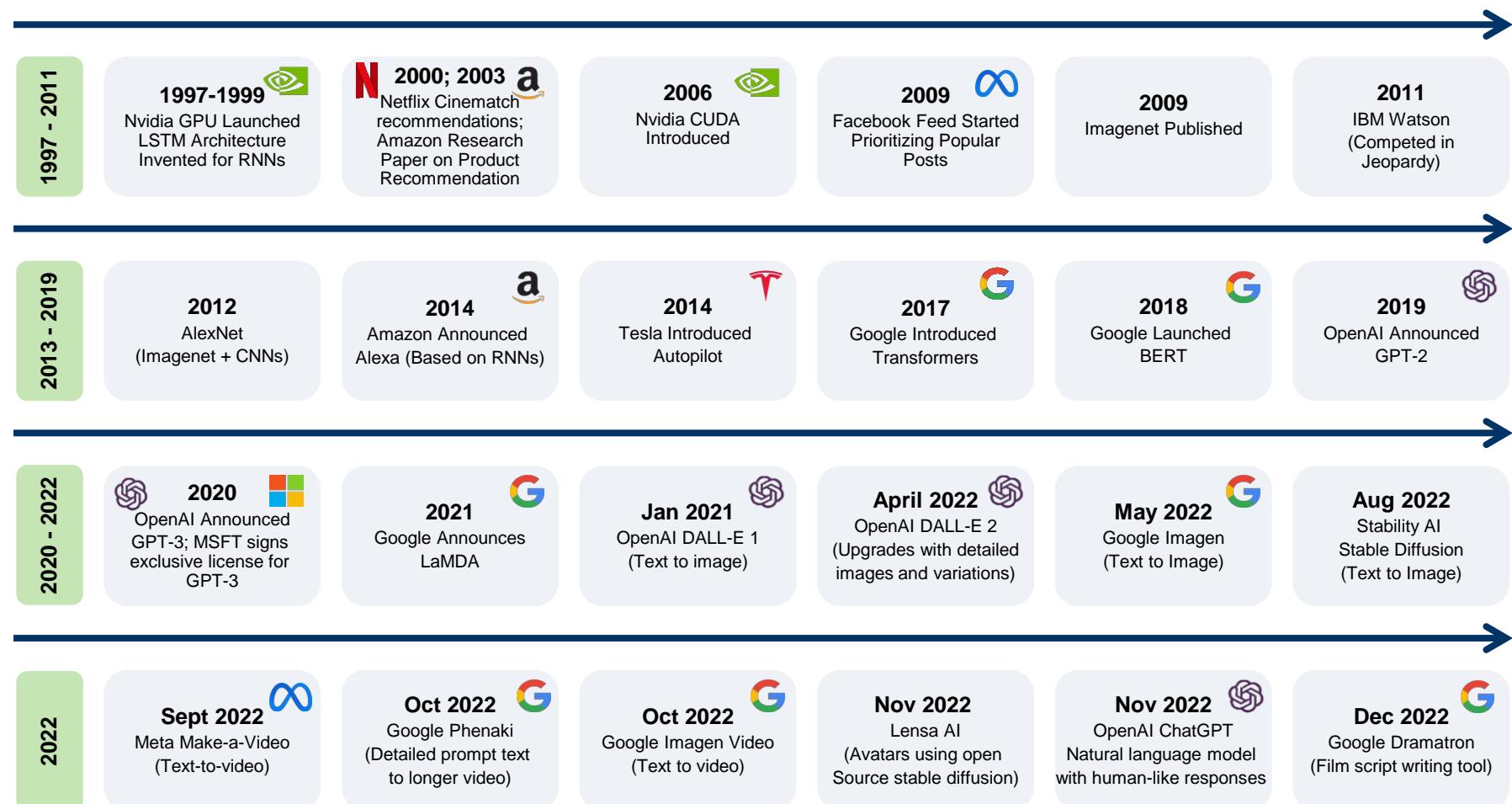
### What Are The Costs of Building The AI Age?

- The primary driver of the cost uplift is the growing attach of accelerated nodes (GPUs, TPUs, Trainium, etc.), which can increase server prices 2-3x. Training is the most expensive process in AI model/application development, while Inference costs are more manageable. AI also requires more expensive storage and networking equipment. Operationally, we could see an increase in energy and bandwidth costs as AI workload penetration grows.

### 8 Unresolved Debates

- 1) Will the AI arms race be a zero-sum game due to network effects? 2) What will differentiate AI models and how will the AI ecosystems evolve? 3) The value of unique data is going up. Will new licensing business models emerge? 4) How will regulation impact the AI ecosystem? 5) Open source vs. proprietary offerings? 6) Where will AI inference workloads run? 7) What about Artificial General Intelligence? 8) How does AI impact the long-term demand for AI silicon & infrastructure?

## The Concept of AI Isn't New...It's Been Building for Years as Compute Cycles Advance

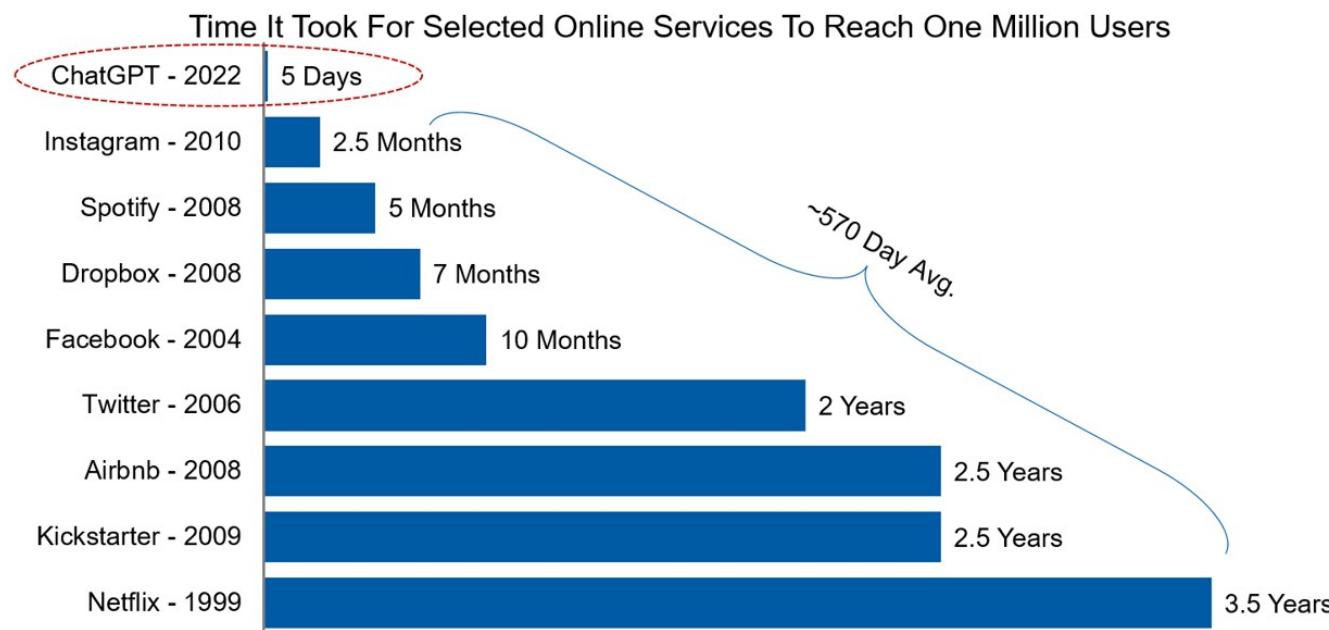


Source: Company Data, Morgan Stanley Research

## And as Seen in Prior Tech Cycles, the Pace of Innovation and Adoption is Accelerating

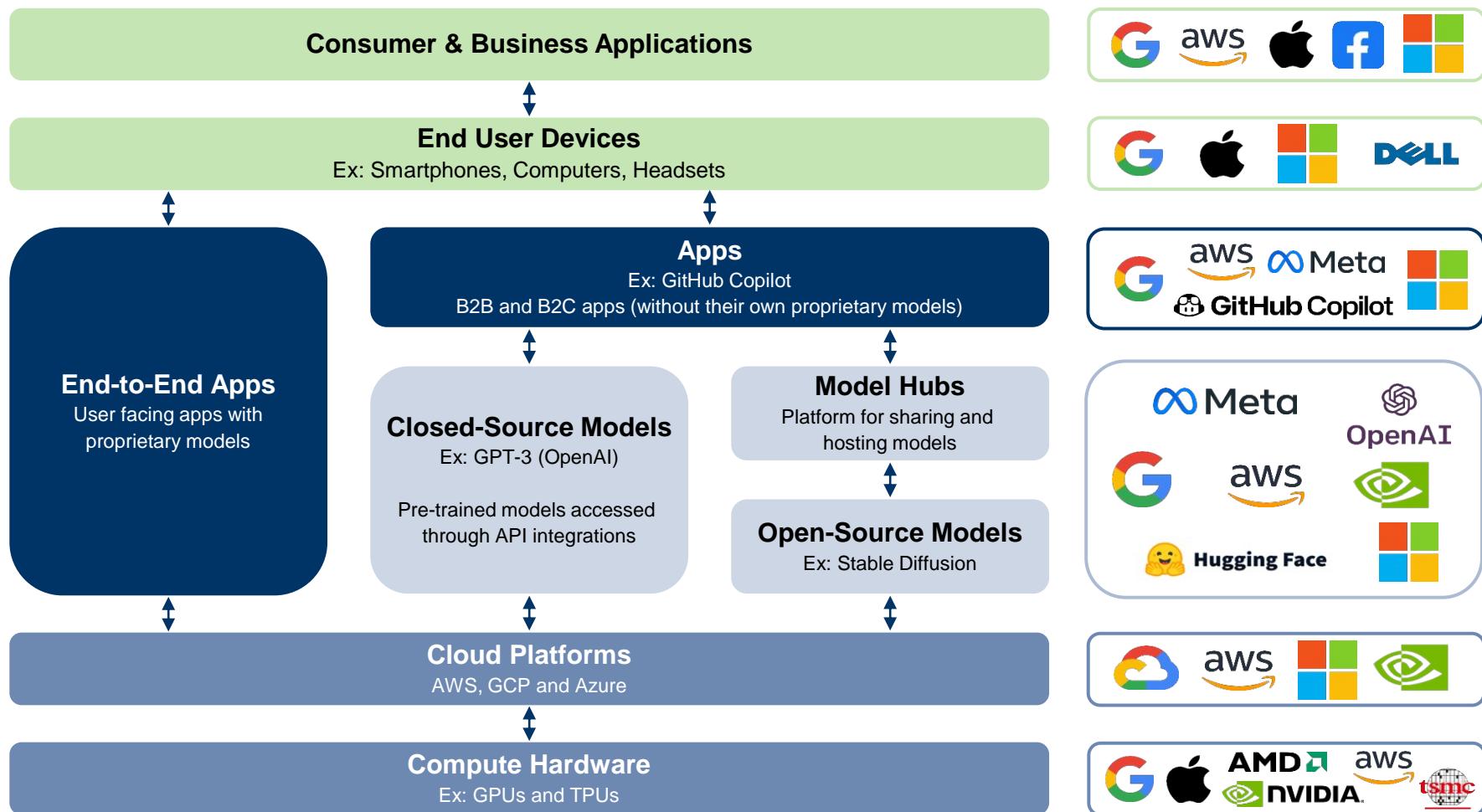
### Accelerating Adoption

- As an example of the accelerating pace of consumer adoption, ChatGPT reached 1mn users in only 5 days, which demonstrates consumer willingness to try new products and engage with new platforms



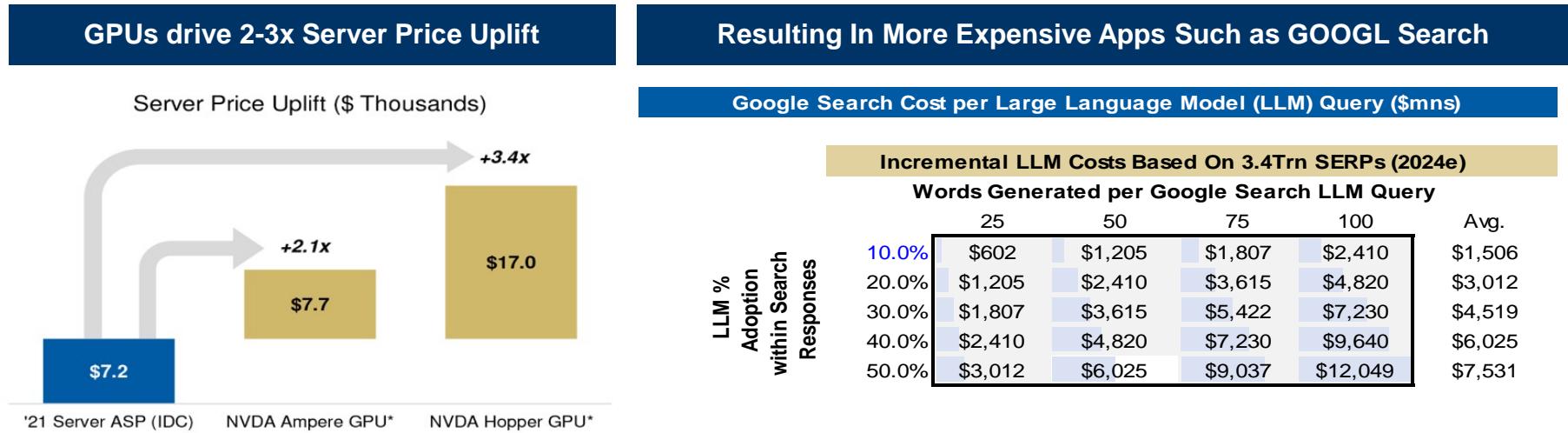
Source: Company data, Statista, Morgan Stanley Research

## From Silicon to Software: We Analyze the Layers of the AI Ecosystem and Positioning of Each Major Enabler



Source: a16z, Company Data, Morgan Stanley Research

## What Are The Costs of Building The AI Age?



### Training Represents The Majority of AI Costs, While Inference Costs Are More Manageable

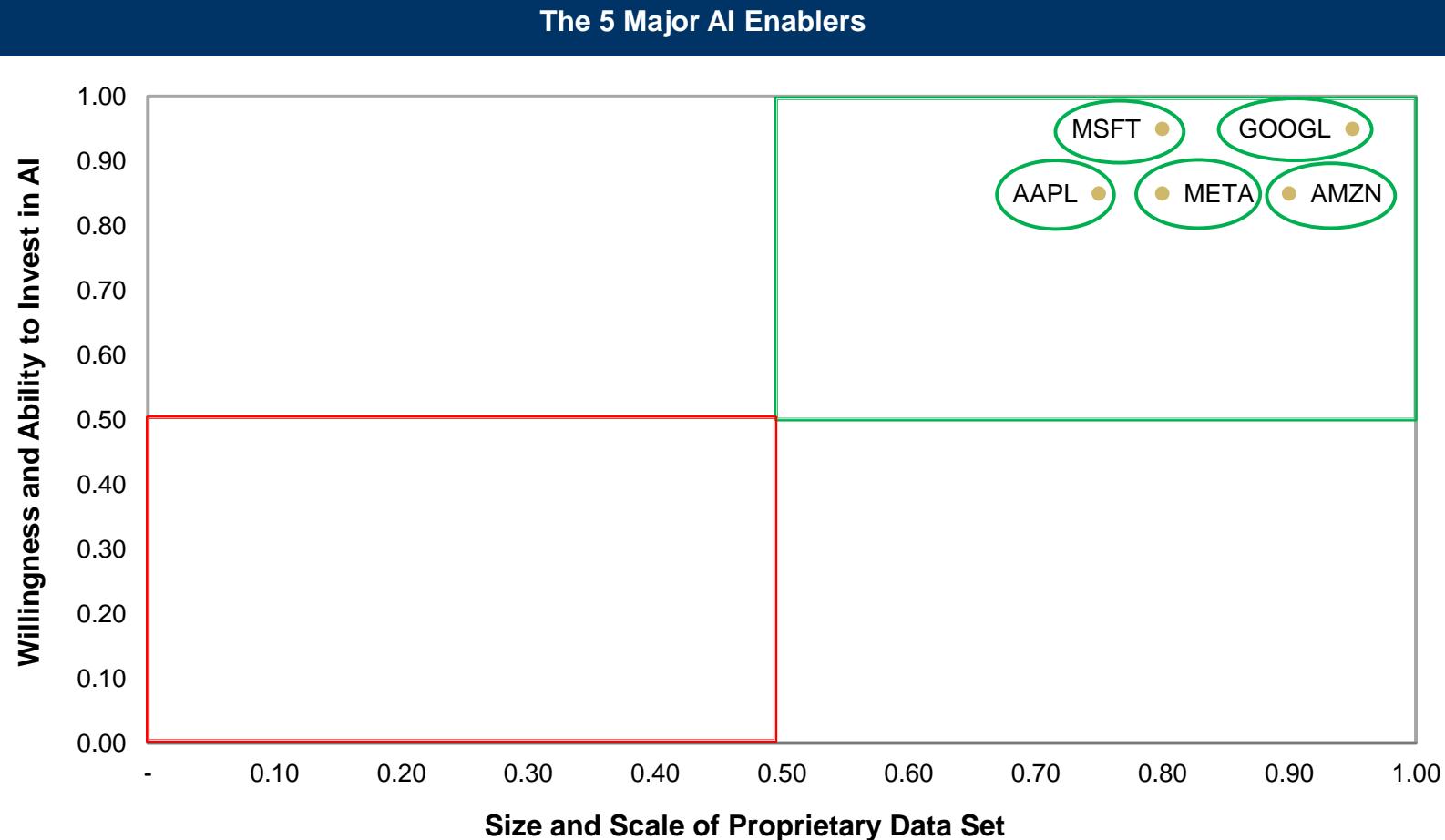
**Training:** GPUs and other forms of custom silicon are the preeminent solutions for running large-scale AI training given the high degree to which these chips can process data in parallel vs a typical CPU which specializes in serial processing. **GPUs carry a significant ASP increase compared to general server processing hardware and tend to consume more energy.** Models the size of GPT-3/4/5 generally require tens of thousands of GPUs, or other custom silicon with a similar architecture, to train, with the training period ranging from weeks to months. Once the model is trained, the training hardware can be used to run inference workloads on that same model or be re-used to train other models.

**Training represents the vast majority of AI costs.**

**Inference:** We have historically seen a wide variety of hardware solutions used, from CPUs to low and high end GPUs, so **costs are not as clear and are highly dependent on the size of the model and scale of deployment.** **Inference requires less compute than training,** but is required on a constant basis as long as the model is deployed. Given the wide range of scenarios, we have found it difficult to coalesce around a simple framework for forecasting inference costs, and believe the industry is focused on bringing costs down.

Source: Company data, Statista, Morgan Stanley Research. \*Note: NVDA GPU pricing assumes a 15% discount to list price for the hyperscalers.

## Stepping Back, We See Companies With the Most High-Quality Data and an Ability/Willingness to Invest Best Positioned for this AI Age (Across All Industries)

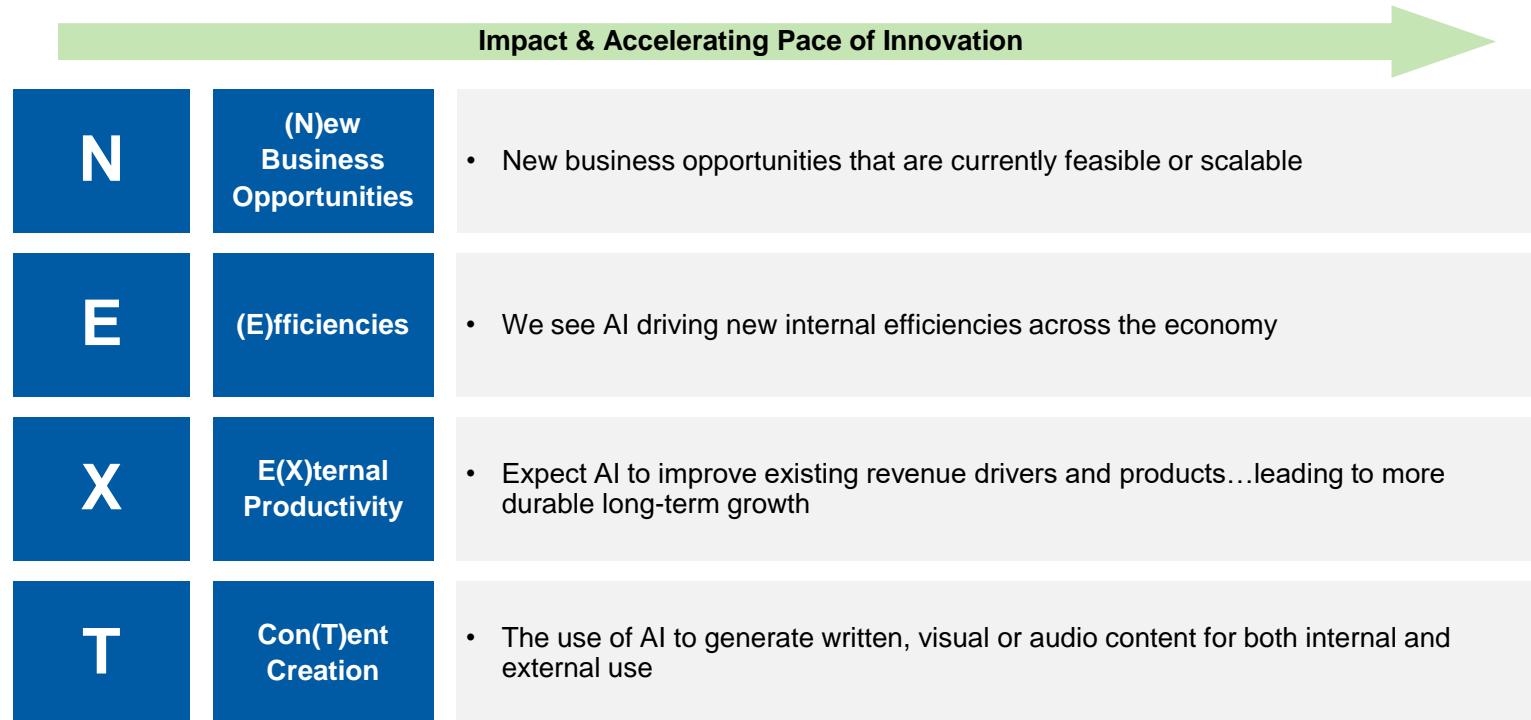


Source: Company data, Morgan Stanley Research

## What's NEXT? Our Framework Laying Out How AI Could Impact Companies Across the Economy and Drive Tech Diffusion...

### We See 4 Areas of AI Innovation Set to Impact the Economy

- Our **NEXT framework analyzes the ability for AI to drive incremental (N)ew Business Opportunities, (E)fficiencies, E(X)ternal Productivity and Con(T)ent Creation across the economy**
- **We analyze potential opportunities in the next 3 years and those beyond 3 years**



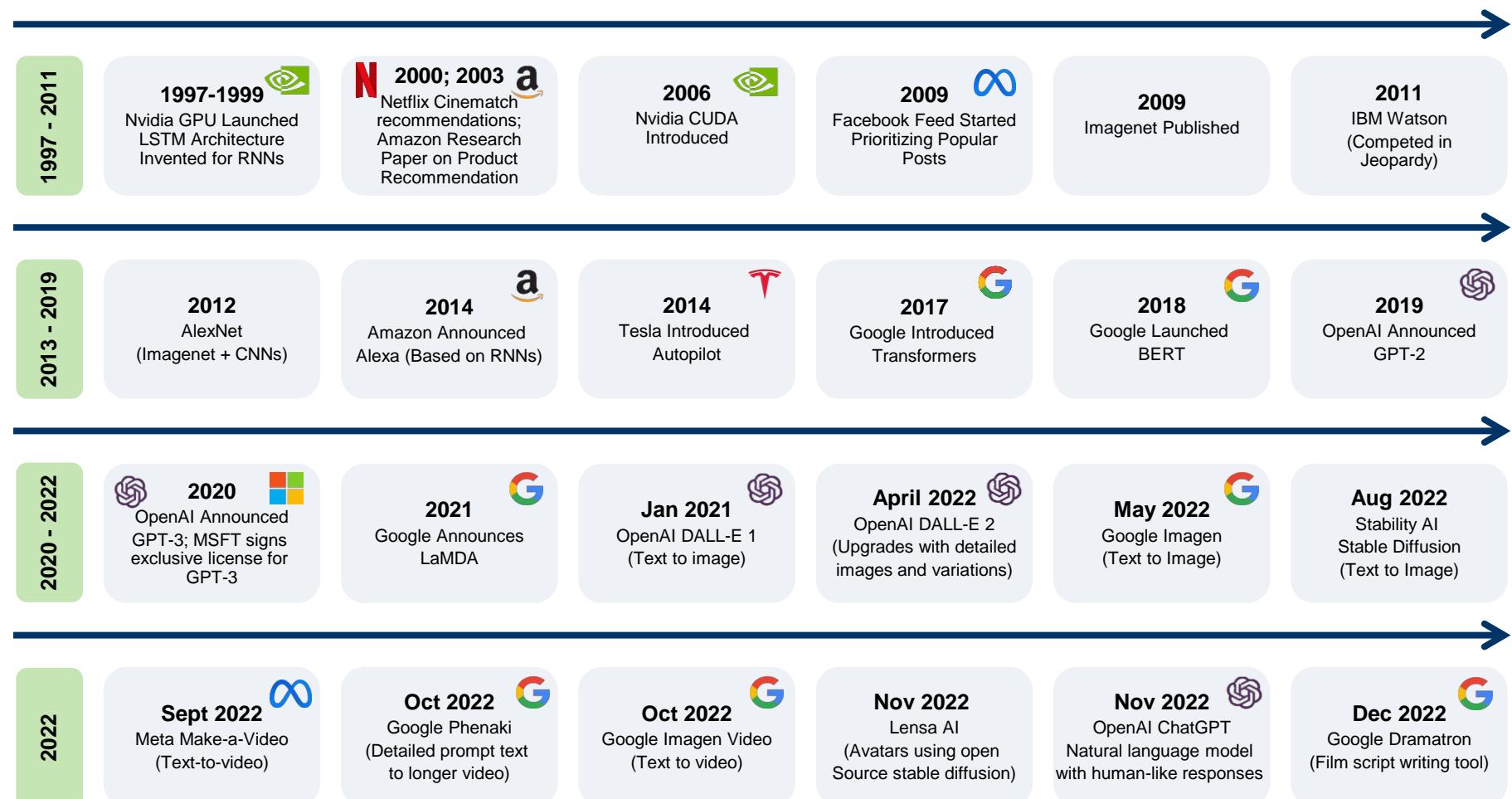
## ...With Broad-based Emerging/Future AI Applications Set to Drive Productivity and Efficiency

Healthcare	Financials	Advertising & Digital Content	Retail & Freight	Energy & Industrials	Customer Service	Business Intelligence
Smart Implants (Ex: Hip & Knee)	AI Thematic Fund Offerings	Marketing Efficiency	3D Shopping & Product Try On	AI Tools for Pipelines	Customer Analytics	Developer Tools & Assisted Code
Medical Imaging	New Trade Pricing Tools	Enhanced Ad Targeting	Sidewalk Robots for Deliveries	Geological Models	Insurance Claims and Records	AI-Related Consulting
Pathology Detection	Generate Client Portfolio Reviews	Recommendation Engine	Supply Chain Efficiency	AI-Enabled Microgrid Tools	Transcribe and Summarize	Integrated Smart Home Interface
Personalized Medicine	Automated Trade Prices, Execution	Higher Ad Conversion	Inventory Management	Energy Usage Analytics	Client Onboarding	Automate Back Office Tasks
Identify Biomarkers	AI Portfolio Management	Ad Auction Dynamics	Demand Prediction	Energy Trading Enhancements		Fraud Prevention and Protection
New Drug Development	Increase Trading Velocity	Content Creation	Truck Routing Capabilities	Labor Scheduling		Cybersecurity Capabilities
Analysis of Genomic Data		Customized Travel Itineraries	Higher Fleet Utilization	Reservoir Optimization		Risk Assessment & Management
Physician Point of Service Tools		Video Game Development	Autonomous Fleet Networks	Leak Detection & Track Emissions		Accelerated Data Analysis
						Predictive Modeling

Source: Company Data, Morgan Stanley Research

## AI: How Did We Get Here and The Tech Diffusion Ahead

## The Concept of AI Isn't New...It's Been Building for Years as Compute Cycles Advance



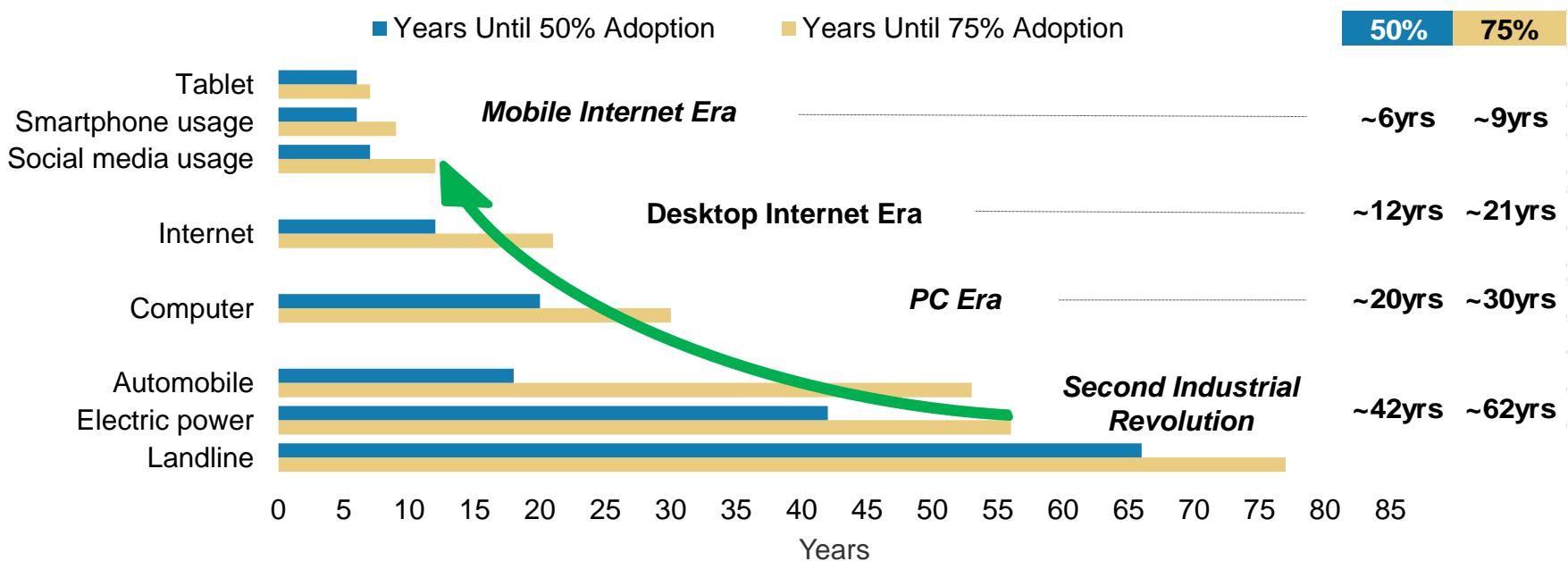
Source: Company Data, Morgan Stanley Research

## And As Seen In Prior Tech Cycles, the Pace of Innovation and Adoption is Accelerating

### Faster Pace of Innovation

- Technology builds on itself, and increasingly, **new technologies are beginning to converge, speeding up the time to mass adoption**

Years Until 50% and 75% US Household Adoption of New Technology

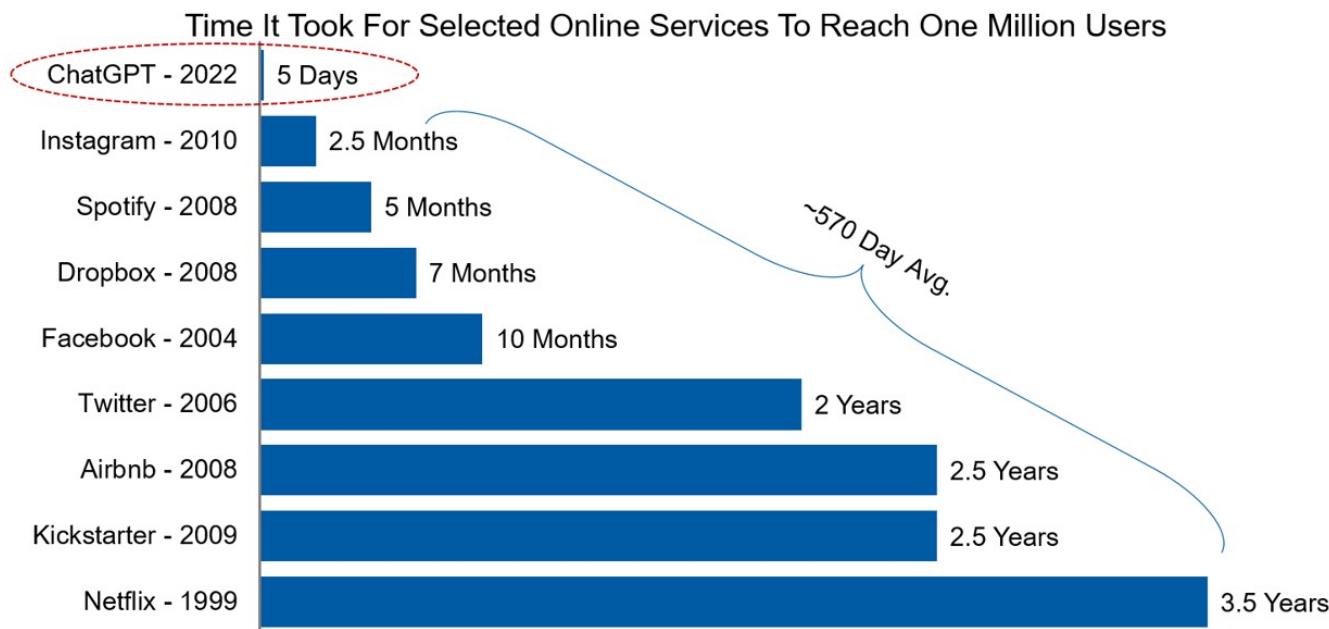


Source: OurWorldinData, various websites, Morgan Stanley Research ([Thematic Alpha: Data Era Spend - Generating Alpha and Productivity \(22 Jul 2021\)](#))

## With ChatGPT Reaching 1mn Users in 5 Days...vs Facebook Reaching That in ~300 Days, and Other Technologies Taking Longer to Scale (~550 Day Avg)

### Accelerating Adoption

- As another example of the accelerating pace of consumer adoption, ChatGPT reached 1mn users in only 5 days, which demonstrates consumer willingness to try new products and engage with new platforms



Source: Company data, Statista, Morgan Stanley Research

## Fundamentally AI is Built Upon 1) Silicon and Compute Power, 2) Machine Learning, and 3) Deep Learning

### Artificial Intelligence

Machines that can perform tasks that typically require human intelligence like understanding, reasoning, learning, decision making etc.

### Machine Learning

Involves training algorithms to make predictions based on data

### Deep Learning

Involves training neural networks to perform tasks like image recognition

#### Transformers

Input data is transformed into a sequence of vectors, and then the vectors predict an output sequence (translation, summary, or answer to a question)

#### General Adversarial Networks (GANs)

Used to generate new images or videos that are similar to a given set of input data. GANs pre-date Transformers

#### Recurrent Neural Networks (RNNs)

Process and analyze data sequentially (time series, speech, natural language)

#### Convolutional Neural Networks (CNNs)

Process and analyze data that has a grid-like structure (images and videos)

### Software

PyTorch and TensorFlow

### Compute

GPUs and TPUs

Source: Company Data, Morgan Stanley Research

## Transformers Are Foundational to Generative AI and Emerging State-of-the-Art AI Models

### Transformers

Input data is transformed into a sequence of vectors, and then the vectors predict an output sequence

### Generative AI

A type of AI model designed to generate new, synthetic data based on patterns learned from existing data (i.e. text, images, videos, and audio)

### Large Language Models (LLMs)

A type of natural language processing (NLP) that uses deep learning techniques to process and analyze human language at scale

### Diffusion Models

A type of generative model that is based on the idea of iteratively diffusing noise through a set of transformations to generate realistic samples

### Computer Vision Models (CV)

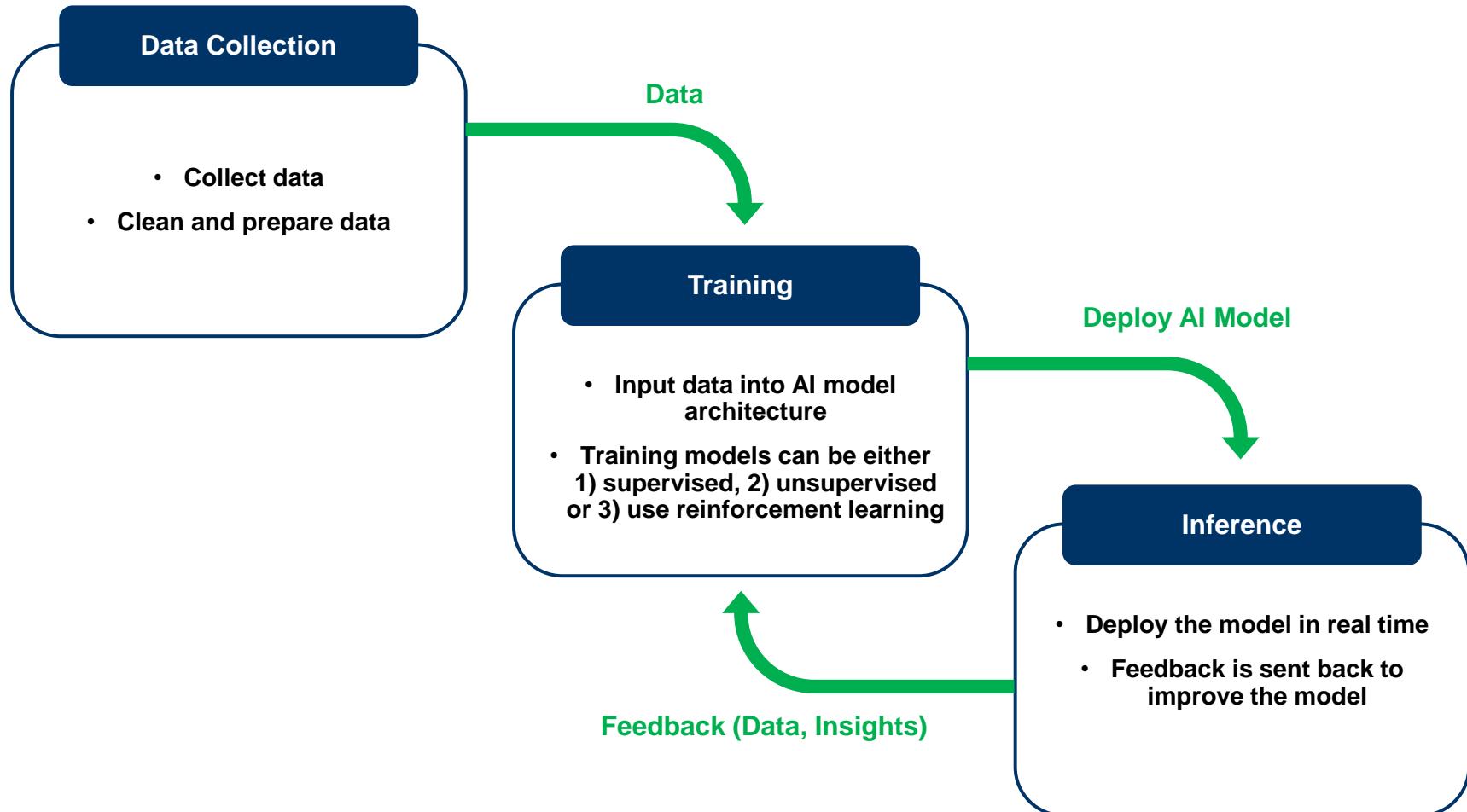
CV models enable machines to interpret and understand the visual world, such as images and videos

### Multimodal Models

AI models that combine information from multiple modalities/data such as images, text, and audio

Source: Company Data, Morgan Stanley Research

## With Machine Learning Model Building Having 3 Defined Stages: Data Collection, Training, Inference



Source: Company Data, Morgan Stanley Research

## Importantly, Human Feedback Assists The Model Training Process

**1**

### Data Collection

- Prepare and clean input data

**2**

### Training

- Human input is used to rank generated text outputs from the language model
- Use reinforcement learning to update and improve model outputs over time

**3**

### Inference

- For models with continuous training, new live inference versions of the model can be deployed in real time as the model improves



how do you play golf?



Golf is a sport that involves hitting a small ball into a series of holes using a club. Here are the basic steps for playing golf:

1. Familiarize yourself with the equipment: Golf clubs come in different sizes and shapes and are used for different types of shots. Learn the basics of each club and their purpose.
2. Choose your club: Depending on the distance you want to hit the ball, select a club that will help you achieve that goal.
3. Address the ball: Stand behind the ball and align your clubface with the target. Place your feet shoulder-width apart and position the ball in the center of your stance.
4. Take your stance: Stand with your knees slightly bent,



Model continues to train based on human feedback



Provide additional feedback

What would the ideal answer have been?

Submit feedback



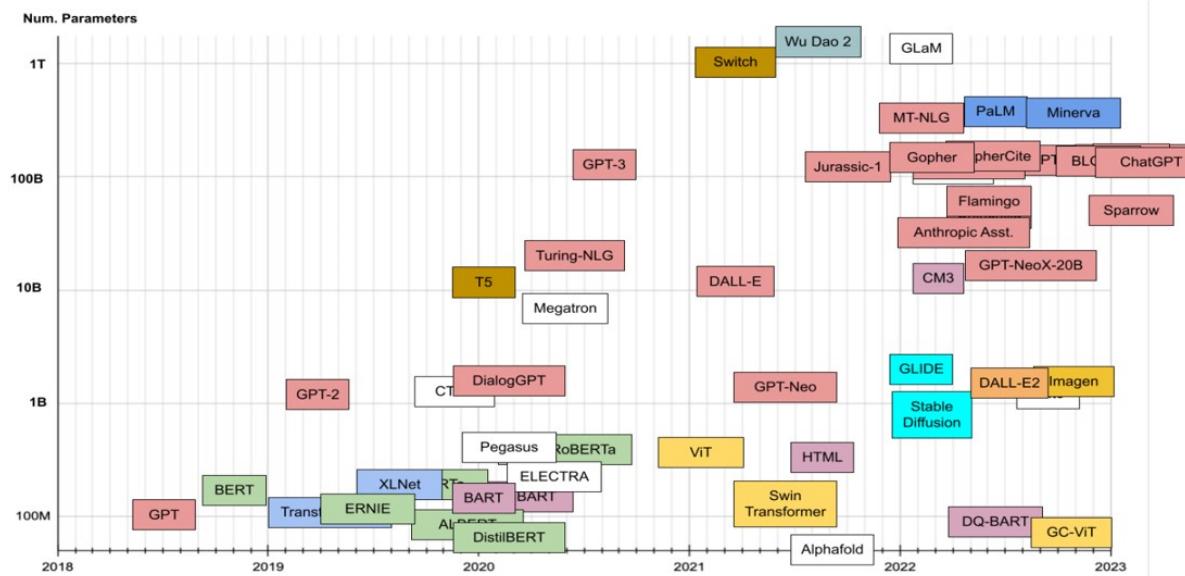
Additional comments and feedback allow model to improve so that when the new inference version is deployed the model accuracy increases

Source: Company Data, ChatGPT, Morgan Stanley Research

## Why is AI Becoming More Consumer and Business Facing? Transformer Models

### Transformers & Why They Matter

- Google unveiled the first Transformer in 2017**, which solved many of the drawbacks associated with RNNs (recurrent neural networks).
- Transformers are the foundation of large language models** because they enable models to understand context by allowing for 1) positional encoding (assigns every word in an input a number) and 2) multi-headed attention (model can look ahead or back at the input sequence and at different parts of the input).
- Pretrained transformer models can adapt quickly** to tasks they have not been trained on, which allows them to be applied to a variety of use cases.
- Transformers enable the algorithm to better understand context, scan across broader bases of text to process all of the input data at once and can be trained more effectively compared to prior technology including CNNs and RNNs.**



### Key Advantages of Transformers

- Manage longer sequences of input data
- Learn more effectively
- Understand context and reasoning
- Can adapt quickly

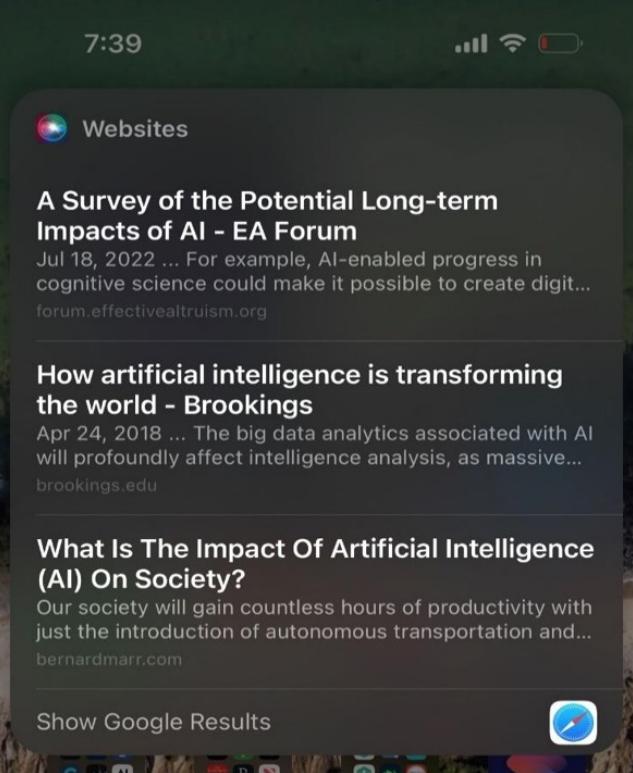
Source: [Transformer Modes: An Introduction and Catalog \(Xavier Amatriain, Cornell\)](#), Company Data, Morgan Stanley Research

## Consider the Difference Between Voice Assistants (Built on RNNs) vs ChatGPT (Built On Transformers)

**Siri & Google Results**

*"Siri, write me an intro to a research paper about AI's potential long-term impact?"*

*Siri: "I found this on the web"*



The screenshot shows a mobile interface. At the top, there's a dark header with the title 'Siri & Google Results'. Below it is a white search bar containing the query. Underneath the search bar, the text 'Siri: "I found this on the web"' is displayed. The main content area is titled 'Websites' and lists three search results:

- A Survey of the Potential Long-term Impacts of AI - EA Forum**  
Jul 18, 2022 ... For example, AI-enabled progress in cognitive science could make it possible to create digit...  
[forum.effectivealtruism.org](http://forum.effectivealtruism.org)
- How artificial intelligence is transforming the world - Brookings**  
Apr 24, 2018 ... The big data analytics associated with AI will profoundly affect intelligence analysis, as massive...  
[brookings.edu](http://brookings.edu)
- What Is The Impact Of Artificial Intelligence (AI) On Society?**  
Our society will gain countless hours of productivity with just the introduction of autonomous transportation and...  
[bernardmarr.com](http://bernardmarr.com)

At the bottom of the screen, there are two buttons: 'Show Google Results' on the left and a magnifying glass icon on the right.

**ChatGPT Result**

K Write me an intro to a research paper about AI's potential long term impact?

 The rapid advancements in artificial intelligence (AI) technology have sparked much debate and speculation about its potential long-term impact on society. While some believe that AI has the potential to greatly benefit humanity, others are concerned about its potential negative effects. In this research paper, we explore the potential long-term impact of AI on various aspects of society, including its potential to transform the economy, affect the job market, and impact personal privacy. We also discuss the potential risks and challenges associated with the development and implementation of AI technology, and consider possible solutions for addressing these concerns.

Source: Siri, Google, ChatGPT, Morgan Stanley Research

## The AI Applications & Implications Are Far Reaching: Content Creation

### Content Creation

- We see content creation and generative AI generating significant utility to companies and consumers.
- META and GOOGL have developed **text-to-video models**. GOOGL's work uses a transformer-based model to generate video tokens based on a text description.
- Music is another beneficiary of this innovation as AI models use existing data to generate new outputs based on patterns (GOOGL's MusicLM can generate music from text prompts).
- **Longer term, AI could lower content creation costs** for advertisers, platforms, creators.
- Implications for YouTube, Meta, Netflix, Spotify, Adobe, Microsoft, video game companies and more.

### Video Generation from Diffusion Models



### GOOGL's Generative Image Advancements



Source: Company Data, Morgan Stanley Research

## The Applications & Implications Are Far Reaching: AI-Assisted Coding

### Developer Tools

- AI coding tools for developers are a key area of innovation with programs like GitHub Copilot now able to suggest code in real-time.
- Copilot is an AI-based computer programmer and coder that uses OpenAI Codex to suggest code in real-time.
- Improvements in AI-assisted coding already demonstrate the ability to make developers faster/more efficient. A GOOGL study reported that a pilot of their model (used by 10K software engineers) reduced coding iteration time by 6% and contributed 2.6% of code written.
- Over time, we believe AI-assisted coding will make coders faster, more efficient, and drive tech expense leverage. Expect integration of voice commands to be an even further game changer.
- Implications for Alphabet, Meta, Amazon, Microsoft, Gitlab, Atlassian, JFrog, and more as engineer productivity increases across industries.

### GitHub Copilot Suggest Code in Real-Time

A screenshot of a GitHub Copilot interface. The top navigation bar shows files: runtime.go (selected), course.rb, time.js, and IsPrimeTest.java. The main area displays a Go code snippet for calculating average runtime. The code includes imports, a package declaration, a struct definition for Run, and a function averageRuntimeInSeconds. The GitHub Copilot logo is visible at the bottom left of the code editor.

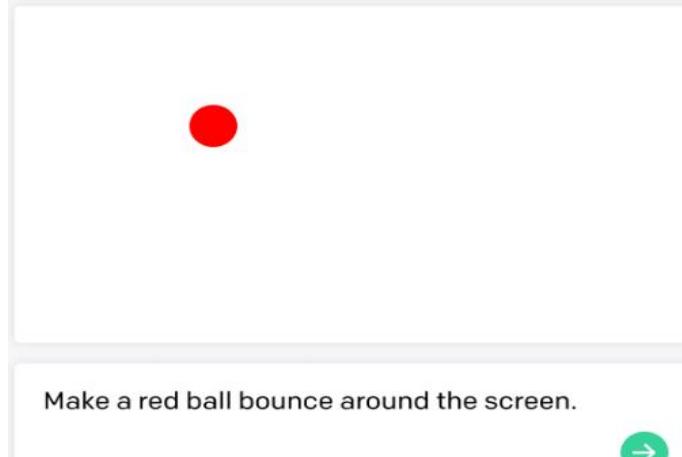
```
1 package main
2
3 type Run struct {
4     Time int // in milliseconds
5     Results string
6     Failed bool
7 }
8
9 // Get average runtime of successful runs in seconds
10 func averageRuntimeInSeconds(runs []Run) float64 {
11     var totalTime int
12     var failedRuns int
13     for _, run := range runs {
14         if run.Failed {
15             failedRuns++
16         } else {
17             totalTime += run.Time
18         }
19     }
20
21     averageRuntime := float64(totalTime) / float64(len(runs) - failedRuns) / 1000
22     return averageRuntime
23 }
```

Source: Company Data, GitHub Copilot Morgan Stanley Research

## The Applications & Implications Are Far Reaching: AI Generated Code

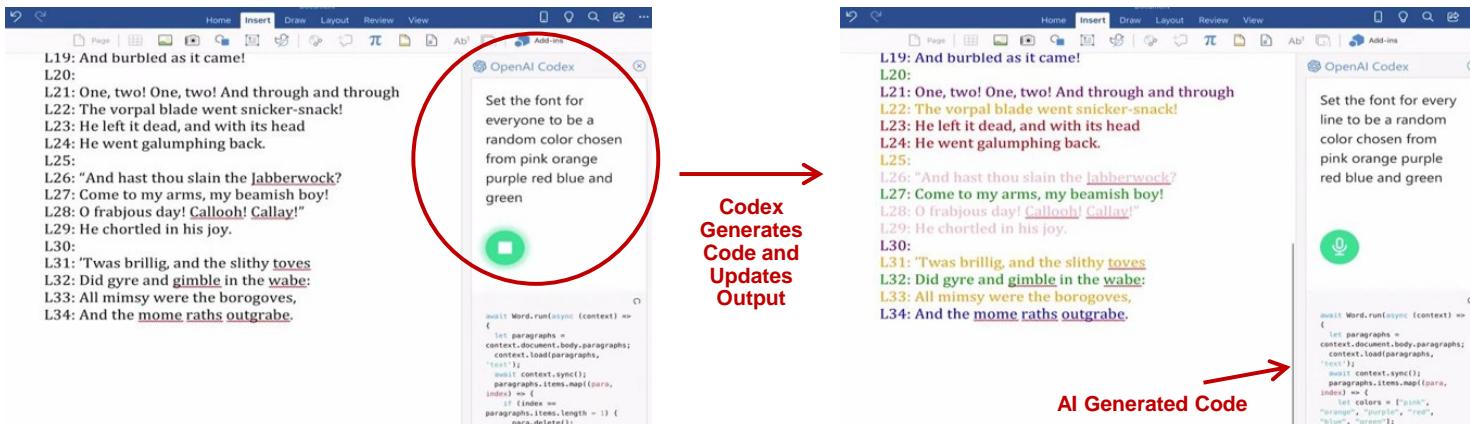
**OpenAI Codex**

- In these examples, we see OpenAI's Codex turning natural language prompts into code to create an output.
- Codex can be used to:
  - 1) Create code
  - 2) Complete next line or function
  - 3) Help find libraries and APIs
  - 4) Add comments
  - 5) Rewrite code for efficiency
  - 6) Be used in productivity apps



Make a red ball bounce around the screen.

```
/* Make a red ball bounce around the screen */
var canvas = document.createElement('canvas');
canvas.width = window.innerWidth;
canvas.height = window.innerHeight;
document.body.appendChild(canvas);
var ctx = canvas.getContext('2d');
var ball = {
  x: canvas.width / 2,
  y: canvas.height / 2,
  radius: 20,
  speed: {
    x: 2,
    y: 2
  }
};
var draw = function() {
  ctx.clearRect(0, 0, canvas.width, canvas.height);
  ctx.beginPath();
  ctx.arc(ball.x, ball.y, ball.radius, 0, Math.PI * 2, false);
  ctx.fillStyle = 'red';
  ctx.fill();
}
```



**Codex Generates Code and Updates Output**

**AI Generated Code**

Source: OpenAI, Morgan Stanley Research

## The Applications & Implications Are Far Reaching: E-commerce Search To Drive Further Transactions Online and (Potentially) Collapse the Shopping Funnel

### AI Could Collapse The Online Shopping Funnel

The screenshots illustrate a conversational AI's role in simplifying the shopping process:

- Screenshot 1:** The AI greets the user and asks for their needs: "I'm looking for a new pair of jeans. Can you help me find a comfortable pair for under \$200?" This message is highlighted with a red box.
- Screenshot 2:** The AI confirms the search parameters: "Searching for: comfortable jeans under \$200" and begins generating answers.
- Screenshot 3:** The AI recommends a specific style: "Okay, slim-straight fit jeans are a great choice for a modern and versatile look. One of the best men's jeans under \$200 with a slim-straight fit is **Paige Denim's Federal style**". It then asks for color preference: "What color do you prefer?"
- Screenshot 4:** The AI suggests a color: "Blue." and continues to search for "Paige Denim Federal style blue".
- Screenshot 5:** The AI finds a medium wash option: "Medium wash is a good choice for a casual and relaxed look. I found a pair of Paige Denim Federal style jeans in medium wash for \$199. Do you want to buy them?" This message is highlighted with a red box.
- Screenshot 6:** The user agrees: "Yes, please."
- Screenshot 7:** The AI concludes: "Great! To buy them, please visit and follow the instructions. I hope you enjoy your new jeans. Is there anything else I can help you with today?"

Source: Bing, Morgan Stanley Research

## The Applications & Implications Are Far Reaching: Significantly Improved Online Travel Research

### Online Travel

- We see online travel as one of the potentially most impacted internet sub-industries as AI tools change consumer behavior, impact customer/concierge service, itinerary personalization, marketing channels, and traveler/consumer knowledge
- ChatGPT answered the question **I want to go skiing in Switzerland for 4 days. Where should I ski and where can I stay?** by producing a complete list of resort options with details on each village and accommodation options.
- We see AI based online travel tools increasing engagement and conversion with leading platforms as real-time data and relevant AI-driven suggestions (eventually pre-packaged itineraries) become available.

Any of these resorts could pay to be listed in the top recommendations and over time these results could become more personalized and targeted, leading to a higher user utility and conversion rates

Similarly, the OTAs could advertise in this new format

### AI Generated Itinerary from ChatGPT



Switzerland is renowned for its stunning Alpine ski resorts, and you have several options for a 4-day ski trip, depending on your preferences and budget. Here are a few suggestions:

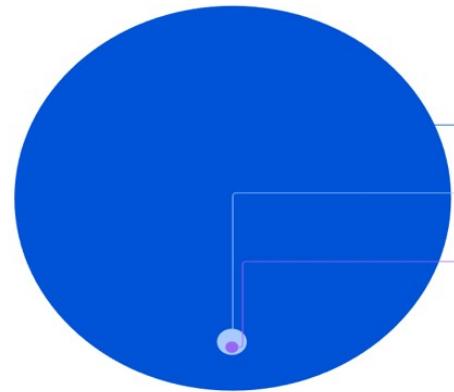
1. **Zermatt:** One of the most famous ski resorts in Switzerland, Zermatt is known for its breathtaking views of the Matterhorn, and its extensive ski runs that cater to all levels of skiers. You can stay in one of the many hotels in the town or in a charming chalet in the surrounding villages.
2. **Verbier:** Another top ski resort in Switzerland, Verbier is located in the Valais region and offers 410 km of ski runs, including some of the most challenging off-piste terrain in the country. The town is lively and cosmopolitan, with many high-end hotels and restaurants.
3. **St. Moritz:** If you're looking for luxury and glamour, St. Moritz is the place to go. The town is famous for its high-end shops, restaurants, and hotels, and its ski area is expansive, with 350 km of ski runs.
4. **Davos-Klosters:** This resort is perfect for families, with a range of ski runs and activities for all ages. You can stay in one of the many hotels or chalets in either Davos or Klosters, and enjoy the charming Swiss mountain atmosphere.
5. **Andermatt:** Andermatt is a lesser-known ski resort in Switzerland, but it has recently undergone extensive development, making it a great choice for skiers who want to explore some of the less-crowded slopes in the country. You can stay in one of the many new hotels or traditional chalets in the town.

No matter where you choose to ski in Switzerland, you can find plenty of accommodation options to suit your preferences and budget. You can choose to stay in a traditional chalet, a modern hotel, or a cozy bed and breakfast. To find the best deals on accommodation, you can check online travel sites such as Booking.com or Expedia, or contact a travel agent who specializes in ski holidays.

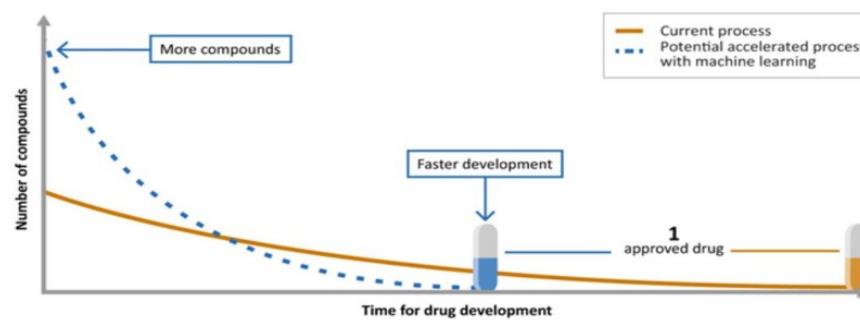
Source: Company Data, ChatGPT, Morgan Stanley Research

## The Applications & Implications Are Far Reaching: Drug Discovery and Development

### DeepMind's AlphaFold Can Now Predict Nearly All Catalogued Proteins Known to Science



### Machine Learning To Accelerate Drug Discovery...



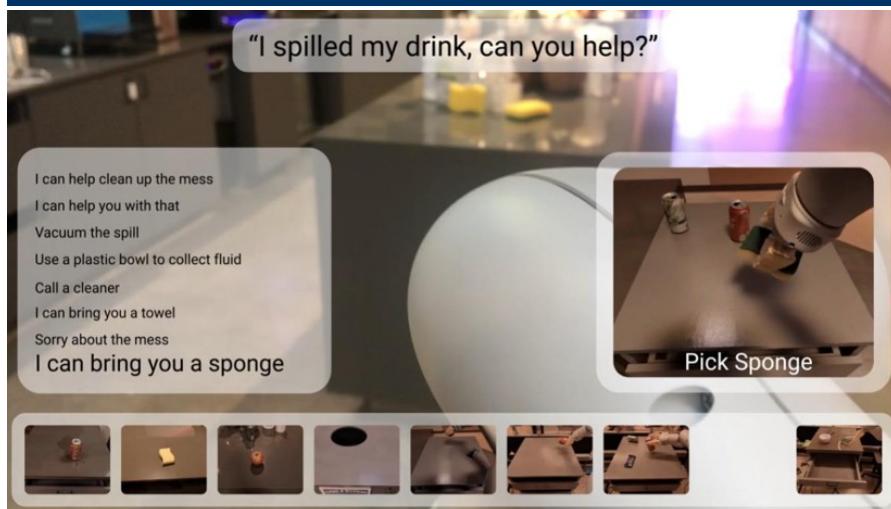
### ...and Improve Diagnostic Capabilities



Source: DeepMind, [Google Research, 2022 & beyond: Health \(February 23, 2023\)](#), GAO, Morgan Stanley Research. Note: Proteins are the fundamental building blocks of living organisms. If we can widely predict protein structures using AI, we can better understand how diseases progress and more effectively & efficiently discover new drugs.

## The Applications & Implications Are Far Reaching: Robotics and Automation

### New AI Robotic Systems Can Perform Day-to-day Tasks...



### ... And Improve Business Efficiency



*"With PaLM-SayCan [A Google LLM], the robot acts as the language model's "hands and eyes," while the language model supplies high-level semantic knowledge about the task."*

*"Amazon Robotics develops sophisticated machinery and software to optimize efficiency in Amazon fulfillment centers. As a purveyor of cutting-edge technologies, Amazon Robotics has long known that using artificial intelligence and machine learning (ML) to automate key aspects of the fulfillment process represented extraordinary potential gains..."*

Source: [Google Research, 2022 & beyond: Robotics \(February 14, 2023\)](#), Amazon, Morgan Stanley Research

## As We See AI Driving Innovation and Change Across the Economy...From Retail to Healthcare to Freight

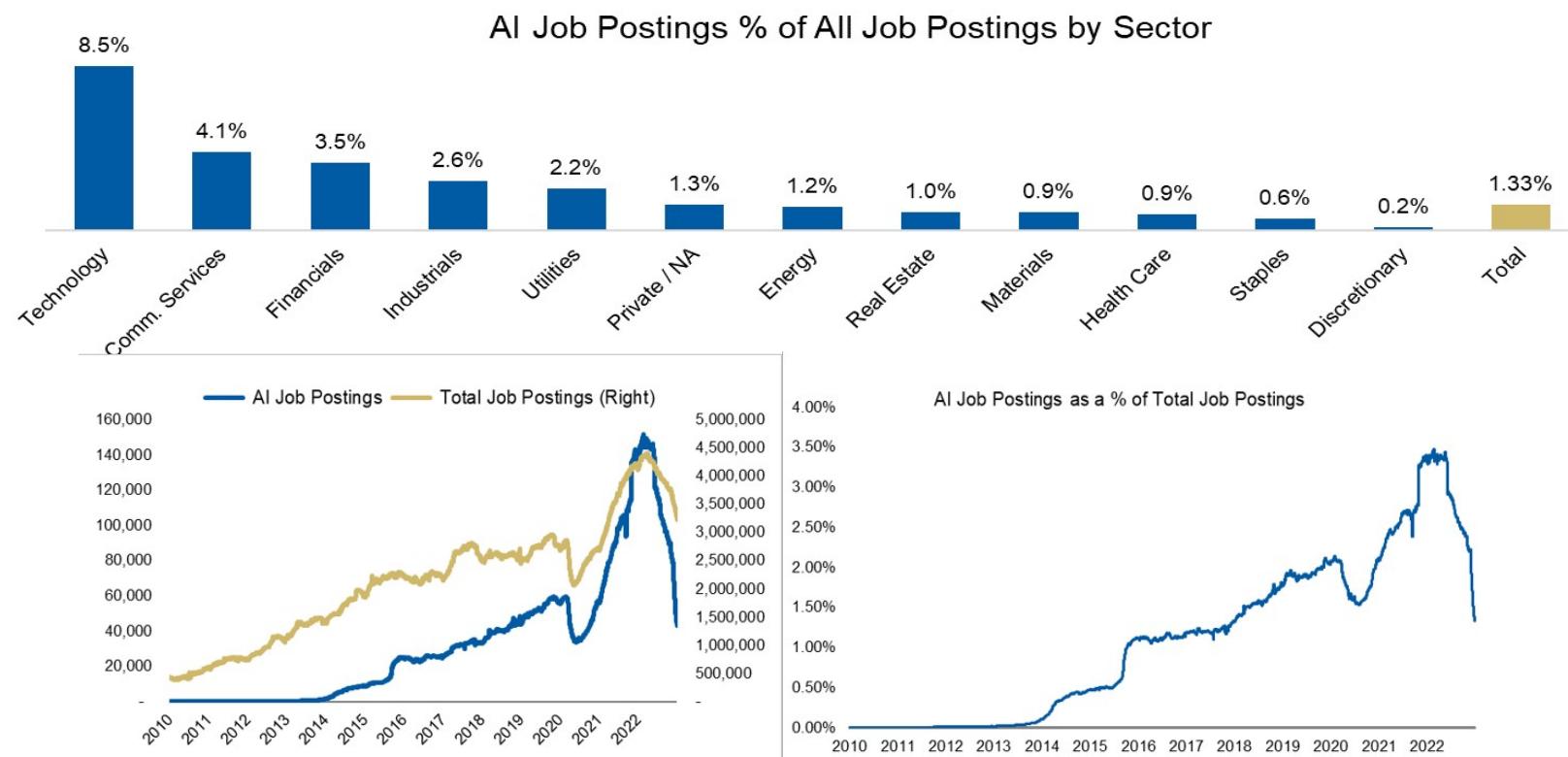
Healthcare	Financials	Advertising & Digital Content	Retail & Freight	Energy & Industrials	Customer Service	Business Intelligence
Smart Implants (Ex: Hip & Knee)	AI Thematic Fund Offerings	Marketing Efficiency	3D Shopping & Product Try On	AI Tools for Pipelines	Customer Analytics	Developer Tools & Assisted Code
Medical Imaging	New Trade Pricing Tools	Enhanced Ad Targeting	Sidewalk Robots for Deliveries	Geological Models	Insurance Claims and Records	AI-Related Consulting
Pathology Detection	Generate Client Portfolio Reviews	Recommendation Engine	Supply Chain Efficiency	AI-Enabled Microgrid Tools	Transcribe and Summarize	Integrated Smart Home Interface
Personalized Medicine	Automated Trade Prices, Execution	Higher Ad Conversion	Inventory Management	Energy Usage Analytics	Client Onboarding	Automate Back Office Tasks
Identify Biomarkers	AI Portfolio Management	Ad Auction Dynamics	Demand Prediction	Energy Trading Enhancements		Fraud Prevention and Protection
New Drug Development	Increase Trading Velocity	Content Creation	Truck Routing Capabilities	Labor Scheduling		Cybersecurity Capabilities
Analysis of Genomic Data		Customized Travel Itineraries	Higher Fleet Utilization	Reservoir Optimization		Risk Assessment & Management
Physician Point of Service Tools		Video Game Development	Autonomous Fleet Networks	Leak Detection & Track Emissions		Accelerated Data Analysis
						Predictive Modeling

Source: Company Data, Morgan Stanley Research

## Further Evidenced by AI Hiring Across The Economy

### AI Diffusion

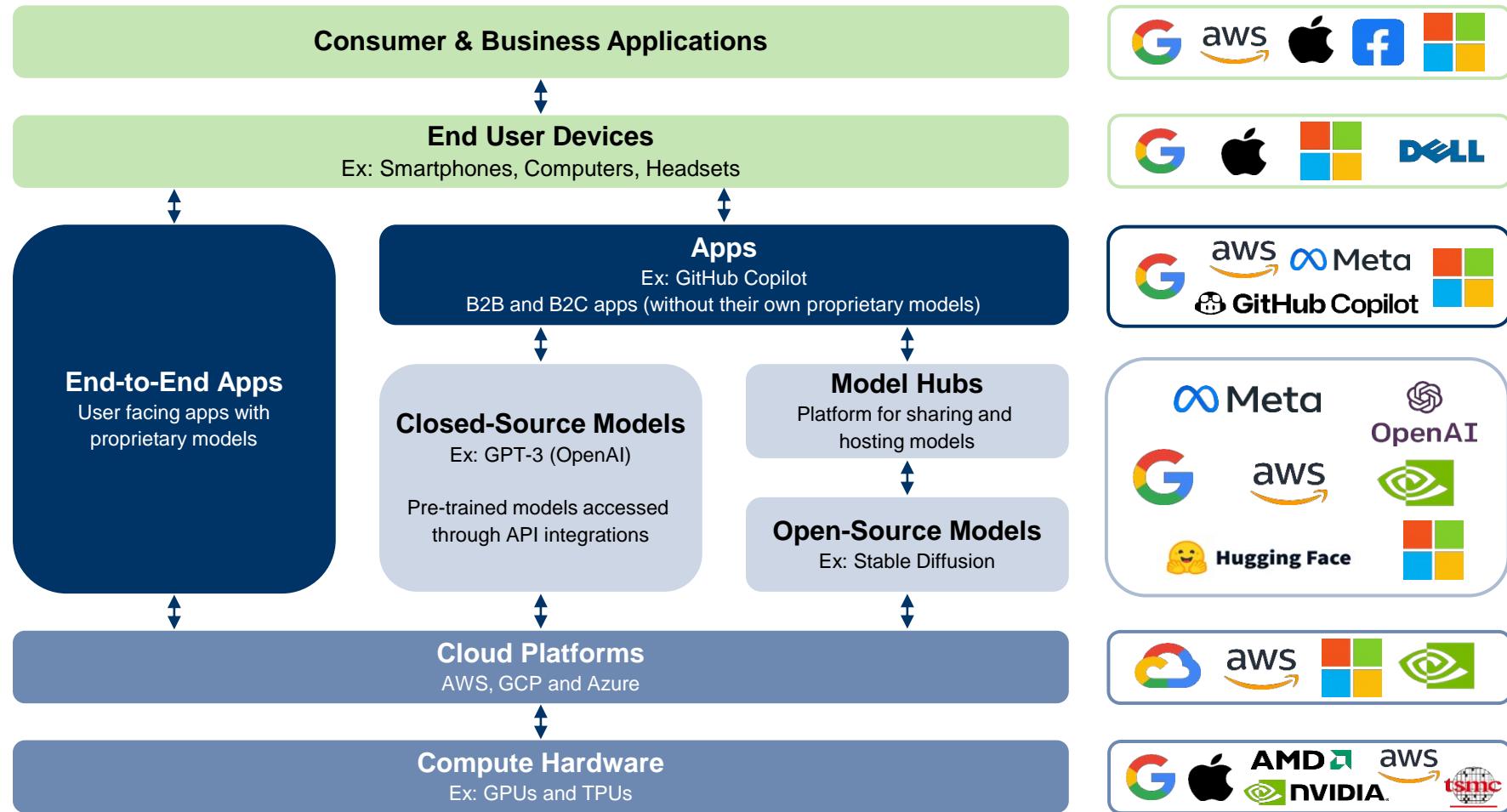
- Companies in Every Sector Are Hiring for AI Roles.** While the absolute number and % of job listings for AI roles is down in recent months, AI job postings are highly correlated with total job postings and by extension, tied to macro-economic trends.



Source: Compustat, Morgan Stanley Research. Note: Compustat data as of year end 2022

## Who Are the AI Enablers?

## The AI Ecosystem: From Silicon to Software



Source: a16z, Company Data, Morgan Stanley Research

## The Six Major AI Enablers

Company Offering						
Data Center Hardware	✓	✓	✓	✓	✓	
Public Cloud Offering	✓	✓	✓	✓		
In-House Silicon	✓	✓		✓		✓
Models & Apps	✓	✓	✓	✓	✓	✓
End User Devices	✓	✓	✓		✓	✓
Partnerships	✓	✓	✓	✓	✓	

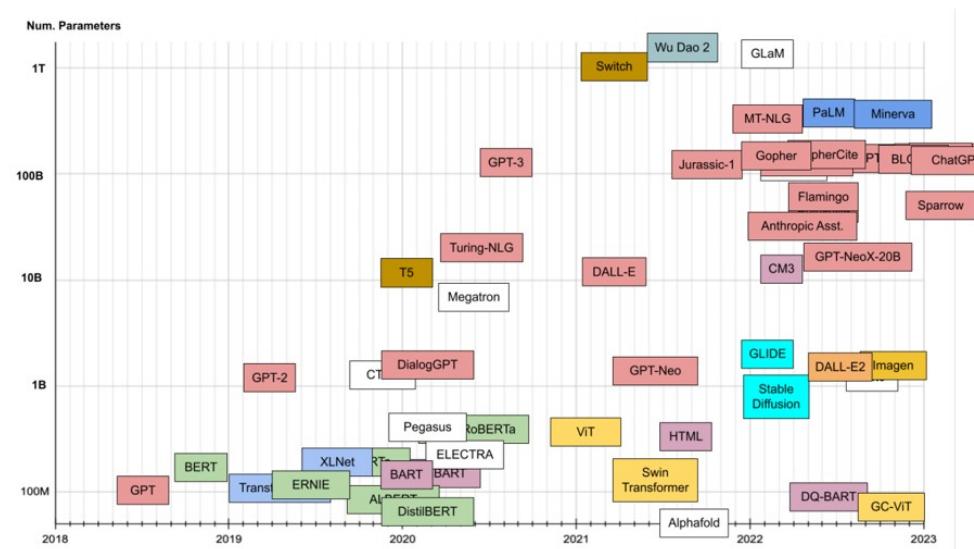
Source: Company Data, Morgan Stanley Research

## Expect a Handful of Scaled “Enablers” as Building, Training and Maintaining Models is Incredibly Compute Intensive...and Requires Large Amounts of Data

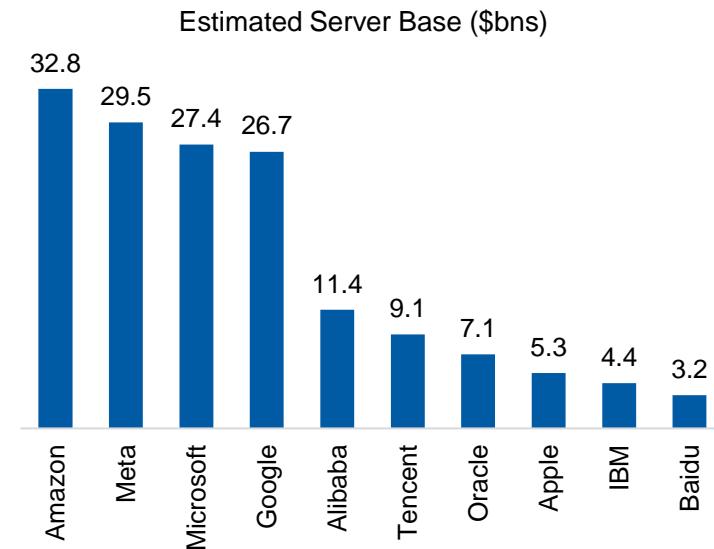
### Parameters & Model Sizes

- Parameters represent the values that are learned during the training process.** The parameters influence the behavior of the model and are the weights/biases used to compute the output of the model. “**Variables**”
- Each model has a certain number of parameters.** The number of parameters varies drastically depending on complexity of the model. Language models have billions of parameters, image models can have hundreds of millions, while simple linear regressions may only have one or two.
- Parameter count is growing exponentially.** Costs scale linearly with parameter count, but **accuracy rates** tend to improve as parameter count increases.

### GPT-3 Has 175bn Parameters vs. GPT-2 Only Had 1.5bn in 2019



### Hyperscalers Estimated Server Base

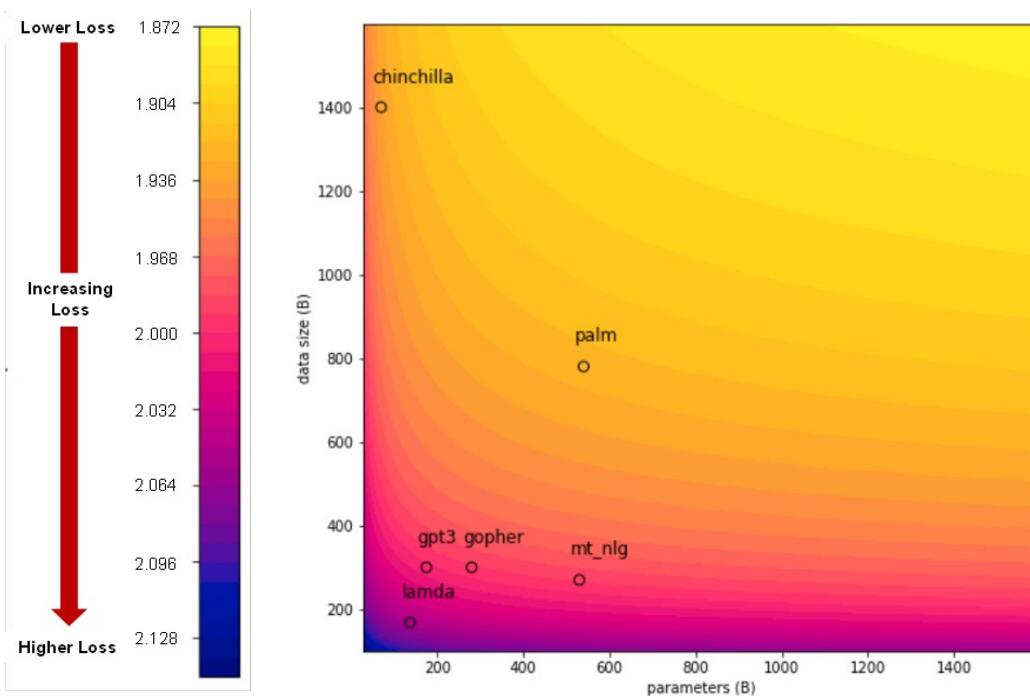


Source: [Transformer Modes: An Introduction and Catalog \(Xavier Amatriain, Cornell\)](#), Company Data, Dell'Oro, Morgan Stanley Research

## New Studies Show that Current Models Incorrectly Prioritize Increasing Parameters Over Scaling Training Data

### Importance of Data in Model Training

- Current Models Improperly Allocate Resources:** While accuracy rates tend to improve as parameter count increases, new studies suggest that current models focus too many resources on scaling parameters and not enough on scaling training data.
- Increasing Data Improves Accuracy and Reduces Costs:** If current models were to reprioritize budgets away from increasing parameters towards scaling training data, models could significantly reduce loss (increase accuracy) at the same (or lower) costs. Achieving increased accuracy using smaller models (fewer parameters) also facilitates use on smaller hardware by reducing inference costs considerably.



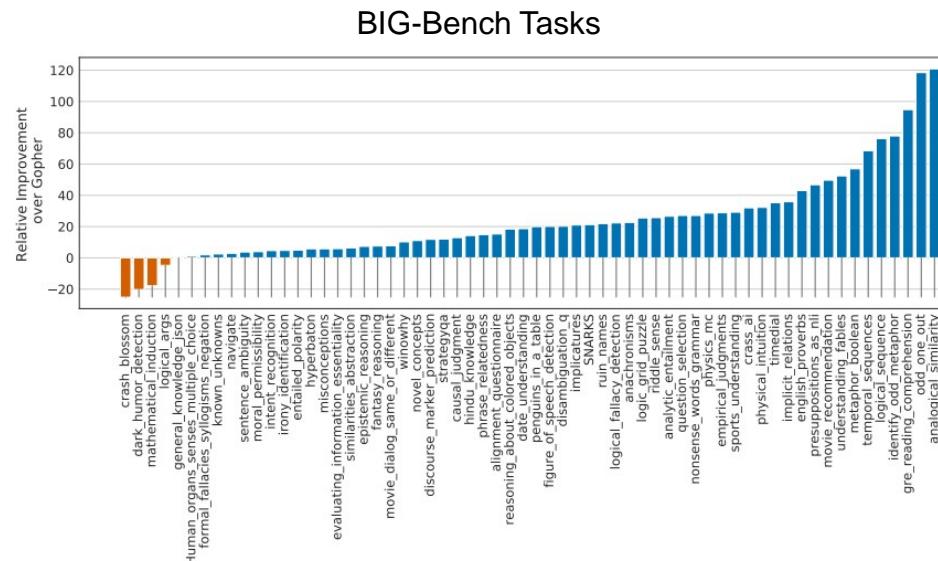
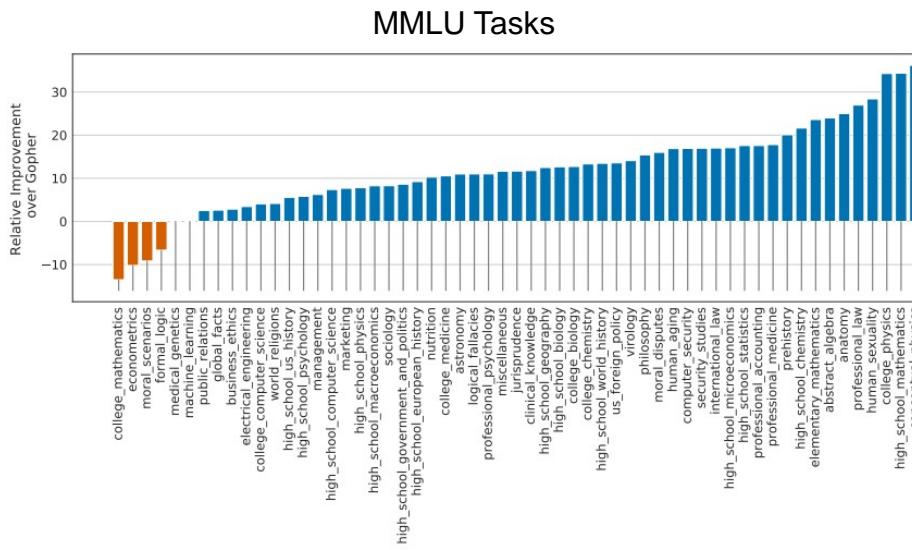
DeepMind trained its Chinchilla model using the same compute budget as the model Gopher, but reprioritized this fixed budget towards increasing training Data (~4x more than Gopher) and away from Parameters (~4x fewer than Gopher). The greater skew towards training data causes Chinchilla to outperform Gopher, better minimizing loss.

Model	Size (# Parameters)	Training Tokens
LaMDA (Thoppilan et al., 2022)	137 Billion	168 Billion
GPT-3 (Brown et al., 2020)	175 Billion	300 Billion
Jurassic (Lieber et al., 2021)	178 Billion	300 Billion
Gopher (Rae et al., 2021)	280 Billion	300 Billion
MT-NLG 530B (Smith et al., 2022)	530 Billion	270 Billion
Chinchilla	70 Billion	1.4 Trillion

Source: [DeepMind: Training Compute-Optimal Large Language Models](#), [AI Alignment Forum](#), Morgan Stanley Research

## Importance of Data in Creation of More Optimal Models Favors Companies With Large, Unique Data Sets

- Data Driven Outperformance**
- Chinchilla Outperforms Gopher On Vast Majority of Tasks:** When analyzed across a large set of BIG-bench (Beyond the Imitation Game Benchmark) and MMLU (Massive Multitask Language Understanding) tasks in addition to others, Chinchilla outperforms Gopher as well as other LLMs including GPT-3.
  - Implications of a Potential Reprioritization of Data:** Should these new findings shift the focus towards scaling training data, we think it favors companies with access to large unique data sets. We will continue to monitor new ways for LLMs to train on more data, for example the continued development of multimodal models that take in both text and images (we note humans process multiple input modes each second) as well as privacy implications if companies become more guarded about their data, limiting the ability for LLMs to scrape data for training.



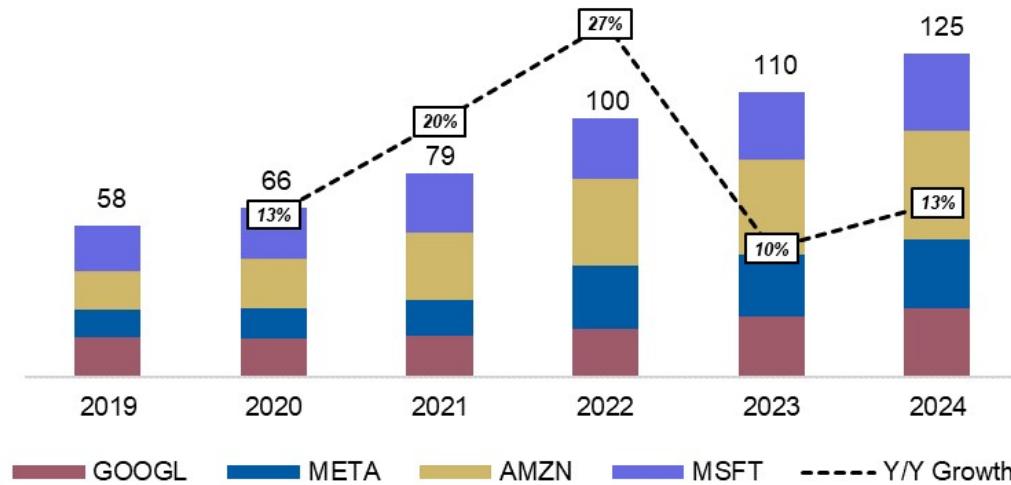
Source: [DeepMind: Training Compute-Optimal Large Language Models](#), Morgan Stanley Research

## And The Capex Requirements are Significant in This New AI Age

### Why Does AI/ML Lead to Increased Capex and Opex?

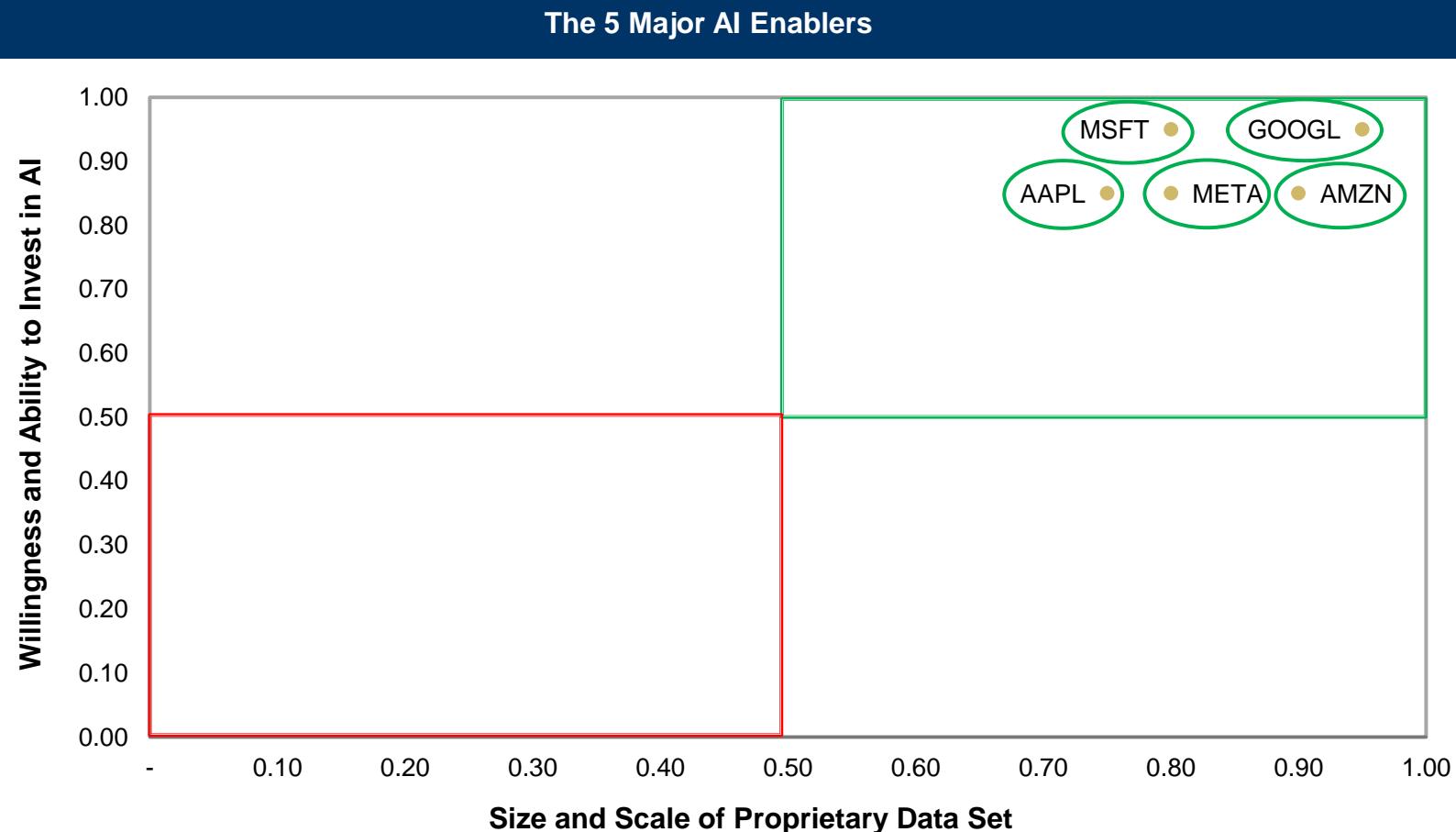
- AI requires incremental spend throughout the data center complex: more computer power, faster storage, faster networking, higher energy & bandwidth costs and (in some cases) additional data scientists.
- For data center owners – most notably, the public cloud vendors and META – this will come in the form of higher capex and then cost of revenue (D&A and energy costs).
- For companies that leverage public cloud vendors, incremental AI spend will result in higher cloud costs.

Est. Hyperscale Data Center Capex (\$Bn)



Source: Dell'Oro, Company data, Morgan Stanley Research

## As We See Beneficiaries As Those With the Most High Quality, Unique Data...and a Strong Ability and Willingness to Invest



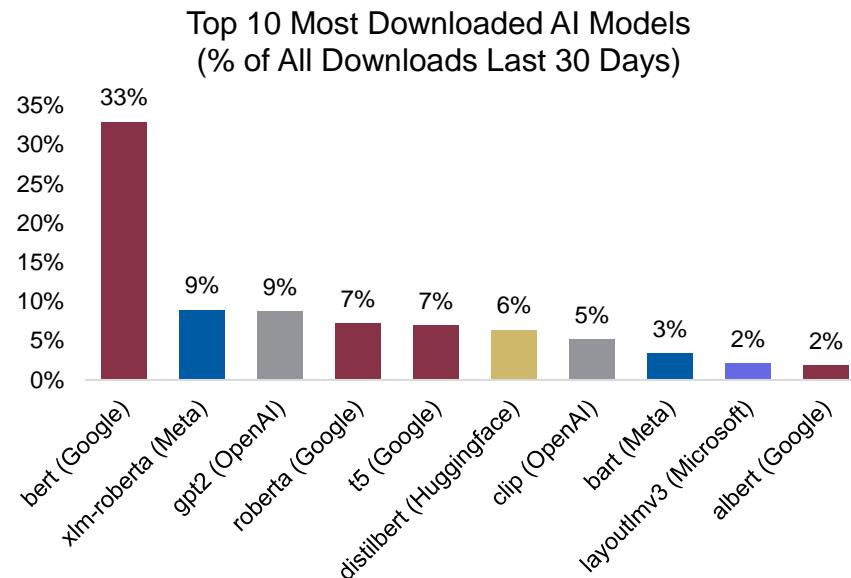
Source: Company data, Morgan Stanley Research

## The Developer Community is Likely to be Critical to Forward AI Product and Tool Development too...So Platform Scale Will Matter

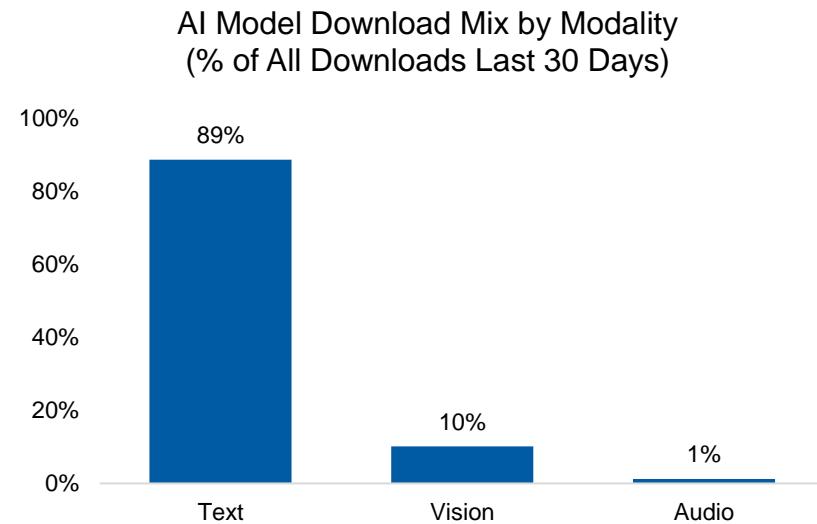
### Developer Community

- **The developer community is an important indicator for how the ecosystem will develop.** As a proxy for how foundational certain open-source models are, we look at the most downloaded models over the last 30 days
- The developer community here will be critical to innovation (and a potential battleground for platforms) and we're **already seeing developers build application using emerging AI tools and foundational models.**
- The two most common AI libraries are PyTorch and TensorFlow.

### 3 of the Top 5 Models Are From Google



### 89% of AI Models Downloaded Are Text Based



Source: Hugging Face, Morgan Stanley Research



## GOOGL: Well-Positioned Across The Entire AI Ecosystem

Data Center Capabilities	Models & Apps	End User Devices
Large scale to support AI demand	Large breadth and scale of AI models	Pixel + Custom Tensor Chip
In-house silicon (TPUs)	LLMs: LaMDA, PaLM, Sparrow, Gopher	Chromebook
Invested in richly configured servers for longer	Imagen & Imagen Video	Wearables
Public cloud offering	Deepmind and research efforts	Waymo

### Core Opportunities

- **Revenue** – Google has broadest set of capabilities and is accelerating its AI efforts, which we see leading to ~mid-teens% '25 rev upside
- **Search** – Every 1% pt. increase in search conversion would drive a 15% ROI and 6% upside to our '25 EBIT (even if cost per query is 2x)
- **YouTube** – Generative AI tools, improved algorithm matching, and ad attribution can lead to higher engagement and monetization
- **Cloud** – Next gen AI tools drive more durable multi-year public cloud (and GCP) adoption
- **Costs** – Incremental compute, networking, bandwidth, and energy costs...but AI can also drive efficiency for simple and complex tasks

### Risks & Uncertainties

- Go-to-market execution mis-steps as GOOGL turns research projects into commercial offerings
- Other new AI based software/platforms can become mainstream quickly, increasing disruption risk
- Business model fit: how will LLM Search monetization rates compare to traditional Search?
- Larger incremental infrastructure costs could be required

### Key Partnerships



Source: Company Data, Morgan Stanley Research



## AMZN: Leading Cloud Footprint Delivers Comprehensive AI/ML Offering and E-commerce Could Become More Efficient

Data Center Capabilities	Models & Apps	End User Devices
Largest Data Center Footprint	SageMaker Platform for Developers	Home: Echo, Ring
Purpose Built Trainium and Inferentia Chips	AI Services: Kendra, Code Whisperer, etc.	Halo (Wearable)
Data Gravity	Immediate Access to Scaled Customer Base	Zoox
Public Cloud Offering	Integration with Stability AI and Hugging Face	

### Core Opportunities

- **Frequency** – Improved personalization/recommendation engines drive increased frequency resulting in potential 12%+ Retail EBIT uplift
- **Category Expansion** – Generative AI makes shopping more interactive, expanding access to previously underpenetrated categories
- **Advertising** - AI enables higher conversions for advertisers with better optimization and targeting capabilities
- **Cloud** – Every 200bp penetration of the \$268bn in Global AI cloud spend could drive \$1.9bn of incremental EBIT
- **Costs** – Fulfillment/shipping cost per unit improvements can drive operating efficiency. Engineering productivity can improve too

### Risks & Uncertainties

- GOOGL (57% top of funnel product research traffic) collapsing e-comm search funnel and possibly requiring AMZN to spend more on ads
- AWS AI competition likely to increase vs MSFT and GCP
- Other new AI based software/platforms can come mainstream quickly, increasing risk of disruption

### Key Partnerships



Source: Company Data, Morgan Stanley Research



## MSFT: Focused on Exposing AI Across Its Broad Product Portfolio

### Data Center Capabilities

Public cloud offering (Azure)

X-Cloud

Massive Horizontal Application Scaling

### Models & Apps (not exhaustive)

New Bing / Prometheus & more leveraging OpenAI's LLM tech (GPT-3, Dall-E, Codex)

Office 365 Applications

GitHub Copilot

1P (Dynamics)/3P (Mattel) Applications

### End User Devices

1.4bn MAU Windows Devices

Surface Devices

Xbox

### Core Opportunities

- As OpenAI's preferred commercial partner Microsoft is increasingly wrapping AI functionality into its broad product portfolio.**
- Revenue** – While early days to size the revenue impacts, we expect growing AI offerings to be revenue accretive over time.
  - Main categories of revenue opportunities include premium SKUs, increased cloud workloads and advertising.
- Cloud** – Next gen-AI tools drive productivity gains and provide further support for secular tailwinds driving shift to the cloud.
- Costs** – Incremental compute power is a factor; however, marginal costs should decline over time driven by efficiency gains.

### Risks & Uncertainties

- Few companies have the resources to work with LLMs, creating a narrow but intense competitive field
- Many unknowns remain around capital intensity medium term, specifics of partnership with OpenAI
- LLMs can present factually incorrect information as credible which is limiting in B2B use cases

### Key Partnerships



Source: Company Data, Morgan Stanley Research



## NVDA: The AI/ML Arms Dealer

Data Center Capabilities	Models & Apps	End User Devices
A100 & H100 Product Cycles	NVIDIA NeMo	
DGX & HGX systems-level capabilities	NVIDIA CUDA-X library	
Switching and interconnect fabric	TensorRT for inference	
Specialized inference hardware	Pre-trained model catalog (NGC)	

### Core Opportunities

- **Revenue** – Maintains substantial market-share lead within commercial AI/ML training hardware with some of the strongest pricing power in semis
- **Scale** – Desire for larger models will increase reliability on cutting edge training and inference hardware
- **Systems and software** – NVDA's large hardware install base will enable a move up-market into the system and software layers
- **Install base** – Opportunity to better penetrate enterprise as AI/ML use grows for everyday businesses

### Risks & Uncertainties

- Customers like AWS and Google have built in-house custom solutions that could one day undermine the industry's reliance on Nvidia
- Software efficiencies could make existing hardware more efficient or compress models to lessen hardware requirements even as models grow
- Failure to push beyond volume GPU sales if systems and software initiatives fail to materialize

### Key Partnerships



Source: Company Data, Morgan Stanley Research



## META: Strongest at the Application Layer

Data Center Capabilities	Models & Apps	End User Devices
Large scale to support AI demand	AI Template inference framework	Meta Quest
Building capacity efficiently	PyTorch open-source machine learning	
(-) No Public Cloud	Generative AI: LLaMA, Make-a-Video	
(-) No Custom Silicon	Content recommendation engine	
Core Opportunities		
<ul style="list-style-type: none"> <li><b>Revenue</b> – Content recommendation and AI driven ad improvements (including auction mechanics) could lead to mid-single digit%+ '25 rev upside</li> <li><b>Improved Engagement:</b> AI can lead to improved creator tools...which combined with better matching leads to higher engagement</li> <li><b>Ad Tools</b> – AI enables higher conversions for advertisers with better targeting and optimization capabilities</li> <li><b>Costs</b> – Incremental compute, networking, bandwidth, and energy costs...but AI can also drive efficiency for simple and complex tasks</li> </ul>		
Risks & Uncertainties		Key Partnerships
<ul style="list-style-type: none"> <li>Other social media or content apps can become mainstream quickly, increasing risk of disruption</li> <li>Larger incremental infrastructure costs required</li> <li>Creator content is critical; a slow approach to Generative AI could cause shift to another platform's tools</li> <li>Regulation limits the ability to algorithmically recommend content</li> </ul>		

Source: Company Data, Morgan Stanley Research



## AAPL: The Key AI Enabler at the Edge

### Data Center Capabilities

Leverages AWS & GCP

Invests in High End Servers Internally

(-) No Public Cloud

### Models & Apps

Core ML (Vision, NLP, Speech, Sound)

Siri

App Store (Distribution)

### End User Devices

iPhone + A-Series Chips

Mac + M-Series Chips

iPad + A & M-Series Chips

Wearables

### Core Opportunities

- Revenue** – AAPL enables the proliferation of AI-apps at the edge driving greater differentiation vs. peers and accelerates share gains
- Privacy** – [Differential Privacy](#) proves to be a viable framework for running AI models on AAPL devices without data leaving the device
- Platform Utility** – New AI applications optimized for Apple Silicon enhance performance and enable new use cases
- Costs** – Increases in compute requirements could drive silicon costs higher

### Risks & Uncertainties

- It's unclear if and how quickly developers will move to optimize AI applications for the edge and Apple Devices specifically
- Certain AI apps may be too large and compute intensive to move to end user devices, such as LLMs
- Uncertain if Apple can drive share gains from AI (dependent on consumer willingness to adopt AI tools)

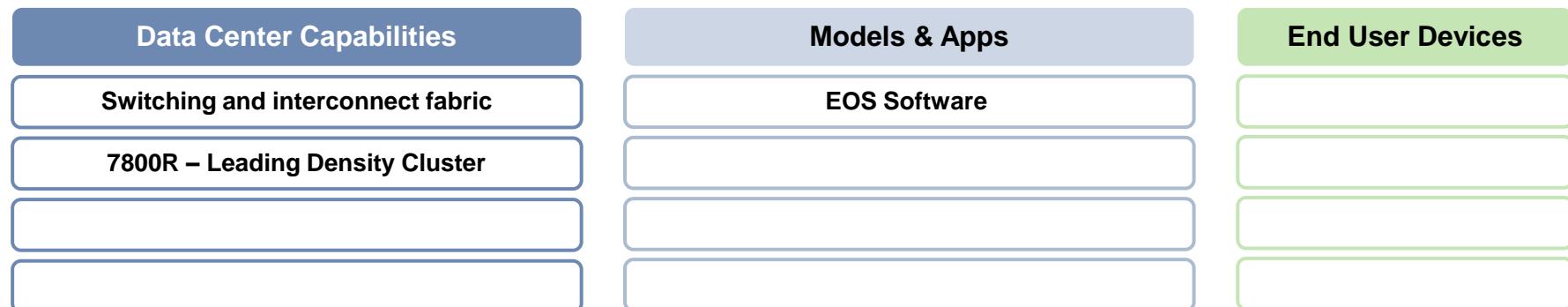
### Key Partnerships

NA

Source: Company Data, Morgan Stanley Research

## Who Are the Other AI Enablers?

## ARISTA ANET: Removing Networking Bottlenecks



### Core Opportunities

- **Revenue** – Strongest networking partner for META and MSFT Data centers (25.5% and 16% of revenue in 2022)
- **Scale** – 7800R allows for 460 Tb/s throughput, collision and congestion free architecture
- **Systems and software** – EOS – Modern state-oriented architecture
- **Install base** – Already large installed base and development partnership with Cloud Titan customers

### Risks & Uncertainties

- Multiple ways to address latency issues from networking bottlenecks (Infiniband, more switches, higher speed switches)
- Nvidia trying to make more of a push into both Ethernet and existing Infiniband portfolio
- Not currently in Amazon or Google (at scale)

### Key Partnerships



Source: Company Data, Morgan Stanley Research



## Baidu: Full Stack AI Capabilities

Data Center Capabilities	Models & Apps	End User Devices
Personal Cloud	Digital Human	Xiaodu Smart System
Industry Specific Public Cloud Offerings	LLMs	Ernie Bot
In-house KunLun Chip 3.0	Apollo Autonomous Driving System	Apollo/Robotaxi/JiDU
Open-source deep learning platform (Paddle paddle)	Big data analysis and simulation	Smart Transportation

### Core Opportunities

- **Cloud Revenue** – Resilient cloud demand seen in traditional industries (transportation, utilities), driving a 26% 3-year revenue CAGR
- **Ernie Bot** – To embed in Baidu Search in March, which we expect to capture additional user traffic and enhance search experiences
- **OEM partnerships** – Rmb\$11bn+ est. partnership revenue with BYD, GAC, DongFeng Motor etc in 2024 and after
- **Robotaxi** – Expect RT6 to mass roll out in 2025 with significantly much lower per vehicle cost
- **JiDu** – JV with Geely's first smart EV car model (ROBO-01) will be mass produced in 2H23

### Risks & Uncertainties

- China regulatory risk in content filtering and approval for AI generated contents
- AI chip ban impact and potential incremental cost impact
- Will ChatGPT style product disrupt traditional search?
- Execution risk on robotaxi/full autonomous driving application

### Key Partnerships



Source: Company Data, Morgan Stanley Research



## BABA: Cloud-native Data Solutions – Integrated Big Data + AI

Data Center Capabilities	Models & Apps	End User Devices
Large scale to support AI demand	Data Computing (MaxCompute, Hologres...)	Intelligent Customer Service
Global data centers infrastructure	Data Management (DataWorks, Dataphin...)	City Brain, AI Earth
Public cloud offering (AliCloud)	Machine Learning Platform (PAI-EAS, PAI-DSW)	Industry Solutions (Finance, Education, Transportation, New Retail, etc.)
AI Chips (Xuantie-910, Hanguang 800)	Open Services (Visual, Voice, NLP, etc.)	

### Core Opportunities

- **Revenue** – Integration of the capability into the business of consumption, user experience for content generation to drive advertising effectiveness, leverage AI technology to make content customizable to users, as well as improving pricing mechanism
- **Cloud** – Provision of computing power for various generative AI models and its applications; chatbot integration with DingTalk
- **Costs** – Incremental compute, networking, bandwidth, and energy costs

### Risks & Uncertainties

- Regulatory concerns around offering direct or third-party ChatGPT services on platforms
- Execution risks in specific industry verticals, such as biometric authentication/facial recognition in fintech
- Competition risks from other AI platforms, leading to disruptions in the industry
- Incremental infrastructure costs could be required

### Key Partnerships



Source: Company Data, Morgan Stanley Research



## Tencent: Long-term Revenue Expansion Driver

### Data Center Capabilities

Collaborative software offerings

CRM management

One-stop computing, storage mgmt platform

Direct linkage to Wechat commerce ecosystem

### Models & Apps

Cloud virtual machine (CVM)

Content Delivery Network (CDN) acceleration

Cloud database and big data analysis

Tencent Cloud lighthouse for SMEs + developers

### End User Devices

Wechat

Tencent Meeting/  
Cloud/Doc/Wecom

### Core Opportunities

- Cloud Revenue** – Recovery in cloud demand and IT budget with macro recovery, driving a 20% 3-year revenue CAGR
- Increasing SaaS demand** – Rapid growth in SaaS adoption in China
- Wide range of vertical solutions** – Integration of Tencent Meeting and Docs empowers Wecom as a one stop core 2B platform to enhance merchants' efficiency
- Advanced technologies** in AI, cloud, real time communications and security, with experiences in operating large-scale internet services

### Risks & Uncertainties

- China regulatory risk in AI generated contents
- Intense competition between key competitors (Bytedance, BABA, Kingsoft Cloud, Microsoft)
- Execution risks in market share expansion, with Tencent Cloud still being in the early development stage and will need 2-3 years to breakeven, in our view.

### Key Partnerships



Source: Company Data, Morgan Stanley Research

## Certain Private Companies Also Set To Play An Important Role



**OpenAI**

- **Foundational General-Purpose AI Models**

- Models-as-a-Service (MaaS) and end-to-end applications (i.e. ChatGPT)
- Background: Founded in 2015 by Sam Altman and Elon Musk. Raised \$11bn to-date with a post-money valuation of \$29bn. Partnered with MSFT



- **Automated Data Labeling and Platform Tools**

- Annotation APIs, AI/ML dev. tools, platform for LLM models (Spellbook)
- Background: Founded in 2016 by Alexandr Wang and Lucy Guo. Raised \$603mn to-date with a post-money valuation of \$7.3bn

**ANTHROPIC**

- **General-Purpose AI Models**

- Potential OpenAI competitor in MaaS and end-to-end applications (i.e. Claude)
- Background: Founded in 2021 by former OpenAI employees. Raised \$1bn to-date with post-money valuation of \$3bn. Partnered with GOOGL



- **Open-Source Foundational AI Models**

- Open-source models (i.e. Stable Diffusion). Expanding into language, audio, video, and 3D models.
- Background: Founded in 2020 by Emad Mostaque. Raised \$99mn to date with post-money valuation of \$1bn. Close partnership with AWS



- **The ‘Github’ of AI Models**

- Platform that aggregates open-source AI models: language, computer vision, multimodal, and audio
- Background: Founded in 2016 by Clem Delangue. Raised \$160mn to-date with post-money valuation of \$2bn. Deep partnership with AWS

Source: AlphaSense, Company data, Morgan Stanley Research

## What Are The Costs of Building The AI Age?

## AI Cost Considerations: Training More Compute Intensive than Inference

### Training vs. Inference

#### Training:

- GPUs and other forms of custom silicon are the preeminent solutions for running large-scale AI training given the high degree to which these chips can process data in parallel vs a typical CPU which specializes in serial processing. **GPUs carry a significant ASP increase compared to general server processing hardware and tend to consume more energy.**
- Models the size of GPT-3/4/5 generally require tens of thousands of GPUs, or other custom silicon with a similar architecture to train, with the training period ranging from weeks to months. Once the model is trained, the training hardware can be used to run inference workloads on that same model or be re-used to train other models. **Training represents the vast majority of AI costs.**

#### Inference:

- We have historically seen a wide variety of hardware solutions used, from CPUs to low and high end GPUs, so **costs are not as clear and are highly dependent on the size of the model and scale of deployment.** Inference requires less compute than training, but is required on a constant basis as long as the model is deployed. Given the wide range of scenarios, we have found it difficult to coalesce around a simple framework for forecasting inference costs, and believe the industry is focused on bringing costs down.

### Cloud Vendors vs. Cloud Customers

- **Cloud Vendors:** The largest cost uplift is data center equipment. Within that, AI will drive server, storage, and networking costs higher. The biggest component is servers. From an accounting perspective, this results in higher capex which flows through the Income Statement as D&A expense. Operationally, AI could also cause energy and bandwidth costs to increase, which tend to fall into Cost of Revenue.
- **Cloud Customers:** Adoption of Cloud-based AI tools/applications/models should drive incremental Cloud spend. Typically, companies recognize cloud spend in Cost of Revenue. The degree of model fine-tuning could cause AI costs to increase. For example, both the training and inference costs associated with fine-tuned LLMs from OpenAI are higher than the base price.

Open AI LLMs:	Price per Thousand Tokens		
	Base Model Cost:	Fine Tuning Costs: Training*	Usage
Davinci	\$0.0200	\$0.0300	\$0.1200
Curie	\$0.0020	\$0.0030	\$0.0120
Babbage	\$0.0005	\$0.0006	\$0.0024
Ada	\$0.0004	\$0.0004	\$0.0016

Note: 1,000 Tokens = 750 Words

Source: OpenAI, Morgan Stanley Research. \*Note: Reflects fine-tuning on pre-trained models, where OpenAI already incurred the training costs for the base model.

## For Example, We See Embedding AI into End-to-End Applications Such as Search Leading to Substantially Higher Costs per Query

### Google Search Cost per Large Language Model (LLM) Query (\$mns)

- We estimate that Google's incremental AI Search costs could reach \$6bn in 2025... assuming 50% LLM adoption within Search responses.**

Incremental LLM Costs Based On 3.4Trn SERPs (2024e)						
LLM % Adoption within Search Responses	Words Generated per Google Search LLM Query					Avg.
	25	50	75	100		
	10.0%	\$602	\$1,205	\$1,807	\$2,410	\$1,506
	20.0%	\$1,205	\$2,410	\$3,615	\$4,820	\$3,012
	30.0%	\$1,807	\$3,615	\$5,422	\$7,230	\$4,519
	40.0%	\$2,410	\$4,820	\$7,230	\$9,640	\$6,025
	50.0%	\$3,012	\$6,025	\$9,037	\$12,049	\$7,531

Note: Assumes Google Achieves a 20% Efficiency Gain Over Azure's Lowest Cost Tier Today

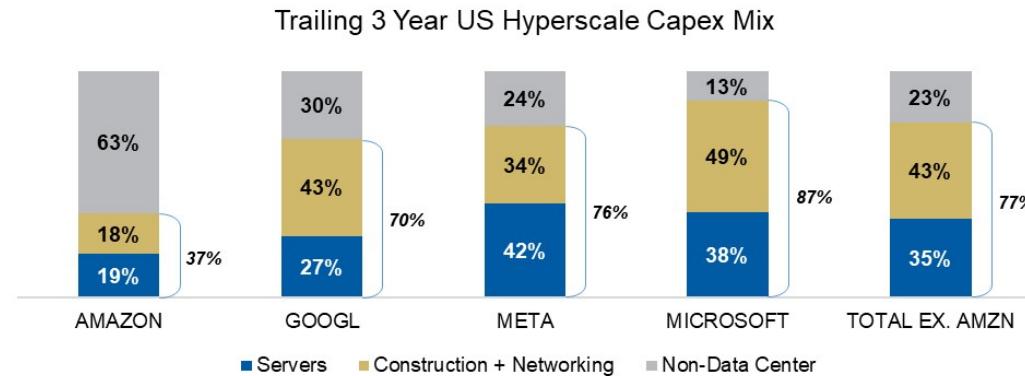
Note: Assumes Google Pays Ratably for TPUs/GPUs Similar to OpenAI\*

and at the cost of Azure's lowest priced tier

Source: Company Data, Morgan Stanley Research: [Alphabet Inc.: How Large are the Incremental AI Costs...and 4 Factors to Watch Next \(9 Feb 2023\)](#).

## How Are Data Center AI Costs Broken Down...and the GPU Pricing Uplift

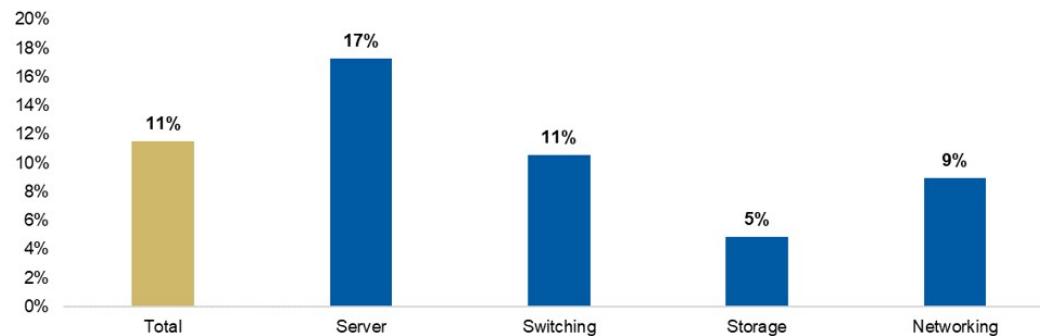
### Data Center Spend Represents ~75% of Hypescale Capex



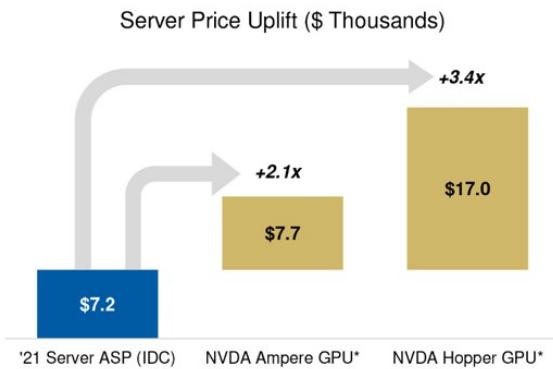
Most of The Data Center Growth Will Come From Servers...

... With GPUs 2-3x More Expensive

'21-'26 Data Center CAGR



Server Price Uplift (\$ Thousands)



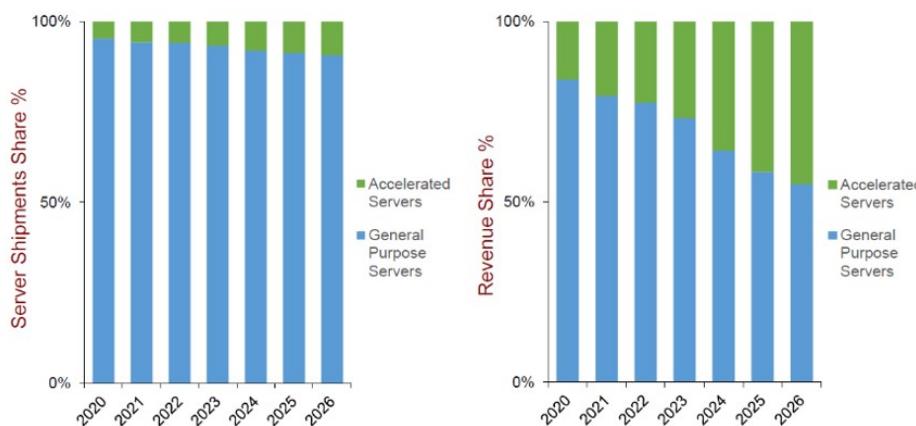
Source: Company Data, Dell'Oro, IDC, Morgan Stanley Research. Note: NVDA GPU pricing assumes a 15% discount to list price for the hyperscalers.

## And GPU/Accelerator Attach Rates Are The Largest Cost Driver Going Forward...

### GPU Spend and Attach Rates Are Scaling

- Accelerated nodes (GPUs, TPUs, Trainium, etc.) will be the largest drivers of AI data center spend.
- An increase in accelerated node attach rates drives server spend higher.** Today, we believe hyperscale accelerator attach rates are between 5-10% of new server units. We expect the attach rate to increase from here. **20%** attach at a ~\$5k ASP would represent 4-9% of hyperscalers' 2022 total capex.

### Accelerated Server Adoption, Cloud



### Hyperscale Accelerator Capex Analysis

#### Accelerator Units (Thousands)

Attach Rate:	5%	10%	15%	20%
AMZN	104	208	312	416
GOOGL	43	86	129	173
META	98	196	294	392
MSFT	55	110	165	220

#### Accelerator Capex (\$mns)

Attach Rate:	5%	10%	15%	20%
AMZN	795	1,591	2,386	3,181
GOOGL	330	660	991	1,321
META	751	1,501	2,252	3,002
MSFT	421	842	1,263	1,685

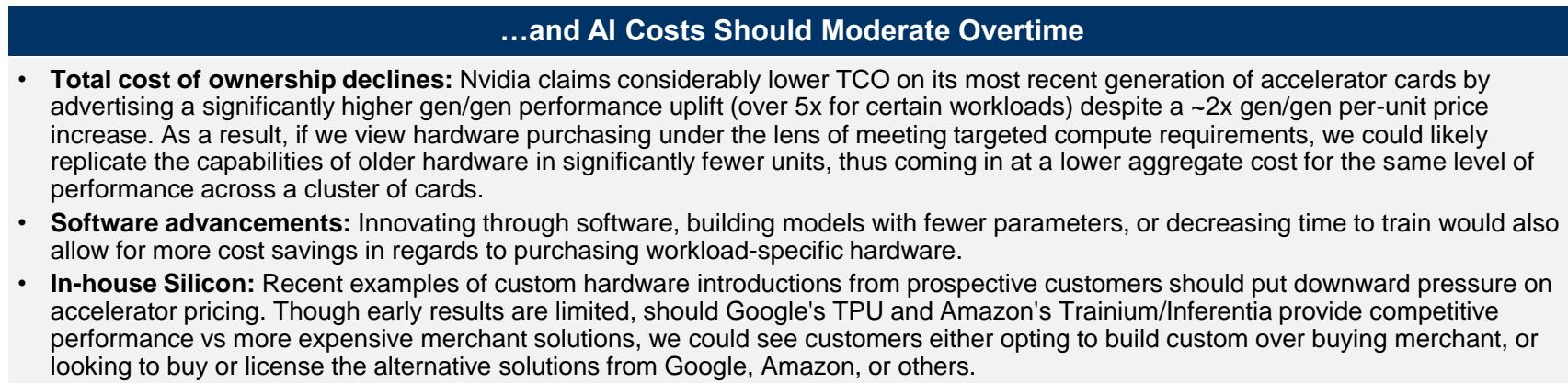
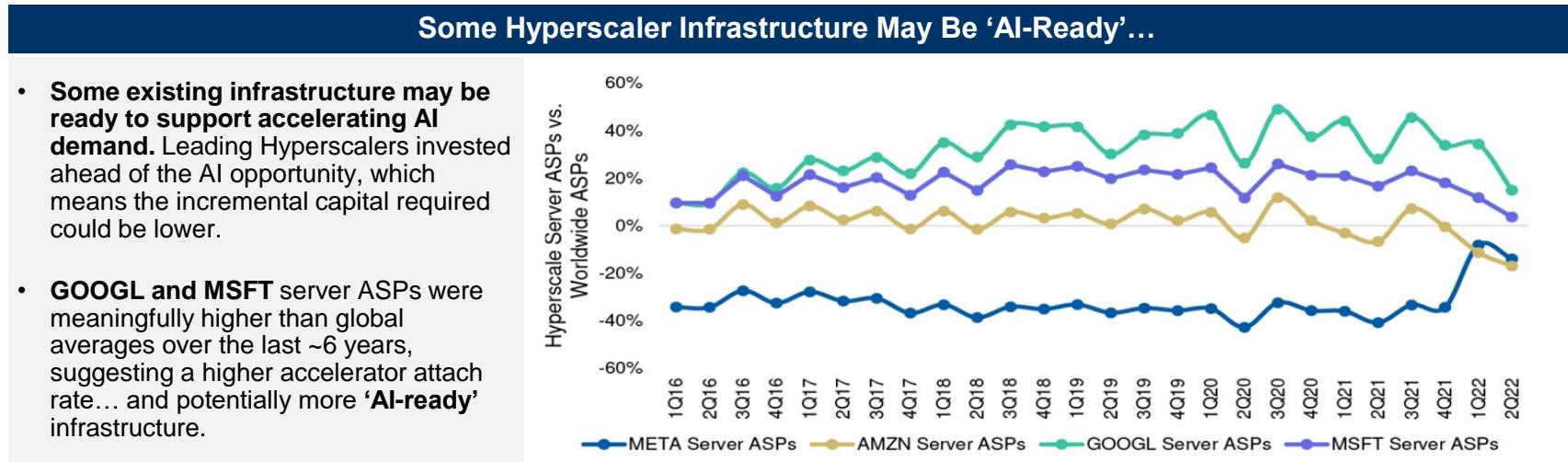
Assumes \$5k Average Accelerator Price

#### % of 2022 Capex

Attach Rate:	5%	10%	15%	20%
AMZN	1.3%	2.5%	3.8%	5.1%
GOOGL	1.1%	2.1%	3.2%	4.2%
META	2.3%	4.6%	6.9%	9.2%
MSFT	1.7%	3.4%	5.0%	6.7%

Source: Company Data, Dell'Oro, Morgan Stanley Research.

## ...But There Are Other Important Dynamics to Consider

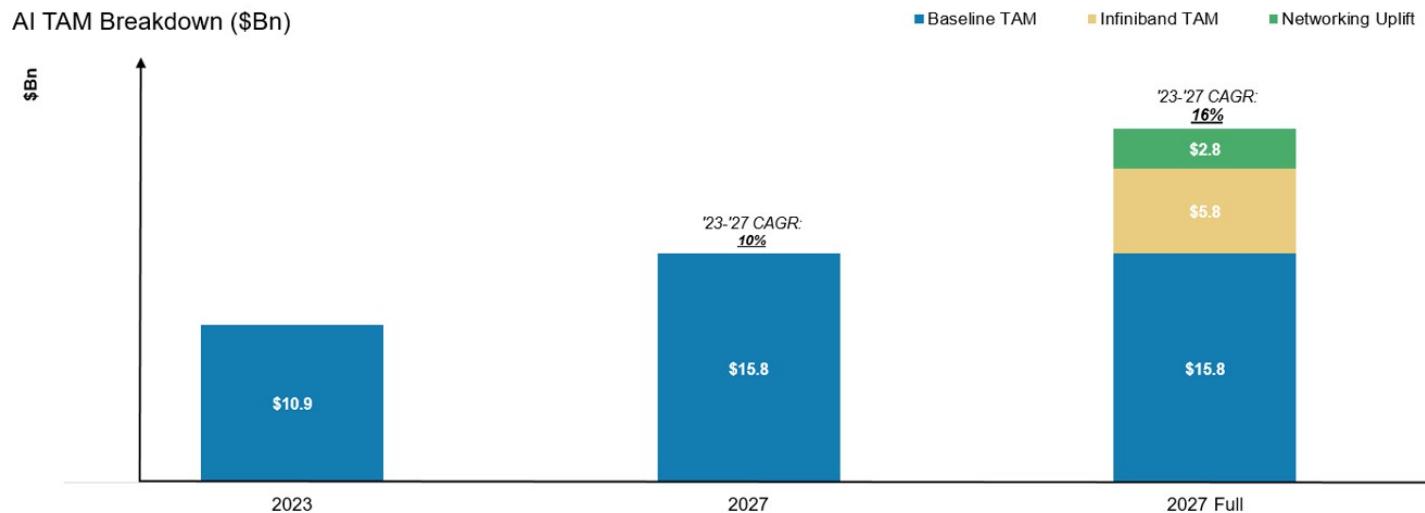


Source: Dell'Oro, Morgan Stanley Research

## How Large is the AI Networking TAM?

### We Size a ~\$24bn Total AI Cloud Networking Opportunity Across 3 Primary Verticals:

- **Baseline TAM** estimates total cloud Ethernet switching spend, growing from ~\$11bn today at a 10% CAGR to ~\$15.8bn by 2027 (CAGR greater than Ethernet market as a whole)
- **AI Uplift** estimates increased networking spend from estimated tax on network from GPU servers, creating incremental ~\$2.8bn opportunity by 2027 on assumption of ~100% networking uplift per GPU
- **InfiniBand** estimates the market that could be addressed by Ethernet switching, which we estimate grows at a ~40% CAGR from 2023-2027, creating ~\$5.8bn opportunity by 2027
- *Networking historically represented a high-single digit % of data center spend*



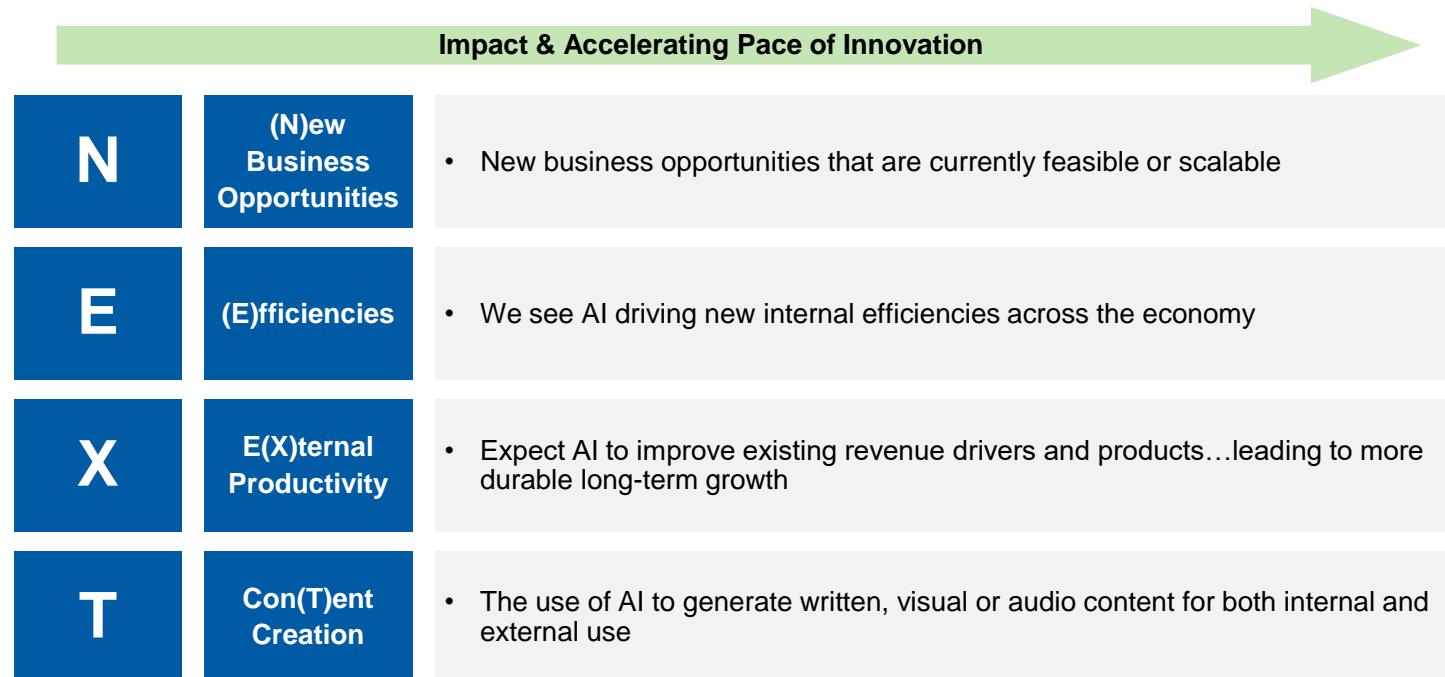
Source: Dell'Oro, Morgan Stanley Research

## **What's NEXT and How Will AI Impact the Economy?**

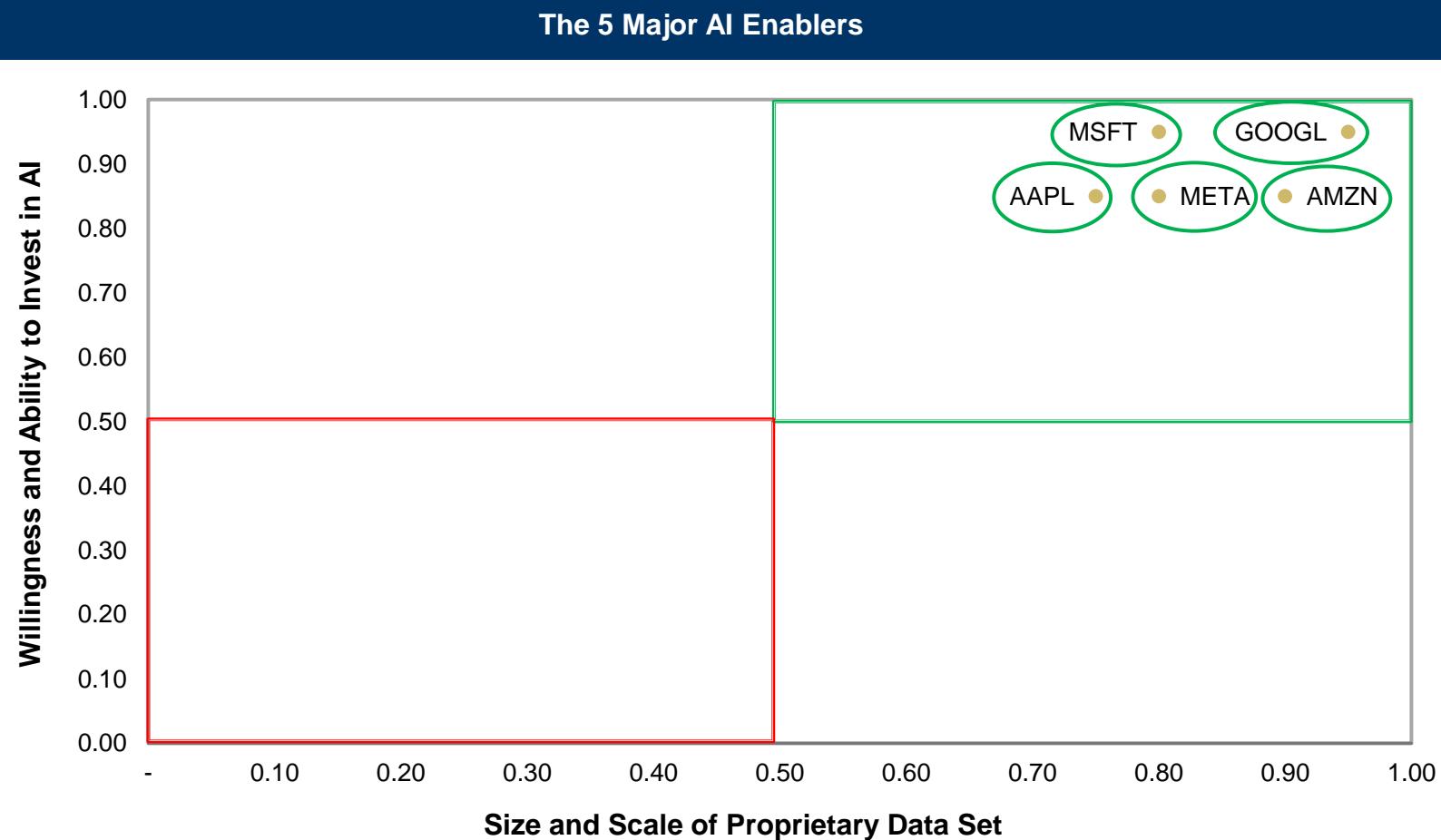
## We Introduce our NEXT Framework Laying Our 4 Areas AI Could Impact Companies Across the Economy

### We See 4 Areas of AI Innovation Set to Impact the Economy

- Our **NEXT framework analyzes the ability for AI to drive incremental (N)ew Business Opportunities, (E)fficiencies, E(X)ternal Productivity and Con(T)ent Creation across the economy**
- **We analyze potential opportunities in the next 3 years and those beyond 3 years**



## But We Also Think Companies with the Most High-Quality Data...and an Ability/Willingness to Invest Are Better Positioned



Source: Company data, Morgan Stanley Research

## As We See AI Driving Change Across All Industries... From Retail to Healthcare to Freight

Healthcare	Financials	Advertising & Digital Content	Retail & Freight	Energy & Industrials	Customer Service	Business Intelligence
Smart Implants (Ex: Hip & Knee)	AI Thematic Fund Offerings	Marketing Efficiency	3D Shopping & Product Try On	AI Tools for Pipelines	Customer Analytics	Developer Tools & Assisted Code
Medical Imaging	New Trade Pricing Tools	Enhanced Ad Targeting	Sidewalk Robots for Deliveries	Geological Models	Insurance Claims and Records	AI-Related Consulting
Pathology Detection	Generate Client Portfolio Reviews	Recommendation Engine	Supply Chain Efficiency	AI-Enabled Microgrid Tools	Transcribe and Summarize	Integrated Smart Home Interface
Personalized Medicine	Automated Trade Prices, Execution	Higher Ad Conversion	Inventory Management	Energy Usage Analytics	Client Onboarding	Automate Back Office Tasks
Identify Biomarkers	AI Portfolio Management	Ad Auction Dynamics	Demand Prediction	Energy Trading Enhancements		Fraud Prevention and Protection
New Drug Development	Increase Trading Velocity	Content Creation	Truck Routing Capabilities	Labor Scheduling		Cybersecurity Capabilities
Analysis of Genomic Data		Customized Travel Itineraries	Higher Fleet Utilization	Reservoir Optimization		Risk Assessment & Management
Physician Point of Service Tools		Video Game Development	Autonomous Fleet Networks	Leak Detection & Track Emissions		Accelerated Data Analysis
						Predictive Modeling

Source: Company Data, Morgan Stanley Research

## Key Unresolved Debates

## We Highlight 8 Unresolved Debates to Watch From Here

1

### What are the long term industry specific implications?

- It's not difficult to imagine industry specific AI models trained in law, finance, and healthcare.
- Through a partnership with Bain, OpenAI is bringing its technology to financial services, CPG, healthcare, and other industries.
- **Will the AI arms race be a zero-sum game due to network effects?**
- The potential emergence of industry specific AI models (either from emerging companies or incumbents) could pose a threat to industry leaders that are slow to adapt.

2

### How will the AI ecosystem evolve and what differentiates AI models?

- We believe that the companies with the **most proprietary data sets** will be best positioned.
- **Will the capital requirements to train models create a barrier to entry?**
- Models-as-a-Service (MaaS) companies will emerge to provide foundational models that business build on top of, which will reduce the upfront cost for new application development. On the other hand, industries that require a high level of accuracy may require more capable models than the foundational ones.

3

### Will new business models emerge such as data licensing?

- Potential for content creation companies to license their data to MaaS platforms to help train models (SSTK is a strong early example of this).
- As the shopping and search funnel compresses, **will these companies look to license access to their news reports, customer reviews, and digital content to offset lower traffic and advertising revenue?**

4

### How will regulatory changes impact the AI ecosystem and pace of innovation?

- AI regulations could re-shape the ecosystem and potentially slow the pace of innovation and adoption.
- **New regulation takes a long time though, and it's too early to talk about** how regulation could hinder the ecosystem and pace of development.

Source: Company Data, Morgan Stanley Research

## We Highlight 8 Unresolved Debates to Watch From Here

5

### Open source vs. proprietary offerings?

- It's unclear whether the most utilized/popular models will come from the open-source community or licensed cloud-based software companies. Stability AI has taken an open-source approach while new license models are emerging from OpenAI.
- **What approach will GOOGL, META, and others take with their new potential AI/ML offerings: LaMDA, PaLM, Imagen, Make-a-Video, etc.?**

6

### Where will these AI workloads run: In the Cloud or at the Edge?

- The majority of AI training today is done in the cloud, given relatively unlimited access to compute resources and flexibility. **Overtime though, there are strong developer incentives to push these applications to the edge post training.**
- Apple recently optimized its operating systems to run Stable Diffusion on the device, instead of running these workloads in the cloud...which begs the question if and how fast developers will optimize their AI apps for the edge.

7

### What about Artificial General Intelligence?

- If and when AGI is created, it would have far reaching implications.
- On the **positive side** it could increase abundance, accelerate economic growth, and lead to the discovery of new scientific knowledge that reshape our views on the limits of possibility.
- On the **negative side** there's serious risk of misuse, accidents, and societal disruption – particularly in the hands of bad actors. Companies may decide to slow the pace of AI advancements in order for governments, society, and humankind to adapt.

8

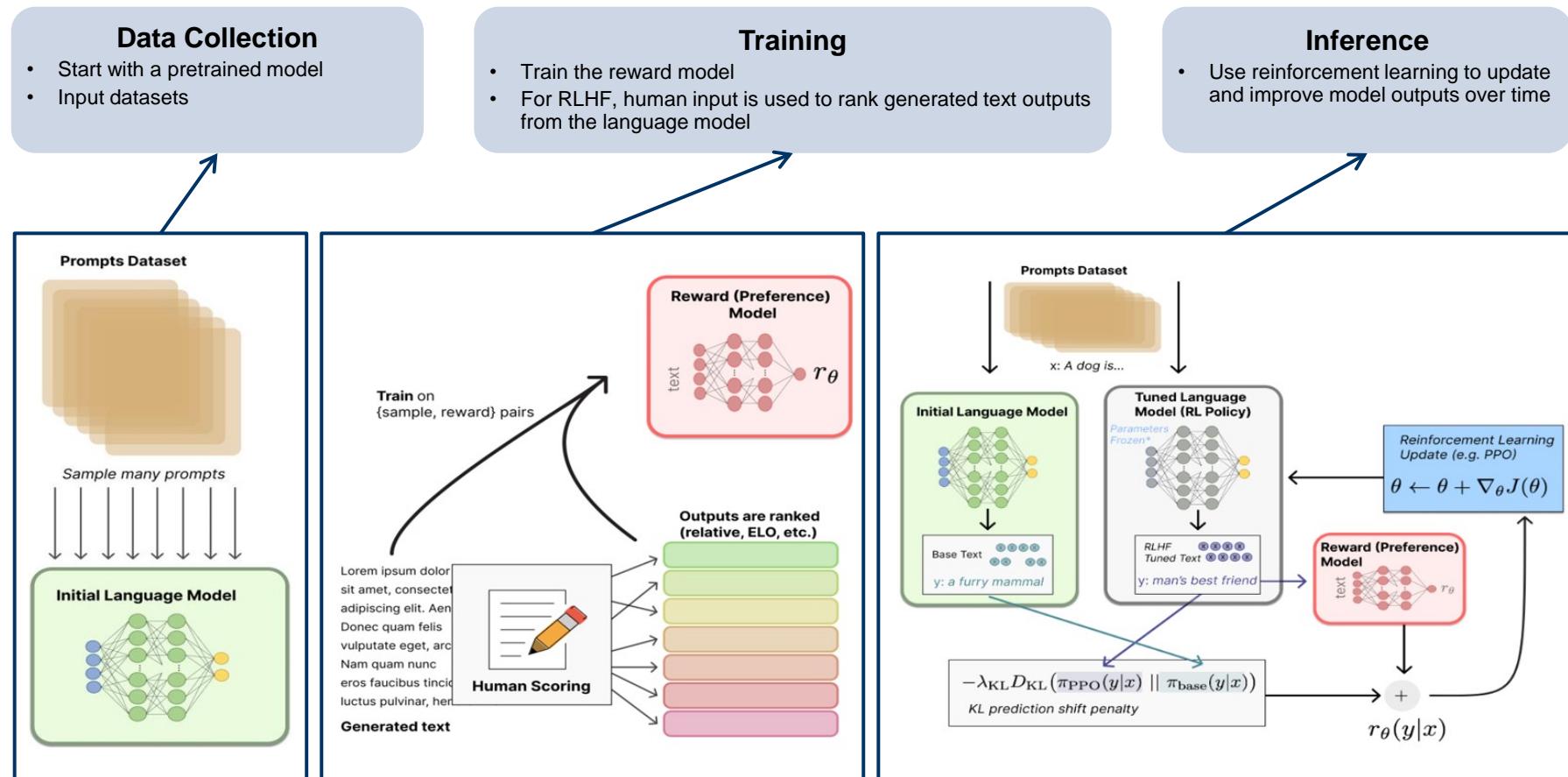
### How does this impact long term demand for AI silicon and infrastructure?

- The fixed and variable costs associated with these new AI models is large.
- What is the **long-term demand for AI silicon** (GPUs, TPUs, ASICs, memory, etc.) and infrastructure (networking, storage, liquid cooling) as these cloud and hardware providers embed more AI capabilities into their current offerings?'

Source: Company Data, Morgan Stanley Research, [Planning for AGI and beyond \(February 24, 2023\)](#)

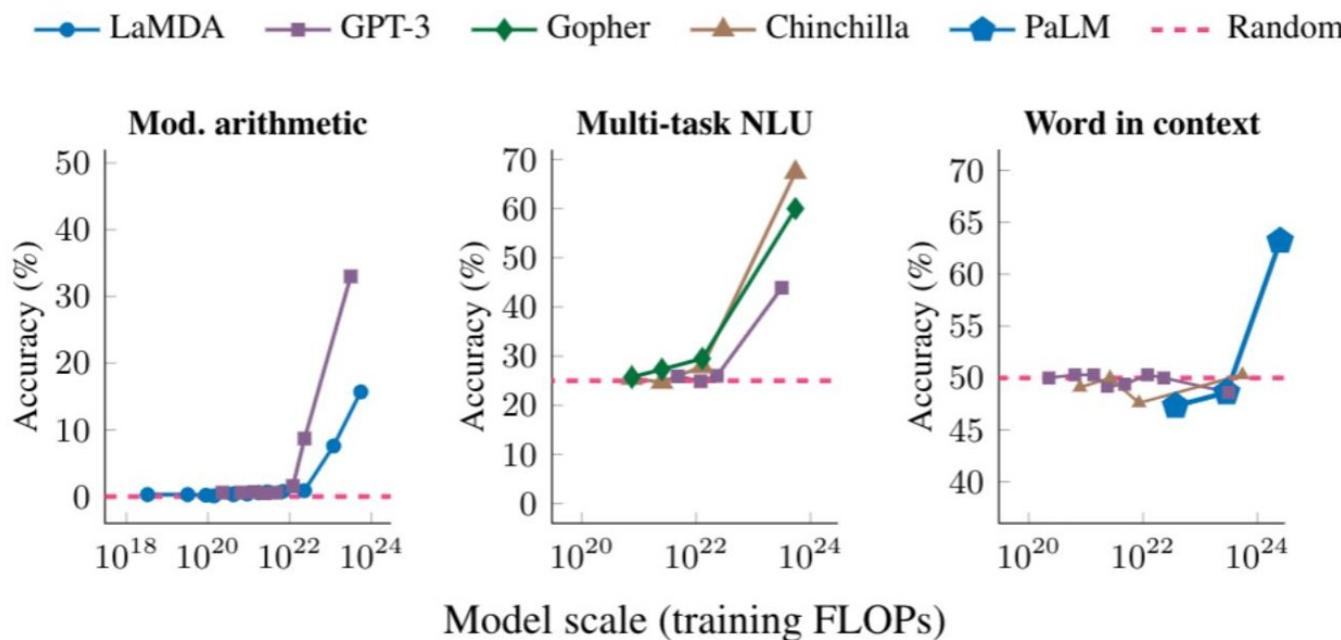
## Appendix and AI Taxonomy/Terms

## How is ChatGPT Going Through Data Collection, Training and Inference?



Source: [Hugging Face: Illustrating Reinforcement Learning from Human Feedback \(RLHF\)](#), Morgan Stanley Research

## Expect AI Models to Continue to Grow as Model Accuracy Tends to Improve as The Model Scale Increases



*"The ability to perform multi-step arithmetic (**left**), succeed on college-level exams (**middle**), and identify the intended meaning of a word in context (**right**) all emerge only for models of sufficiently large scale. The models shown include [LaMDA](#), [GPT-3](#), [Gopher](#), [Chinchilla](#), and [PaLM](#)."*

Source: Google ([Google Research, 2022 & beyond: Language, vision and generative models](#)), Morgan Stanley Research

## AI Taxonomy: The Basics (1)

---

**Artificial Intelligence (AI):** Artificial Intelligence is a broad field that involves creating machines that can perform tasks that typically require human intelligence, such as understanding, perception, reasoning, learning, and decision-making. **The three primary components of AI are 1) models, 2) data, and 3) compute.** Models are the algorithms that take an input and create an output. The models are trained using large amounts of data. The quantity and quality of the data leads to more useful outputs. Lastly, there needs to be enough computing power to train and run the algorithms.

**Machine Learning (ML):** Machine Learning is a subset of AI. It involves training algorithms to make predictions based on data. In ML, algorithms can learn from the data without being explicitly programmed to perform a certain task. Common ML models include:

1. **Supervised Learning Models** learn from labeled training data to make predictions about new data.
2. **Unsupervised Learning Models** learn from unlabeled data to discover patterns and relationships in the data.
3. **Reinforcement Learning Models** learn from interactions with an environment or user to maximize a reward signal.

**Deep Learning (DL):** Deep Learning is a subset of Machine Learning that involves training neural networks that mimic the structures of human brains. Neural networks typically have multiple layers and can be trained to perform specific tasks such as image or speech recognition. Examples of Deep Learning models include CNNs, RNNs, GANs, and Transformers.

## AI Taxonomy: The Basics (2)

---

**Natural Language Processing (NLP):** NLP is a field of AI and computational linguistics that focuses on enabling machines to understand and generate human language. Use cases include language translation, sentiment analysis, text summarization, question-answering, and speech recognition. Involves several steps, including text processing (i.e. tokenization), feature extraction, and machine learning modeling (i.e. classification, clustering, regression). New techniques and models are being applied to NL systems to address new challenges and improve accuracy and efficiency.

**Training:** Training is the process of inputting data into specific AI model architectures with the goal of recognizing patterns and/or producing a desired output. The training process is highly iterative. It also requires massively parallel computing, fulfilled by Nvidia GPUs.

**Inference:** Inference is the process of deploying the model in real time and occurs after the training process is complete. For certain models, the training process is continuous and after the model reaches certain performance thresholds (i.e. accuracy), a new live inference version is deployed in real time.

**Parameters:** Each AI model has a certain number of parameters, which represent the values that are learned during the training process. The parameters influence the behavior of the model. They are the weights and biases that are used to compute the output of the model for a given input. During training, the model adjusts its parameters to minimize a loss function – the difference between the predicted output and true output. The **optimization** process involves iteratively adjusting the parameters to improve the predictions and reduce the loss function. The number of parameters varies drastically depending on complexity of the model. For example, an advanced neural network may have millions or billions of parameters, while a simple linear regression may only have a few.

## AI Taxonomy: Deep Learning (1)

---

**Convolutional Neural Networks (CNNs):** CNNs are a type of deep learning neural network introduced in the 1990s, but weren't practical at the time due to their computing power requirements, that are designed to process and analyze data that has a grid-like structure, such as images and videos. CNNs can learn and identify features from input data. They are similar in structure to the brain's visual cortex.

**Recurrent Neural Networks (RNNs):** A type of deep learning neural network designed to process and analyze data sequentially, such as time series, speech, and natural language. Each input in a sequence is processed one at a time and the network maintains an internal state that captures information about the previous inputs.. However, RNNs struggle with long-term dependencies. This led to the development of variant RNNs such as **Long Short-Term Memory (LSTM)** and **Gated Recurrent Units (GRUs)**. LSTM and GRUs help address errors and improve RNNs.

**General Adversarial Networks (GANs):** A deep learning model that is used to generate new images or videos that are similar to a given set of input data. They typically consist of two neural networks that work together to create new data that is similar from the original. GAN's pre-date transformers. One of their primary benefits was the ability to explore latent space easily and quickly. **Latent space** represents a combination of pixels that when combined, represent a part of the image or video (i.e. hair, hands, tree, etc.).

## AI Taxonomy: Deep Learning (2)

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**Transformers:** Transformers are a type of deep learning model that was introduced by Google in 2017, and can transform a sequence of inputs into a different sequence of outputs using a complex series of rules. Unlike RNNs and CNNs which process inputs sequentially, transformers process all the input data at once using a technique called self-attention. There were two fundamental breakthroughs that led to Transformers: **1) Positional Encoding** which assigns every word in an input a number; **2) Multi-Headed Attention** which allows the model look ahead or back at the input sequence (attention) and at different parts of the input sequence (multi-headed) to figure out what the most relevant output is. The Transformer made machine translation possible, but also made it possible for these model to understand context. Transformers have several advantages over CNNs and RNNs: 1) they can handle longer sequences of input data, 2) can learn more effectively, 3) can understand context and reasoning, and 4) can adapt quickly. They have become the state-of-the-art model for many natural language tasks.

## AI Taxonomy: Deep Learning Models (1)

---

**Generative AI Models:** A type of AI model designed to generate new, synthetic data based on patterns learned from existing data. Outputs can be produced in multiple types of mediums: text, image, videos, and audio. Use cases include creating new artwork, generating new music, videos, and text. They can also be used in scientific research such as generating new drug molecules and simulating physical systems. Generative AI models can use or combine multiple types of different models, such as LLMs, diffusion models, computer vision, and multi-modal models. Transformers are increasingly used for Generative AI.

**Large Language Models (LLMs):** Are a type of NLP that uses deep learning techniques to process and analyze human language at scale. These models are trained on massive amounts of text data, such as books, articles, web pages, code, and can generate coherent and fluent responses. One of the primary features of LLMs is their ability to learn and generate language with very little human supervision, achieved through 'unsupervised learning' where the model is trained to predict the next word in a sentence or paragraph given the preceding context. LLMs most commonly use Transformer models.

**Diffusion models:** A type of generative model that is based on the idea of iteratively diffusing noise through a set of transformations to generate realistic samples. These models historically used GANs but are increasingly combined with Transformers to increase the latent space. For example, OpenAI's GPT LLM can be combined with a diffusion model to generate high-quality images from text descriptions (i.e. DALL-E). Diffusion models tend to use GAN and Transformer models.

## AI Taxonomy: Deep Learning Models (2)

---

**Computer Vision Models (CV):** CV models enable machines to interpret and understand the visual world, such as images and videos. CV is used in a wide range of applications, including image recognition, facial recognition, object detection, image segmentation, and autonomous vehicles. CV models can use multiple types of deep learning techniques, including CNNs, GANs, and Transformers.

**Multimodal Models:** AI models that combine information from multiple modalities/data such images, text, and audio. They are used to learn complex relationships and patterns across different modalities and tend to consist of two or more sub-models each designed for a specific modality. The models are combined to generate a joint representation of the input data, and then can be used in tasks such as image captioning, video captioning, visual question answering. Today, they're mostly in autonomous vehicles (multiple sensors such as cameras, lidar, radar) and medical imaging.

## AI Taxonomy: Architecture & Design

---

**Graphic Processing Units (GPUs):** GPUs are the foundational infrastructure for AI training. AI training is very computationally intensive for complex models. What separates the computational requirements of these types of models vs other, more traditional, large workloads, is that AI model training requires very specific processes that can be optimized via parallel processing (i.e. processing multiple calculations at once, also known as matrix multiplication). Traditional linear CPU microprocessors are not optimal for conducting these types of computations, as they are typically designed to be too general in nature with fewer, albeit more versatile cores, that compute calculations sequentially. As a result, the world's best microprocessors are more limited when it comes to building AI models...and graphics chips (GPUs) are more efficient and effective for training AI models.

**PyTorch & TensorFlow:** Two of the most popular AI code libraries. TensorFlow is an open-sourced library developed by Google that is used for building and training AI models, particularly deep learning models. PyTorch is an open-source machine learning library developed by Meta that is designed to be more flexible and intuitive than other frameworks. It is popular for building deep learning models, particularly NLP and computer vision tasks.

## Disclosure

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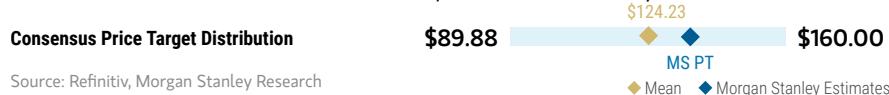
*Morgan Stanley is acting as financial advisor to Activision Blizzard Inc. ("Activision") in relation to its agreement to be acquired by Microsoft Corp., as announced on January 18, 2022. The proposed acquisition is subject to customary closing conditions and completion of regulatory review. Activision has agreed to pay fees to Morgan Stanley for its services. Please refer to the notes at the end of this report.*

## Risk Reward – Alphabet Inc. (GOOGL.O)

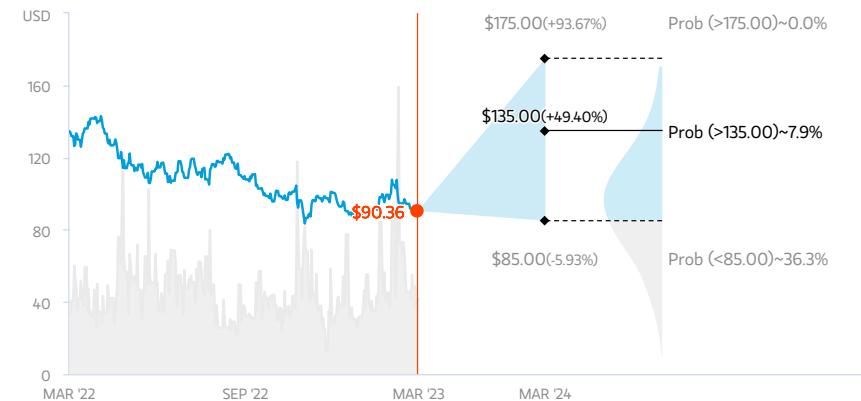
Alphabet Inc.

### PRICE TARGET \$135.00

Our price target is determined using a discounted cash flow/discount to long-term EBITDA multiple. It implies a ~11X 2024e adjusted EBITDA. Our DCF uses a ~10% WACC and a ~3% terminal growth rate (in line with other growth-oriented internet companies). Our multiple based valuation uses a ~12x EV/EBITDA multiple, ~11% below the 3-year median.



### RISK REWARD CHART AND OPTIONS IMPLIED PROBABILITIES (12M)



Key: — Historical Stock Performance ● Current Stock Price ◆ Price Target

Source: Refinitiv, Morgan Stanley Research, Morgan Stanley Institutional Equities Division. The probabilities of our Bull, Base, and Bear case scenarios playing out were estimated with implied volatility data from the options market as of 01 Mar, 2023. All figures are approximate risk-neutral probabilities of the stock reaching beyond the scenario price in either three-months' or one-years' time. View explanation of Options Probabilities methodology [here](#)

#### BULL CASE \$175.00

**Implied ~13X 2024e bull case EBITDA.**  
**Better than expected expense discipline and share repurchases lead to multiple expansion and higher earnings power.** Online ad spending accelerates into 2H and '24 as GOOGL continues to take share of Search spend. New AI offerings prove incremental to the top and bottom line and don't cannibalize core Search. YouTube becomes an even bigger contributor to top-line growth, and operates at a higher margin than in our base case.

#### BASE CASE \$135.00

**Implied ~11X 2024e base case EBITDA.**  
**Assumes pragmatic revenue/EBITDA growth in '23 and continued incremental platform monetization.** As GOOGL continues platform-level innovation on Search and other categories, we assume pragmatic revenue/EBITDA growth while digital ad budgets expand. GOOGL introduces new AI offerings which increase confidence in the durability of long term growth and calm fears around competition. GOOGL executes towards improved operating efficiency throughout '23 and into '24,

#### BEAR CASE \$85.00

**Implied ~8X 2024e bear case EBITDA.**  
**Global ad growth slows further and margins compress.** Assumes slower search advertising growth, and that ad spending slows further. Expense discipline fails to materialize leading to lower than expected adj. EBITDA. New AI products create greater than expected margin pressure due to lower monetization rates and increased compute intensity.

## Risk Reward – Alphabet Inc. (GOOGL.O)

### KEY EARNINGS INPUTS

Drivers	2022	2023e	2024e	2025e
Total operating income (GAAP) (\$, mm)	74,842	84,960	99,668	115,821
GAAP Operating Income (Loss) (\$, mm)	81,425	89,385	104,768	119,871

### INVESTMENT DRIVERS

- Search advertising spend continues to gain share of global advertising budgets.
- Mobile search advertising continues to take share of online budgets.
- Investments in video driving longer-term monetization at YouTube.
- Moderation of expense growth.

### GLOBAL REVENUE EXPOSURE



- 0-10% APAC, ex Japan, Mainland China and India
- 0-10% India
- 0-10% Japan
- 0-10% Latin America
- 0-10% MEA
- 0-10% UK
- 10-20% Europe ex UK
- 40-50% North America

Source: Morgan Stanley Research Estimate  
View explanation of regional hierarchies [here](#)

### MS ALPHA MODELS

2/5 <b>BEST</b>	24 Month Horizon	2/5 <b>MOST</b>	3 Month Horizon
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Source: Refinitiv, FactSet, Morgan Stanley Research; 1 is the highest favored Quintile and 5 is the least favored Quintile

### RISKS TO PT/RATING

#### RISKS TO UPSIDE

- New products generate higher than expected top line contribution.
- Capital returns through greater share buybacks.
- Hiring and/or spend per headcount is lower than expected

#### RISKS TO DOWNSIDE

- High exposure to SMB and travel could pressure ad revenue in a recession
- Improved disclosure around the Google and Other Alphabet segments may not decrease the overall investment activity of the business.

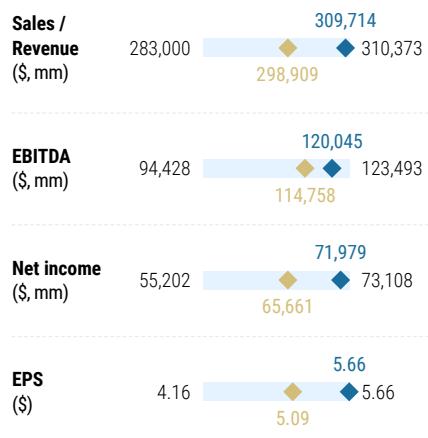
### OWNERSHIP POSITIONING

Inst. Owners, % Active	62.4%	
HF Sector Long/Short Ratio	2.2x	
HF Sector Net Exposure	10.9%	

Refinitiv; MSPB Content. Includes certain hedge fund exposures held with MSPB. Information may be inconsistent with or may not reflect broader market trends. Long/Short Ratio = Long Exposure / Short exposure, Sector % of Total Net Exposure = (For a particular sector: Long Exposure - Short Exposure) / (Across all sectors: Long Exposure - Short Exposure).

### MS ESTIMATES VS. CONSENSUS

FY Dec 2023e



♦ Mean   ♦ Morgan Stanley Estimates

Source: Refinitiv, Morgan Stanley Research

## Risk Reward – Microsoft (MSFT.O)

Navigating Through Choppy Seas, Great Long Term Story

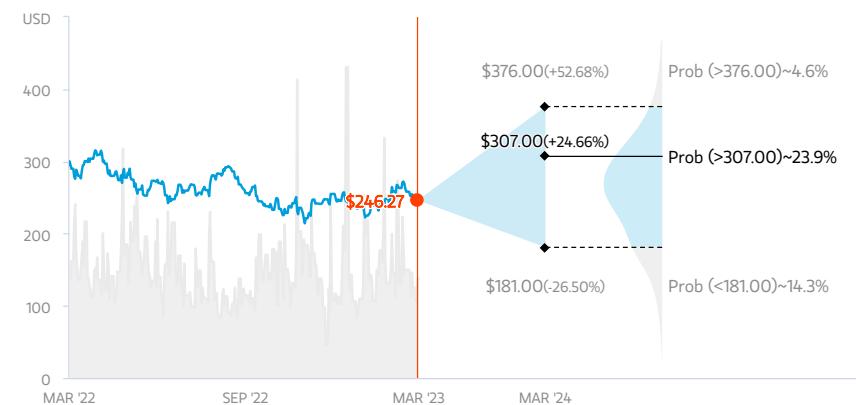
### PRICE TARGET \$307.00

~25x Base Case CY24e GAAP EPS of \$12.22; Trading at ~21x EPS, MSFT trades at a discount to >\$50 billion market-cap software peers growing EPS double-digits.



Source: Refinitiv, Morgan Stanley Research

### RISK REWARD CHART AND OPTIONS IMPLIED PROBABILITIES (12M)



Key: — Historical Stock Performance ● Current Stock Price ◆ Price Target

Source: Refinitiv, Morgan Stanley Research, Morgan Stanley Institutional Equities Division. The probabilities of our Bull, Base, and Bear case scenarios playing out were estimated with implied volatility data from the options market as of 01 Mar, 2023. All figures are approximate risk-neutral probabilities of the stock reaching beyond the scenario price in either three-months' or one-years' time. View explanation of Options Probabilities methodology [here](#)

#### BULL CASE \$376.00

~27x Bull Case CY24e EPS: \$14.04

**Azure and O365 Drive Top-Line Growth.** Intelligent Cloud, driven by rapid Azure adoption and sustained legacy and hybrid Server growth, supports near-term rev growth in the mid to high-teens %. Adoption of higher priced O365 Commercial SKUs and LinkedIn further drive PBP revenues. Operating margins expand to ~46% and CY24e EPS is \$14.04. ~27x PE is at a premium to large cap software peers.

#### BASE CASE \$307.00

~25x Base Case CY24e EPS of \$12.22

**Durability of Growth — Continuing the Momentum:** Top line drivers include Azure (winning in public cloud), O365, Dynamic 365, and LinkedIn. Op margins expand to ~44% in CY24. Double-digit CY23-CY25 EPS growth and a ~1.2% div yld drive a mid to high-teens total return profile and CY24e EPS of \$12.22. Trading at ~21x EPS, MSFT trades at a discount to >\$50B market-cap software peers growing EPS double digits.

#### BEAR CASE \$181.00

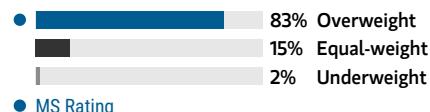
~17x Bear Case CY24e EPS: \$10.92

**Commercial Cloud Growth Decelerates Significantly.** Slower cloud growth drags on PBP and IC segment growth; MPC declines from current levels. Total revenue grows in the high single digits over the near-term. Operating margins reach ~42% in CY24e yielding CY24e EPS of \$10.92. ~17x multiple is at a discount to large cap software peers.

### OVERWEIGHT THESIS

- Strong positioning for public cloud adoption, large distribution channels and installed customer base, and improving margins support growth. Although heavier cyclical environment is weighing on the NT results, the long term path remain durable. This is supported by Azure, data center (share gains and positive pricing trends), O365 and LinkedIn. GM % improvement, opex discipline and strong capital return lead to durable teens total return profile long term .
- At ~20x CY24e GAAP EPS, MSFT trades at a discount to the large cap peers, unwarranted due to MSFT's premium return profile. Multiple expansion will likely come from more comfort in durability of commercial business gross profit dollars.

### Consensus Rating Distribution



Source: Refinitiv, Morgan Stanley Research

### Risk Reward Themes

**Secular Growth:** Positive  
**New Data Era:** Positive

View descriptions of Risk Rewards Themes [here](#)

## Risk Reward – Microsoft (MSFT.O)

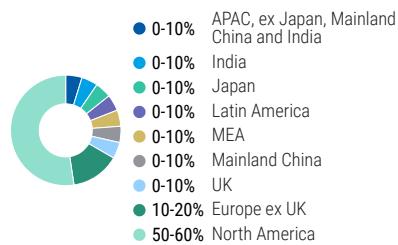
### KEY EARNINGS INPUTS

Drivers	2022	2023e	2024e	2025e
Azure Revenue Growth (%)	45.2	29.6	29.6	31.6
Server Products On-Prem Growth (%)	4.3	(1.2)	2.0	1.8
Gross Margins (%)	68.4	68.7	69.4	69.5
Operating Margins (%)	42.1	41.5	43.4	43.8
GAAP EPS Growth (%)	14.4	2.6	19.1	17.7

### INVESTMENT DRIVERS

- Sustainability of commercial growth, cloud momentum, improving cloud margins
- Improving PC data points

### GLOBAL REVENUE EXPOSURE



Source: Morgan Stanley Research Estimate  
View explanation of regional hierarchies [here](#)

### MS ALPHA MODELS



Source: Refinitiv, FactSet, Morgan Stanley Research; 1 is the highest favored Quintile and 5 is the least favored Quintile

### SUSTAINABILITY & ESG



### RISKS TO PT/RATING

#### RISKS TO UPSIDE

- Operational efficiencies leading to greater than anticipated economies of scale
- Cloud adoption accelerates, with Azure as convincing winner
- Activision Blizzard acquisition results strong earnings accretion from the very beginning

#### RISKS TO DOWNSIDE

- Weak macro impacting global PC sales
- On-premises cannibalization by Cloud
- Increased investments hurt margin expansion
- Activision Blizzard acquisition fails to be accretive

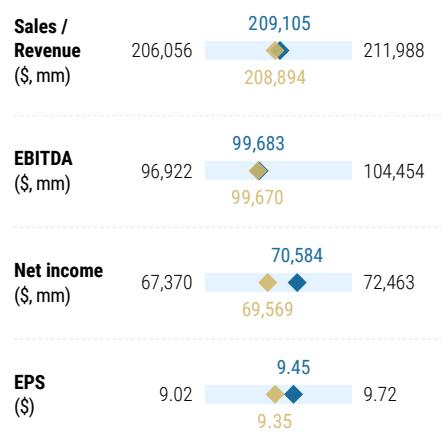
### OWNERSHIP POSITIONING

Inst. Owners, % Active	58.3%	
HF Sector Long/Short Ratio	2.1x	
HF Sector Net Exposure	30%	

Refinitiv; MSPB Content. Includes certain hedge fund exposures held with MSPB. Information may be inconsistent with or may not reflect broader market trends. Long/Short Ratio = Long Exposure / Short exposure. Sector % of Total Net Exposure = (For a particular sector: Long Exposure - Short Exposure) / (Across all sectors: Long Exposure - Short Exposure).

### MS ESTIMATES VS. CONSENSUS

FY Jun 2023e



♦ Mean   ◆ Morgan Stanley Estimates

Source: Refinitiv, Morgan Stanley Research

## Risk Reward – Meta Platforms Inc (META.O)

### PRICE TARGET \$190.00

Our price target is determined using a discounted cash flow/discount to long-term EBITDA multiple. It implies a ~7.0X 2024e adjusted EBITDA. Our DCF uses an ~11.7% WACC and a ~2% terminal growth rate.



### RISK REWARD CHART



### BULL CASE \$240.00

#### Implied ~8.5X bull case 2024e EBITDA

AI investments drive increased engagement and lead to new products/tools, which drives ad monetization and outsized revenue growth. META benefits more from efficiency gains and is more successful in closing the Reels monetization gap. Reality Labs losses moderate.

### BASE CASE \$190.00

#### Implied ~7.0X base case 2024e EBITDA

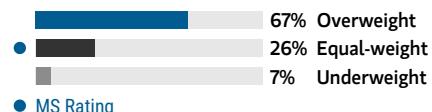
Ad revenue returns to growth (mid-single digit %) in '23 driven by the lapping of easy growth compares, as they continue to navigate IDFA, Reels, and macro-related headwinds. We see the company focusing on efficiency and improving productivity as META continues to invest in AI infrastructure/more expensive GPUs to improve its algorithms.

### EQUAL-WEIGHT THESIS

**META is shifting focus on efficiency.** META is driving efficiency in both opex and capex. It's shifting to a new data center architecture, enabling META to continue to invest in AI infrastructure/more expensive GPUs to improve its algorithms, better analyze its leading 1P data and drive more durable multi-year engagement and revenue growth.

**We watch for signs of advertiser improvement around ROI/scalability of ad buys across core products and Reels.** META is seeing some early positive signal from new AI-driven investments (improved matching on Reels, higher watch time, improved ad offerings) but it's still early. From here, we think revenue matters most.

### Consensus Rating Distribution



Source: Refinitiv, Morgan Stanley Research

### Risk Reward Themes

Self-help: Positive

View descriptions of Risk Rewards Themes [here](#)

### BEAR CASE \$130.00

#### Implied ~5.2x bear case 2024e EBITDA

Declines in engagement and/or evidence of Reels becoming more cannibalistic to time spent (rather than incremental) could lead to lower monetization and greater uncertainty. Any additional opex and capex could weigh on operating income growth and FCF.

## Risk Reward – Meta Platforms Inc (META.O)

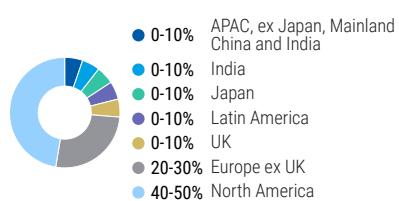
### KEY EARNINGS INPUTS

Drivers	2022	2023e	2024e	2025e
Constant Currency % Growth (%)	4.1	4.7	14.1	15.3
Operating income (GAAP) (\$, mm)	28,945	33,900	39,791	47,267
Consolidated Total Daily Active Users (mm)	2,000.0	2,060.0	2,124.4	2,182.9

### INVESTMENT DRIVERS

- We continue to monitor Meta's ability to innovate and improve its monetization while focusing on efficiency and investing in AI infrastructure/data center footprint to power Reels and recommendations

### GLOBAL REVENUE EXPOSURE



Source: Morgan Stanley Research Estimate  
View explanation of regional hierarchies [here](#)

### MS ALPHA MODELS

2/5 BEST	24 Month Horizon	4/5 MOST	3 Month Horizon
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Source: Refinitiv, FactSet, Morgan Stanley Research; 1 is the highest favored Quintile and 5 is the least favored Quintile

### RISKS TO PT/RATING

#### RISKS TO UPSIDE

- Faster than expected Reels monetization
- Higher monetization from AI-driven rebuild
- Focus on efficiency drives outsized free cash flow growth

#### RISKS TO DOWNSIDE

- Engagement trends decline and time spent falls
- Slower than expected Reels monetization
- High SMB exposure could pressure ad revenue in recession scenario
- Negative press around privacy, concerns about ability to operate platform safely

### OWNERSHIP POSITIONING

Inst. Owners, % Active	60.3%	
HF Sector Long/Short Ratio	2.2x	
HF Sector Net Exposure	10.9%	

Refinitiv; MSPB Content. Includes certain hedge fund exposures held with MSPB. Information may be inconsistent with or may not reflect broader market trends. Long/Short Ratio = Long Exposure / Short exposure. Sector % of Total Net Exposure = (For a particular sector: Long Exposure - Short Exposure) / (Across all sectors: Long Exposure - Short Exposure).

### MS ESTIMATES VS. CONSENSUS

FY Dec 2023e

Sales / Revenue (\$, mm)	117,794		122,921
			122,436
EBITDA (\$, mm)	37,323		56,808
			52,779
Net income (\$, mm)	10,630		27,497
			37,083
			25,268
EPS (\$)	6.65		10.52
			9.53
			13.76

Mean   Morgan Stanley Estimates

Source: Refinitiv, Morgan Stanley Research

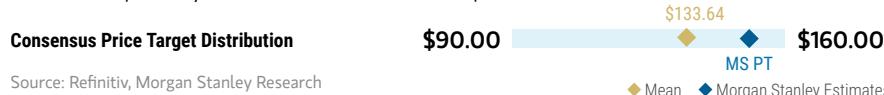
## Risk Reward – Amazon.com Inc (AMZN.O)

Top Pick

### AMZN Risk Reward

#### PRICE TARGET \$150.00

We apply a sum-of-the-parts valuation on AMZN's five businesses (1P, 3P, AWS, Subscription, and Advertising/Other). We value core retail at ~\$425bn based on 1P reaching 1.00% '24 op margins and 3P reaching an 18% EBITDA margin. AWS is worth ~\$646bn, Prime sub revenues are worth ~\$268bn, and AMZN's ad business is ~\$193bn.



#### RISK REWARD CHART AND OPTIONS IMPLIED PROBABILITIES (12M)



Source: Refinitiv, Morgan Stanley Research, Morgan Stanley Institutional Equities Division. The probabilities of our Bull, Base, and Bear case scenarios playing out were estimated with implied volatility data from the options market as of 01 Mar, 2023. All figures are approximate risk-neutral probabilities of the stock reaching beyond the scenario price in either three-months' or one-years' time. View explanation of Options Probabilities methodology [here](#)

#### BULL CASE \$215.00 BASE CASE \$150.00 BEAR CASE \$60.00

##### ~10x Bull Case '24e EV/EBITDA

We apply a sum-of-the-parts valuation on AMZN's five businesses (1P, 3P, AWS, Subscription, and Advertising/Other). We value core retail at ~\$730bn based on 1P reaching 3.5% '24 op margins and 3P reaching a 20% EBITDA margin. AWS is worth ~\$867bn, Prime sub revenues are worth ~\$334bn and AMZN's ad business is ~\$282bn.

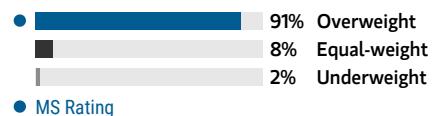
##### ~41x EV/ '24 EBIT

We apply a sum-of-the-parts valuation on AMZN's five businesses (1P, 3P, AWS, Subscription, and Advertising/Other). We value core retail at ~\$425bn based on 1P reaching 1.00% '24 operating margins and 3P reaching an 18% EBITDA margin. AWS is worth ~\$646bn, Prime sub revenues are worth ~\$268bn and AMZN's ad business is ~\$193bn.

#### OVERWEIGHT THESIS

- Amazon's high-margin businesses continue to allow Amazon to drive greater profitability while still continuing to invest (last mile delivery, fulfillment, Prime Now, Fresh, Prime digital content, Alexa/Echo, India, AWS, etc).
- Amazon Prime membership growth drives recurring revenue and positive mix shift.
- Cloud adoption hitting an inflection point.
- Advertising serves as a key area for both further growth potential and profitability flow-through.

#### Consensus Rating Distribution



#### Risk Reward Themes

Secular Growth:	Positive
New Data Era:	Positive
Technology Diffusion:	Positive

View descriptions of Risk Rewards Themes [here](#)

## Risk Reward – Amazon.com Inc (AMZN.O)

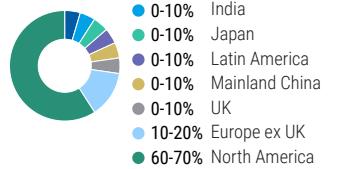
### KEY EARNINGS INPUTS

Drivers	2021	2022e	2023e	2024e
Revenue (\$, mm)	469,822	513,983	555,086	632,433
Gross Profit (\$, mm)	198,018	225,909	257,832	303,449
GAAP EBIT (\$, mm)	24,879	12,248	23,512	37,165
Paid Unit Growth (y/y) (%)	15.5	4.9	5.7	9.6
AWS Revenue Growth (%)	37.1	28.8	8.4	19.2

### INVESTMENT DRIVERS

- Amazon's high-margin businesses continue to allow Amazon to drive greater profitability while still continuing to invest
- Cloud is in a multi-decade secular adoption cycle
- Amazon is gaining share in eCommerce/retail and share of consumers' wallets

### GLOBAL REVENUE EXPOSURE



Source: Morgan Stanley Research Estimate  
View explanation of regional hierarchies [here](#)

### MS ALPHA MODELS

3/5 BEST	24 Month Horizon	5/5 MOST	3 Month Horizon
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Source: Refinitiv, FactSet, Morgan Stanley Research; 1 is the highest favored Quintile and 5 is the least favored Quintile

### RISKS TO PT/RATING

#### RISKS TO UPSIDE

- Faster than expected AWS rev growth and margin expansion
- 1-day shipping cost transition goes faster than expected
- Amazon succeeds in expanding its TAM (logistics, advertising, grocery, etc)

#### RISKS TO DOWNSIDE

- Investments step up and continue for longer than expected
- Unit growth slows
- AWS revenue decelerates and /or margins decline

### OWNERSHIP POSITIONING

Inst. Owners, % Active	59%	
HF Sector Long/Short Ratio	1.3x	
HF Sector Net Exposure	7.1%	

Refinitiv; MSPB Content. Includes certain hedge fund exposures held with MSPB. Information may be inconsistent with or may not reflect broader market trends. Long/Short Ratio = Long Exposure / Short exposure. Sector % of Total Net Exposure = (For a particular sector: Long Exposure - Short Exposure) / (Across all sectors: Long Exposure – Short Exposure).

### MS ESTIMATES VS. CONSENSUS

FY Dec 2022e

Sales / 513,983

Note: There are not sufficient brokers supplying consensus data for this metric

EBITDA 77,293

Note: There are not sufficient brokers supplying consensus data for this metric

Net income (2,722)

Note: There are not sufficient brokers supplying consensus data for this metric

EPS (0.27)

Note: There are not sufficient brokers supplying consensus data for this metric

Mean Morgan Stanley Estimates

Source: Refinitiv, Morgan Stanley Research

## Risk Reward – Arista Networks (ANET.N)

In Midst Of Cloud Upgrade Cycle Now More Captured In Expectations

### PRICE TARGET \$140.00

Our \$140 PT is based on 24x P/24e earnings, a premium to networking peers given growth / hyperscale cycle. 24x P/E is more in-line with secularly growing tech names growing in the double-digits where software value is differentiated (and associated profitability margins are stronger).



### RISK REWARD CHART AND OPTIONS IMPLIED PROBABILITIES (12M)



#### BULL CASE \$180.00

30x bull case FY24e EPS (~\$6)

**The Clouds don't clear, even into '24; new logo wins.** Cloud investments remain elevated through '23 and into '24 driving continued double-digit growth while enterprise share gains continue. Net incremental hyperscale win in '23 supports expectation of continued higher growth for longer. Operating margins near 40% result in EPS ~\$6. 30x is more in-line with software peers and aligns with traditional trading range.

#### BASE CASE \$140.00

24x FY24e EPS (~\$5.9)

**Still Cloudy in '23.** Growth continues through '23 with stable spend from Cloud Titan customers, Enterprise share gains afford growth through a softer macro environment. Multiple reflects 25th percentile of traditional trading range giving macro overhang and expectation for slower growth in '24.

#### \$140.00

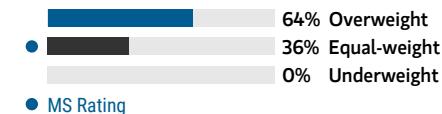
18x FY24e bear case EPS

**200G/400G cycle matures earlier than expected in 2023; enters period of lower growth.** Cloud cycle begins to turn moving past initial phase of elevated investment. Growth in other verticals (Enterprise, Financials, T2 Cloud, Service Provider) faces macro disruption and, along with flattening hyperscale investment levels, results in period of slower growth. ANET trades at the high end of networking peers at ~18x P/E, but low end of traditional trading range.

### EQUAL-WEIGHT THESIS

- 200G / 400G upgrades are underway and driving elevated growth FY22, 25%++ growth is now expected into FY23 and necessary to support valuation.
- Enterprise / campus market share gains continue as business is now scaled and provides a more durable growth engine through hyperscale cycle drivers. Initial share gains were possible without significant investment in channel, but greater scale could lead to more reliance to maintain growth, with cost.
- Data center exposure is relatively more attractive within enterprise budget scenarios, affording premium to networking peers outside of cloud upgrade cycle drivers.
- Opportunity at Google has potential as a catalyst but remains further out.

### Consensus Rating Distribution



Source: Refinitiv, Morgan Stanley Research

### Risk Reward Themes

Disruption:	<i>Positive</i>
Market Share:	<i>Positive</i>
New Data Era:	<i>Positive</i>

View descriptions of Risk Rewards Themes [here](#)

#### BEAR CASE \$80.00

18x FY24e bear case EPS

**200G/400G cycle matures earlier than expected in 2023; enters period of lower growth.** Cloud cycle begins to turn moving past initial phase of elevated investment. Growth in other verticals (Enterprise, Financials, T2 Cloud, Service Provider) faces macro disruption and, along with flattening hyperscale investment levels, results in period of slower growth. ANET trades at the high end of networking peers at ~18x P/E, but low end of traditional trading range.

## Risk Reward – Arista Networks (ANET.N)

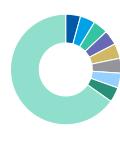
### KEY EARNINGS INPUTS

Drivers	2022	2023e	2024e	2025e
Revenue Growth (%)	48.6	24.9	7.3	7.8
Gross Margin (%)	61.9	61.1	62.9	62.9
Operating Margin (%)	41.2	40.7	39.9	39.6
EPS Growth (%)	60.5	23.4	5.1	6.8
FCF Growth (%)	(33.1)	224.5	11.0	(1.7)

### INVESTMENT DRIVERS

- Is Arista demand macro sensitive?
- Will cloud builders move towards white box solutions, and away from branded vendors?
- Can Arista expand beyond the data center switching?

### GLOBAL REVENUE EXPOSURE



- 0-10% APAC, ex Japan, Mainland China and India
- 0-10% Europe ex UK
- 0-10% India
- 0-10% Japan
- 0-10% Latin America
- 0-10% MEA
- 0-10% Mainland China
- 0-10% UK
- 70-80% North America

Source: Morgan Stanley Research Estimate  
View explanation of regional hierarchies [here](#)

### MS ALPHA MODELS

5/5 BEST	24 Month Horizon	5/5 MOST	3 Month Horizon
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Source: Refinitiv, FactSet, Morgan Stanley Research; 1 is the highest favored Quintile and 5 is the least favored Quintile

### SUSTAINABILITY & ESG

Indicator of Change	0.14	+1.0	-1.0
Disclosure Rate	53%		

### RISKS TO PT/RATING

#### RISKS TO UPSIDE

- Cloud growth drives continued upside on 200G/400G upgrades
- Enterprise share gains accelerate across campus and data center
- Service provider insertion accelerates

#### RISKS TO DOWNSIDE

- Customer concentration, specifically Microsoft
- Difficulties growing international business (particularly with Chinese cloud providers)
- New campus products struggle to gain traction
- Share loss at 400G
- Macro conditions get materially worse

### OWNERSHIP POSITIONING

Inst. Owners, % Active	62.9%			
HF Sector Long/Short Ratio	2.1x			
HF Sector Net Exposure	30%			

Refinitiv; MSPB Content. Includes certain hedge fund exposures held with MSPB. Information may be inconsistent with or may not reflect broader market trends. Long/Short Ratio = Long Exposure / Short exposure. Sector % of Total Net Exposure = (For a particular sector: Long Exposure - Short Exposure) / (Across all sectors: Long Exposure – Short Exposure).

### MS ESTIMATES VS. CONSENSUS

#### FY Dec 2023e

Sales / Revenue (\$, mm)	5,471		5,781
	5,459		5,508

EBITDA (\$, mm)	2,295		2,399
	1,970		2,277

Net income (\$, mm)	1,792		1,996
	1,631		1,820

EPS (\$)	5.69		6.32
	5.20		5.77

Mean   Morgan Stanley Estimates

Source: Refinitiv, Morgan Stanley Research

## Risk Reward – Baidu Inc (BIDU.O)

Recovery underway

### PRICE TARGET US\$160.00

US\$160: base case, sum of the parts

- Baidu core - US\$115/ADS: 10x 2024E EV/EBIT, in line with global search engine peers
- Trip.com - US\$10/ADS: Baidu's stake at price target
- iQIYI - US\$7/ADS: Baidu's stake at price target
- YY Live - US\$10/ADS: Proposed acquisition value
- Current net cash attributable to Baidu - US\$36/ADS
- 30% holding company discount - execution risks given investment in multiple businesses



Source: Refinitiv, Morgan Stanley Research

### RISK REWARD CHART AND OPTIONS IMPLIED PROBABILITIES (12M)



Source: Refinitiv, Morgan Stanley Research, Morgan Stanley Institutional Equities Division. The probabilities of our Bull, Base, and Bear case scenarios playing out were estimated with implied volatility data from the options market as of 01 Mar, 2023. All figures are approximate risk-neutral probabilities of the stock reaching beyond the scenario price in either three-months' or one-years' time. View explanation of Options Probabilities methodology [here](#)

#### BULL CASE

13x NTM bull-case non-GAAP EPS

**Baidu core rebounds and new initiatives pay off, with autonomous driving value to be appreciated by investors**

Total revenue: 16% 2022-25e CAGR. Non-GAAP OPM: 27% in 2024e

**SOTP: Baidu Core - US\$170 per ADS: 12x 2024e EV/EBIT. Trip.com US\$13 and iQIYI - US\$11 per ADS: Baidu's stake at bull case value. YY Live - US\$10 per ADS: proposed acquisition value. Current net cash attributable to Baidu - US\$36 per ADS. 30% holding company discount - execution risks given investment in multiple businesses.**

#### US\$220.00

#### BASE CASE

10x NTM base-case non-GAAP EPS

**Baidu core recovery on track**

Total revenue: 11.8% 2022-25e CAGR. Non-GAAP OPM: 23.6% in 2024e

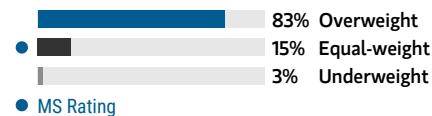
**Sum-of-the-parts: Baidu core - US\$115 per ADS: 10x 2024e EV/EBIT. Trip.com US\$10 and iQIYI US\$7 per ADS: Baidu's stake at price target. YY Live - US\$10 per ADS: proposed acquisition value. Current net cash attributable to Baidu - US\$36 per ADS. 30% holding company discount for non-core - execution risks given investment in multiple businesses.**

#### US\$160.00

### EQUAL-WEIGHT THESIS

- Covid resurgence has slowed ad recovery, especially in offline verticals.
- With much softer ad demand, we remain cautious about the recovery outlook.
- Stringent cost control and sustained cloud growth could provide some earnings support.
- We still like Baidu's long-term potential as the industry pioneer in AI initiatives and autonomous driving, but these investments will take time to yield fruit, likely beyond 2024..
- Our price target implies 10x 2024e non-GAAP P/E vs. the stock's 9-30x trading band since 2018.
- Despite upside potential, we remain on the sidelines owing to near-term ad industry weakness, macro headwinds and Covid-19 uncertainties.

### Consensus Rating Distribution



Source: Refinitiv, Morgan Stanley Research

### Risk Reward Themes

- |             |          |
|-------------|----------|
| Disruption: | Negative |
| Self-help:  | Positive |

View descriptions of Risk Rewards Themes [here](#)

#### BEAR CASE

#### US\$90.00

7x NTM bearcase non-GAAP EPS

**Intensifying competition; margins remain weak**

Total revenue: 8% 2022-25e CAGR. Non-GAAP OPM: 18% in 2024e

**Sum-of-the-parts: Baidu Core - US\$53 per ADS: 6x 2024e EV/EBIT. Trip.com US\$5 and iQIYI US\$3 per ADS: Baidu's stake at bear-case value. YY Live - US\$10 per ADS: proposed acquisition value. Current net cash attributable to Baidu - US\$36 per ADS. 30% holding company discount - execution risks given investment in multiple businesses.**

## Risk Reward – Baidu Inc (BIDU.O)

### KEY EARNINGS INPUTS

Drivers	2022	2023e	2024e	2025e
Baidu Core Online Marketing Revenue Growth (%)	(5.8)	9.2	5.6	5.4
Baidu Core Other Revenue Growth (%)	27.2	26.7	28.1	25.0
S&M Expense as % of Revenue (%)	11.2	12.0	12.6	13.0
R&D Expense as % of Revenue (%)	17.8	17.1	16.1	15.4

### INVESTMENT DRIVERS

- End-consumption demand recovery that boosts ad budgets
- Continued customer acquisition by deeper penetration of lower-tier cities and an expanding product portfolio
- Apollo and DuerOS to be baked into valuation in the near to medium term

### GLOBAL REVENUE EXPOSURE



● 100% Mainland China

Source: Morgan Stanley Research Estimate  
View explanation of regional hierarchies [here](#)

### MS ALPHA MODELS

2/5 <b>BEST</b>	24 Month Horizon	5/5 <b>MOST</b>	3 Month Horizon
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Source: Refinitiv, FactSet, Morgan Stanley Research; 1 is the highest favored Quintile and 5 is the least favored Quintile

### SUSTAINABILITY & ESG

Indicator of Change	0.08	+1.0	-1.0
Disclosure Rate	56%		

### RISKS TO PT/RATING

#### RISKS TO UPSIDE

- Stronger core business recovery driving better top-line growth.
- Solid margin expansion from investment discipline and cost control.
- Materialization of AI initiatives.

#### RISKS TO DOWNSIDE

- Intensifying competition in search and online video, driving up TAC and more aggressive content investments.
- Potential regulation on news feed, healthcare, education and gaming industries, limiting ad revenue growth.

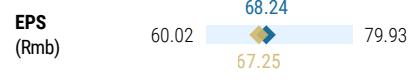
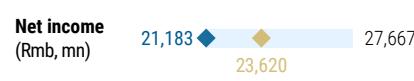
### OWNERSHIP POSITIONING

Inst. Owners, % Active	82.1%	
HF Sector Long/Short Ratio	2.2x	
HF Sector Net Exposure	10.9%	

Refinitiv; MSPB Content. Includes certain hedge fund exposures held with MSPB. Information may be inconsistent with or may not reflect broader market trends. Long/Short Ratio = Long Exposure / Short exposure. Sector % of Total Net Exposure = (For a particular sector: Long Exposure - Short Exposure) / (Across all sectors: Long Exposure - Short Exposure).

### MS ESTIMATES VS. CONSENSUS

FY Dec 2023e



Source: Refinitiv, Morgan Stanley Research  
♦ Mean ◆ Morgan Stanley Estimates

## Risk Reward – Alibaba Group Holding (BABA.N) Top Pick

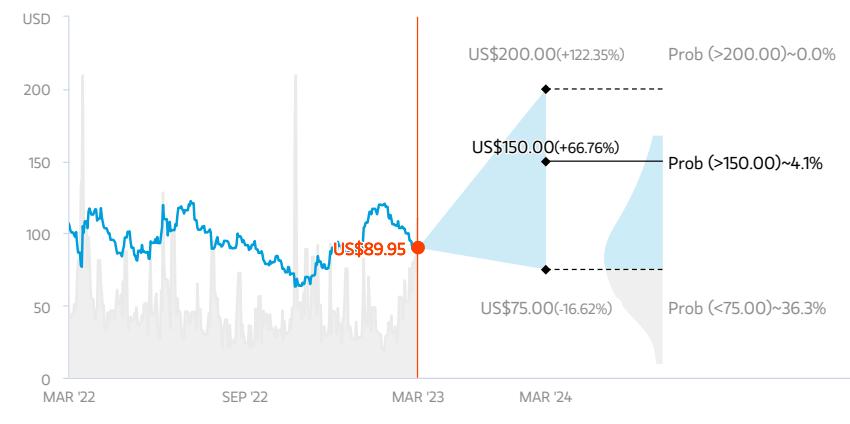
Earnings Inflection, Easing Regulation with Attractive Valuation

### PRICE TARGET US\$150.00

Base case, discounted cash flow model. Key assumptions include 11% WACC (in line with Tencent) and 3% terminal growth rate, in line with our Chinese Internet coverage range.



### RISK REWARD CHART AND OPTIONS IMPLIED PROBABILITIES (12M)



#### BULL CASE

**US\$200.00**  
**18x bull-case non-GAAP F2024e EPS**

- Marketplace-based core commerce at US\$128 per share based on 10x EV/EBITA.
- Direct sales at US\$5 per share.
- AliCloud at US\$21 per share based on 3x F2026e EV/sales.
- International retail at US\$11 per share.
- Local services at US\$9.
- Other businesses at US\$6.
- Equity investments at US\$9 (30% discount).

#### BASE CASE

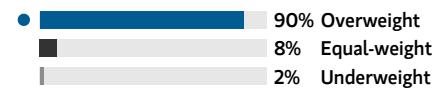
**US\$150.00**  
**16.4x base-case non-GAAP F2025e EPS**

- Customer management revenue CAGR of 7% over F2023-26e.
- Cloud revenue CAGR of 23% over F2023-26e.

### OVERWEIGHT THESIS

- Reopening and consumption recovery drive the turnaround of CMR; we expect cloud reacceleration thanks to recovering demand and the enterprise digitalization trend.
- The regulatory environment for Internet companies appears to be easing and we see BABA as the key beneficiary as a China proxy.
- Valuation remains attractive. At current levels, we think the stock underrepresents the value of cloud, other business segments and investments.
- Strong cash flow-generating capabilities and continued share buyback could also provide downside support.

### Consensus Rating Distribution



Source: Refinitiv, Morgan Stanley Research

### Risk Reward Themes

Disruption:	Negative
Secular Growth:	Positive
Self-help:	Positive

View descriptions of Risk Rewards Themes [here](#)

#### BEAR CASE

**US\$75.00**  
**10.8x bear-case non-GAAP F2025e EPS**

- Customer management revenue CAGR of 2% over F2023-26e as competition pressures GMV growth and regulations affect monetization.
- Cloud revenue CAGR of 10% over F2023-26e.

## Risk Reward – Alibaba Group Holding (BABA.N)

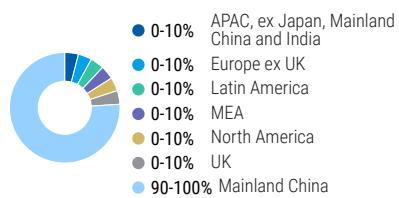
### KEY EARNINGS INPUTS

Drivers	2022	2023e	2024e	2025e
China retail e-commerce annual active consumers (mn)	903	953	989	1,023
China retail e-commerce ARPU (Rmb)	8,833	8,046	8,271	8,477
Core of core take rate (%)	3.9	3.8	3.8	3.9
Core of core adj. EBITA (Rmb, mn)	199,898	182,665	203,918	224,664
AliCloud ARPPU (Rmb)	16,581	19,969	24,163	29,116

### INVESTMENT DRIVERS

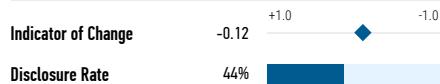
- Revenue growth, especially in core e-commerce in China
- Monetization rate (i.e., Alibaba's Chinese retail marketplace revenue/GMV)
- Non-GAAP EBITA margins

### GLOBAL REVENUE EXPOSURE



Source: Morgan Stanley Research Estimate  
View explanation of regional hierarchies [here](#)

### SUSTAINABILITY & ESG



### RISKS TO PT/RATING

#### RISKS TO UPSIDE

- Better core e-commerce monetization drives earnings growth upside.
- Faster enterprise digitalization re-accelerates cloud revenue growth.
- Cloud margin expansion is stronger.

#### RISKS TO DOWNSIDE

- More intense competition.
- Higher-than-expected reinvestment costs.
- Weaker consumption amid a slower post-Covid recovery.
- Slower pace of enterprise digitalization pace.
- Regulation - additional scrutiny of Internet platforms.

### OWNERSHIP POSITIONING

Inst. Owners, % Active	78.3%	
HF Sector Long/Short Ratio	1.3x	
HF Sector Net Exposure	7.1%	

Refinitiv; MSPB Content. Includes certain hedge fund exposures held with MSPB. Information may be inconsistent with or may not reflect broader market trends. Long/Short Ratio = Long Exposure / Short exposure. Sector % of Total Net Exposure = (For a particular sector: Long Exposure - Short Exposure) / (Across all sectors: Long Exposure - Short Exposure).

### MS ESTIMATES VS. CONSENSUS

FY Mar 2023e

Sales / Revenue	Morgan Stanley Estimates	Mean	Consensus
(Rmb, mn)	868,348	871,427	883,300

EBITDA	Morgan Stanley Estimates	Mean	Consensus
(Rmb, mn)	109,258	176,134	197,876

Net income	Morgan Stanley Estimates	Mean	Consensus
(Rmb, mn)	55,803	140,516	153,084

EPS	Morgan Stanley Estimates	Mean	Consensus
(Rmb)	21.09	53.93	57.84

Source: Refinitiv, Morgan Stanley Research  
♦ Mean   ◆ Morgan Stanley Estimates

## Risk Reward – Tencent Holdings Ltd. (0700.HK)

Strategic investments to drive earnings growth and multiple-rationing

### PRICE TARGET HK\$450.00

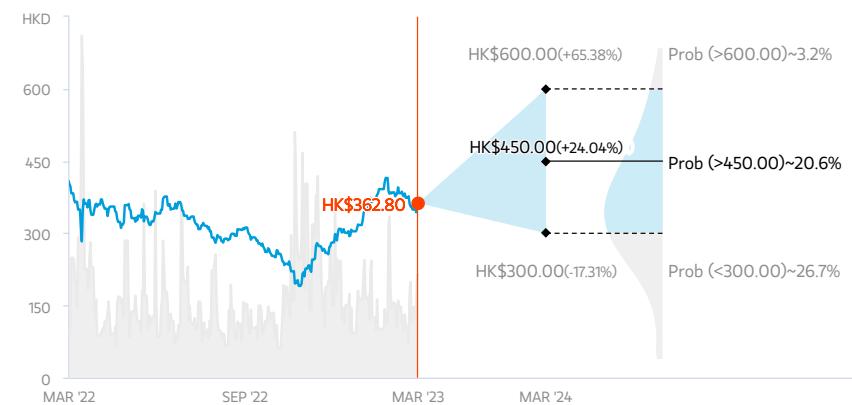
HK\$450.00: Base case, sum-of-the-parts

Core business - HK\$391: DCF (11% discount rate, 3% terminal growth rate).

Associate investments - HK\$59: Listed associates based on target value (per share stakes valued at: Pinduoduo HK\$8, Kuaishou HK\$5, Sea Ltd HK\$4, Nio HK\$2, Beke HK\$1 and Bilibili HK\$1). Other listed associates at HK\$10 and unlisted associates at HK\$28 per share.



### RISK REWARD CHART AND OPTIONS IMPLIED PROBABILITIES (12M)



Source: Refinitiv, Morgan Stanley Research, Morgan Stanley Institutional Equities Division. The probabilities of our Bull, Base, and Bear case scenarios playing out were estimated with implied volatility data from the options market as of 02 Mar, 2023. All figures are approximate risk-neutral probabilities of the stock reaching beyond the scenario price in either three-months' or one-years' time. View explanation of Options Probabilities methodology [here](#)

#### BULL CASE

**HK\$600.00**

**SOTP, 26x bull-case non-IFRS 2024e EPS**  
Strong monetization across all products and services as Tencent successfully monetizes its sizable user traffic

SOTP suggests valuation could reach US\$661bn by 2023, including US\$407bn for online games, US\$91bn for online entertainment, US\$82bn for social network, US\$55bn for FinTech and US\$26bn for Cloud. 26x vs. historical P/E trading band of 18-48x since 2015.

#### BASE CASE

**HK\$450.00**

**22x base-case non-IFRS 2024e EPS**  
Sustained growth in mobile games, with progress in online ads, followed by FinTech and business services expansion

Total Revenue: 13% 2022-25E CAGR.

Mobile Games: 12% 2022-25E CAGR.

Advertising: 18% 2022-25E CAGR.

FinTech and Business Services: 15% 2022-25E CAGR.

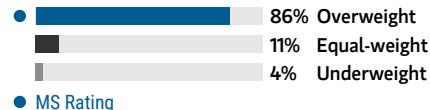
Non-GAAP operating margin: 31% in 2024E.

22x vs. historical P/E trading band of 18-48x since 2015.

#### OVERWEIGHT THESIS

- Tencent dominates China's online consumer market in terms of revenue size and traffic volume. Most of its services rank in the top three by user base.
- Positive earnings levers include globalization of game business, higher social ad monetization, greater FinTech offerings, and strategic upgrades to capitalize consumer and industrial Internet.
- We see relative resilience and think regulatory headlines are not a one-sided negative for Tencent.
- Among China's Internet leaders, Tencent's strong revenue growth and earnings visibility have historically merited a premium valuation. Our price target implies 2024e core P/E of 18x.
- We see recently stepped-up share buybacks cushioning the share price.

#### Consensus Rating Distribution



Source: Refinitiv, Morgan Stanley Research

#### Risk Reward Themes

**Secular Growth:** *Positive*

View descriptions of Risk Rewards Themes [here](#)

#### BEAR CASE

**HK\$300.00**

**21x bear-case non-IFRS 2024e EPS**

**Competition weighing on growth outlook with user time spent being challenged by emerging rivals**

Total Revenue: 9% 2022-25E CAGR.

Mobile Games: 12% 2022-25E CAGR.

Advertising: 10% 2022-25E CAGR.

FinTech and Business Services: 9% 2022-25E CAGR.

Non-GAAP operating margin: 24% in 2024E.

21x vs. historical P/E trading band of 18-48x since 2015.

## Risk Reward – Tencent Holdings Ltd. (0700.HK)

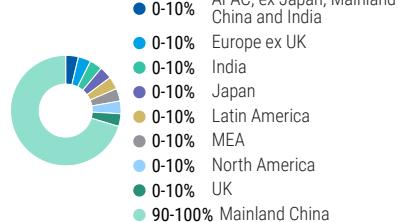
### KEY EARNINGS INPUTS

Drivers	2021	2022e	2023e	2024e
Mobile Game Revenue Growth (%)	12.4	(3.0)	12.6	13.0
Online Ad Revenue Growth (%)	7.8	(8.4)	16.8	20.2
FinTech Revenue Growth (%)	29.0	6.0	15.5	14.0
Cloud Revenue Growth (%)	58.0	(3.2)	20.1	21.0
Non-IFRS Operating Margin (%)	28.5	27.6	29.6	31.0

### INVESTMENT DRIVERS

- Video Accounts ramp-up
- Game monetization in both domestic and overseas markets
- VAS subscriber base and ARPU expansion
- Advertiser base and ARPA expansion
- Long-term growth potential in Industrial Internet

### GLOBAL REVENUE EXPOSURE



Source: Morgan Stanley Research Estimate  
View explanation of regional hierarchies [here](#)

### MS ALPHA MODELS



Source: Refinitiv, FactSet, Morgan Stanley Research; 1 is the highest favored Quintile and 5 is the least favored Quintile

### SUSTAINABILITY & ESG



### RISKS TO PT/RATING

#### RISKS TO UPSIDE

- Solid execution in new game launches, both domestically and overseas.
- Market share gain in social and short video ads.
- Resilience in social network and online entertainment competition.

#### RISKS TO DOWNSIDE

- Gaming industry regulatory uncertainties.
- Intensified competition in social networks and ad budget with emerging entertainment formats.
- Tightened regulations on antitrust and amid US/China tension.

### OWNERSHIP POSITIONING

#### Inst. Owners, % Active

70.3%



Source: Refinitiv, Morgan Stanley Research

### MS ESTIMATES VS. CONSENSUS

#### FY Dec 2022e

<b>Sales / Revenue</b> (Rmb, mn)	548,058		<b>554,675</b>	571,175
			555,150	

<b>EBIT</b> (Rmb, mn)	99,746		<b>148,567</b>	188,028
			142,828	

<b>EBITDA</b> (Rmb, mn)	150,875		<b>211,418</b>	291,198
			183,775	

<b>Net income</b> (Rmb, mn)	73,630		<b>108,297</b>	135,729
			114,301	

<b>EPS</b> (Rmb)	7.27		<b>11.27</b>	12.89
			11.70	

Mean Morgan Stanley Estimates  
Source: Refinitiv, Morgan Stanley Research

## Risk Reward – NVIDIA Corp. (NVDA.O)

EW as near-term gaming headwinds offset unique longer term growth story

### PRICE TARGET \$255.00

45x our MW CY24 EPS estimate of \$5.67, at the higher end of the growth semiconductor complex



### RISK REWARD CHART AND OPTIONS IMPLIED PROBABILITIES (12M)



Key: — Historical Stock Performance ● Current Stock Price ◆ Price Target

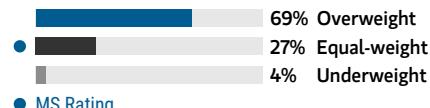
Source: Refinitiv, Morgan Stanley Research, Morgan Stanley Institutional Equities Division. The probabilities of our Bull, Base, and Bear case scenarios playing out were estimated with implied volatility data from the options market as of 01 Mar, 2023. All figures are approximate risk-neutral probabilities of the stock reaching beyond the scenario price in either three-months' or one-years' time. View explanation of Options Probabilities methodology [here](#)

BULL CASE	\$360.00	BASE CASE	\$255.00	BEAR CASE	\$159.00
55x CY24 EPS estimate of \$6.55		45x our MW CY24 EPS estimate of \$5.67		35x CY24 EPS estimate of \$4.54	
Bull case has accelerating gaming growth with DC revenues moving sharply to the upside, while Autos gain traction.		Base case assumes gaming rebounds in 2023, and cloud doesn't materially decelerate		Two key debates both go the wrong direction, causing investors to question future prospects for growth	
<ul style="list-style-type: none"> <li>- Higher margin data center and pro visualization growth accelerates</li> <li>- Lovelace product keeps gaming strong through 2023</li> <li>- LLM enthusiasm drives faster data center growth</li> </ul>		<ul style="list-style-type: none"> <li>- Revenue grows 9.8% in CY23 and up 34.3% in CY24</li> <li>- Growth remains strong in data center (HPC and deep learning)</li> <li>- Valuation remains high due to open ended nature of virtual reality, autonomous driving and data center opportunities</li> </ul>		<ul style="list-style-type: none"> <li>- Gaming slows down leading to lower revenue growth and product mix shift to Tegra (Autos) brings overall margins lower</li> <li>- AMD through its promotional efforts takes back GPU market share and/or causes Nvidia to reduce its GPU prices to compete</li> <li>- GPU sales into supercomputers and data center slow</li> </ul>	

### EQUAL-WEIGHT THESIS

- We expect NVDA's non-gaming business to drive much of the growth near-term, as we forecast a digestion period in the gaming segment. We do see some upside to conservative gaming numbers though, as new Lovelace product set for launch this fall should drive further enthusiasm, even as prices fall in the retail channels.
- Strong gaming and data center growth keeps valuation high: Stock reflects a group-high P/E multiple on the core business. This discounts several open ended growth opportunities in data center, ADAS/autonomous driving and virtual reality.

### Consensus Rating Distribution



Source: Refinitiv, Morgan Stanley Research

### Risk Reward Themes

Disruption:	Positive
New Data Era:	Positive
Secular Growth:	Positive

View descriptions of Risk Rewards Themes [here](#)

## Risk Reward – NVIDIA Corp. (NVDA.O)

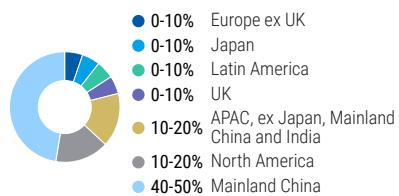
### KEY EARNINGS INPUTS

Drivers	2023	2024e	2025e	2026e
GAAP Revenue (\$, mm)	26,974	29,630	39,799	48,597
MW Gross Margin (%)	58.7	66.2	67.6	68.1
MW EPS (\$)	2.61	3.45	5.67	7.67
Inventory (\$, mm)	5,159	7,048	8,680	4,008
DOI	159.9	240.3	232.7	90.0

### INVESTMENT DRIVERS

- Slate of ray tracing and DLSS-enabled video games
- Next gen Turing gaming GPUs
- Data center continues to be a major focus as key cloud customers focus on "deep learning"
- Potential inflection in Auto revenue as ADAS level 3-5 vehicles go into production

### GLOBAL REVENUE EXPOSURE



Source: Morgan Stanley Research Estimate  
View explanation of regional hierarchies [here](#)

### MS ALPHA MODELS

5/5 BEST	24 Month Horizon	5/5 MOST	3 Month Horizon
-------------	---------------------	-------------	--------------------

Source: Refinitiv, FactSet, Morgan Stanley Research; 1 is the highest favored Quintile and 5 is the least favored Quintile

### CATALYST CALENDAR

Date	Event	Source: Refinitiv, Morgan Stanley
02 Jun 2023 - 06 Jun 2023	NVIDIA Corp Annual Shareholders Meeting	

### RISKS TO PT/RATING

#### RISKS TO UPSIDE

- Growth in DGX and deep learning training and inference propel data center revenue
- Gaming sales rebound following last year's crypto digestion
- Traction in new conversational AI workloads

#### RISKS TO DOWNSIDE

- Significant investment in new but unproven opportunities
- Continuation of sluggish PC market (~50% of revs)
- AMD reemerges as a viable GPU competitor
- Ray tracing underperforms expectations

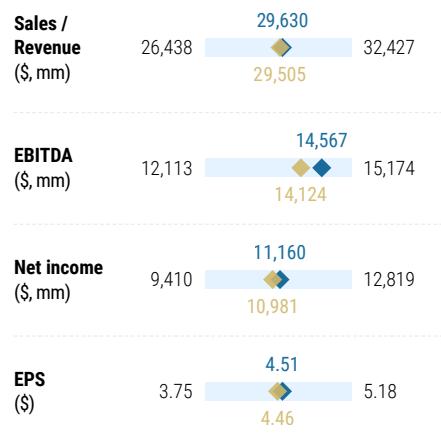
### OWNERSHIP POSITIONING

Inst. Owners, % Active	56.3%	
HF Sector Long/Short Ratio	2.1x	
HF Sector Net Exposure	30%	

Refinitiv; MSPB Content. Includes certain hedge fund exposures held with MSPB. Information may be inconsistent with or may not reflect broader market trends. Long/Short Ratio = Long Exposure / Short exposure. Sector % of Total Net Exposure = (For a particular sector: Long Exposure - Short Exposure) / (Across all sectors: Long Exposure - Short Exposure).

### MS ESTIMATES VS. CONSENSUS

#### FY Jan 2024e



Source: Refinitiv, Morgan Stanley Research

## Risk Reward – Apple, Inc. (AAPL.O)

Top Pick

Stability and Strength of Ecosystem Underappreciated by Investors

### PRICE TARGET \$175.00

Our \$175 PT is sum-of-the-parts driven. We apply a 6.3x EV/Sales multiple on Apple's Product business (iPhone, iPad, Mac, and Wearables) and a 6.7x EV/Sales multiple on Apple's Services business, in-line with their respective peer groups. We also assign ~\$160B of EV to Apple's Future Products (AR/VR, Autos, etc.), which is driven by \$21.5B of revenue and an 7.5x target EV/Sales multiple. This implies a 25.5x target P/E on FY24 EPS of \$6.85.



### RISK REWARD CHART AND OPTIONS IMPLIED PROBABILITIES (12M)



#### BULL CASE \$230.00

LTV-driven; Implies 31.6x Bull FY24 EPS of \$7.27

**iPhone shipments reach all-time record in FY23.** Consumer demand remains resilient, and stronger than expected iPhone purchase intentions and mix shift to higher end iPhone models (and capacity SKUs) drive strong iPhone shipments. Total revenue reaches \$457B in FY23, while EPS reaches \$7.01. We shift to an lifetime value-based valuation in our bull case, which gives Apple credit for the shift towards subscription. Our \$230 bull case valuation implies a 31.6x target P/E multiple.

#### BASE CASE \$175.00

SOTP driven; Implies 25.5x FY24 P/E (6.8x EV/Revs)

**Apple sees some impact from weaker consumer.** iPhone replacement cycles lengthen, Mac declines 20% Y/Y, and Wearables/iPad decline low single digits, but low double digit Services growth and iPhone ASP growth are partial offsets, leading to FY23 rev -2% Y/Y. Mix towards higher margin iPhones & Services and lower FX/inflationary headwinds leads to a mid-44% FY23 GM, and \$80B of share buybacks drives EPS of \$6.02 for FY23 or \$6.85 for FY24. Apple starts to get credit for its upcoming AR/VR launch.

## Risk Reward – Apple, Inc. (AAPL.O)

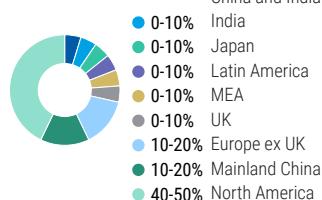
### KEY EARNINGS INPUTS

Drivers	2022	2023e	2024e	2025e
Total Revenue Growth (Y/Y) (%)	7.8	(1.7)	9.8	6.6
iPhone Revenue Growth (Y/Y) (%)	7.0	(2.5)	9.7	4.1
Services Revenue Growth (Y/Y) (%)	14.2	10.3	12.3	13.2
Gross Margin (%)	43.3	44.0	44.5	44.8
EPS Growth (Y/Y) (%)	8.9	(1.6)	13.8	7.3

### INVESTMENT DRIVERS

- iPhone, Mac and iPad share gains
- Gross margin upside
- Faster than expected Services growth
- Shift to hardware subscription model
- Expanding product portfolio in new industries such as AR/VR, healthcare, or autos

### GLOBAL REVENUE EXPOSURE



Source: Morgan Stanley Research Estimate  
View explanation of regional hierarchies [here](#)

### MS ALPHA MODELS



Source: Refinitiv, FactSet, Morgan Stanley Research; 1 is the highest favored Quintile and 5 is the least favored Quintile

### RISKS TO PT/RATING

#### RISKS TO UPSIDE

- Positive est revisions from Product and/or Services strength
- New product launches outperform expectations
- iPhone share gains from easing competitive pressure & aggressive US carrier promotions
- Shift to a hardware subscription model

#### RISKS TO DOWNSIDE

- Weaker global consumer spending
- Production shortages/China lockdowns last longer
- Greater competition in key markets
- Increased regulation, particularly around App Store

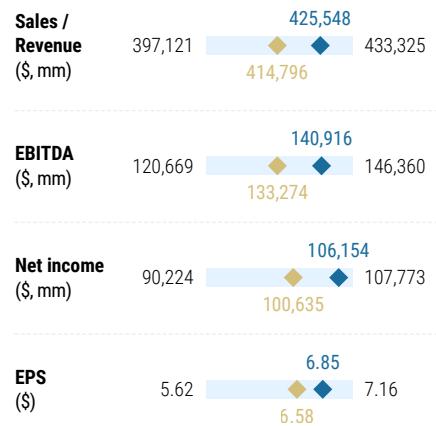
### OWNERSHIP POSITIONING

Inst. Owners, % Active	54.9%	
HF Sector Long/Short Ratio	2.1x	
HF Sector Net Exposure	30%	

Refinitiv; MSPB Content. Includes certain hedge fund exposures held with MSPB. Information may be inconsistent with or may not reflect broader market trends. Long/Short Ratio = Long Exposure / Short exposure. Sector % of Total Net Exposure = (For a particular sector: Long Exposure - Short Exposure) / (Across all sectors: Long Exposure - Short Exposure).

### MS ESTIMATES VS. CONSENSUS

FY Sep 2024e



♦ Mean   ◆ Morgan Stanley Estimates

Source: Refinitiv, Morgan Stanley Research

## Disclosure Section

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(as of February 28, 2023)

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Stock Rating Category	Coverage Universe		Investment Banking Clients (IBC)			Other Material Investment Services Clients (MISC)	
	Count	% of Total	Count	% of Total IBC	% of Rating Category	Count	% of Total Other MISC
Overweight/Buy	1353	37%	284	43%	21%	593	38%
Equal-weight/Hold	1664	45%	294	45%	18%	732	47%
Not-Rated/Hold	4	0%	0	0%	0%	0	0%
Underweight/Sell	660	18%	80	12%	12%	232	15%
Total	3,681		658			1557	

Data include common stock and ADRs currently assigned ratings. Investment Banking Clients are companies from whom Morgan Stanley received investment banking compensation in the last 12 months. Due to rounding off of decimals, the percentages provided in the " % of total" column may not add up to exactly 100 percent.

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COMPANY (TICKER)	RATING (AS OF)	PRICE* (03/02/2023)
<b>Brian Nowak, CFA</b>		
Airbnb Inc (ABNB.O)	U (12/06/2022)	\$122.38
Alphabet Inc. (GOOGL.O)	O (08/11/2015)	\$92.00
Amazon.com Inc (AMZN.O)	O (04/24/2015)	\$92.13
Booking Holdings Inc (BKNG.O)	E (01/09/2019)	\$2,577.83
Compass, Inc. (COMP.N)	E (07/20/2022)	\$3.02
Despegar.com Corp (DESP.N)	E (10/16/2017)	\$6.14
DoorDash Inc (DASH.N)	E (04/24/2022)	\$55.28
Expedia Inc. (EXPE.O)	E (01/09/2019)	\$105.78

Lyft Inc (LYFT.O)	E (10/24/2019)	\$9.78
Meta Platforms Inc (META.O)	E (10/27/2022)	\$174.53
Nextdoor Holdings Inc (KIND.N)	E (02/24/2022)	\$1.91
Pinterest Inc (PINS.N)	E (03/28/2022)	\$25.34
Snap Inc. (SNAP.N)	U (07/25/2022)	\$10.10
TRIVAGO NV (TRVG.O)	E (09/28/2017)	\$1.75
Uber Technologies Inc (UBER.N)	O (06/04/2019)	\$33.69
Wheels Up Experience Inc. (UP.N)	U (11/08/2021)	\$1.12
Zillow Group Inc (Z.O)	E (04/18/2018)	\$42.15
<hr/>		
<b>Lauren Schenk</b>		
Bumble Inc. (BMBL.O)	E (03/08/2021)	\$24.54
Chewy Inc (CHWY.N)	E (04/16/2020)	\$40.00
eBay Inc (EBAY.O)	U (06/23/2022)	\$45.58
Etsy Inc (ETSY.O)	E (08/04/2021)	\$118.46
Farfetch Ltd. (FTCH.N)	O (11/17/2020)	\$4.94
FIGS, Inc. (FIGS.N)	E (06/21/2021)	\$6.98
Match Group Inc (MTCH.O)	O (06/17/2021)	\$41.72
Mytheresa (MYTE.N)	E (04/12/2022)	\$8.32
Peloton Interactive, Inc. (PTON.O)	E (03/14/2022)	\$12.92
RealReal Inc (REAL.O)	E (11/17/2020)	\$1.46
Rent the Runway, Inc. (RENT.O)	E (11/18/2022)	\$3.46
Revolve Group Inc (RVLV.N)	E (02/24/2022)	\$27.18
Rover Group Inc (ROVR.O)	E (08/06/2021)	\$4.30
Shutterstock Inc (SSTK.N)	E (07/28/2022)	\$74.78
Stitch Fix Inc (SFIX.O)	E (12/03/2021)	\$4.77
ThredUp Inc. (TDUP.O)	E (04/20/2021)	\$1.65
WW International Inc (WW.O)	E (04/07/2021)	\$3.87
<hr/>		
<b>Matthew Cost</b>		
Activision Blizzard Inc (ATVI.O)	++	\$77.71
AppLovin Corp (APP.O)	E (11/27/2022)	\$13.70
Criteo SA (CRTO.O)	E (01/26/2016)	\$32.54
Electronic Arts Inc (EA.O)	E (08/04/2021)	\$112.29
Innovid Corp (CTV.N)	E (01/17/2023)	\$1.60
Integral Ad Science Holding Corp. (IAS.O)	O (07/26/2021)	\$10.70
Playstudios Inc. (MYP.S.O)	E (09/23/2021)	\$3.77
Playtika Holding Corp (PLTK.O)	E (11/27/2022)	\$9.72
Quotient Technology Inc. (QUOT.N)	U (12/19/2019)	\$3.35
Roblox Corporation (RBLX.N)	U (01/19/2023)	\$39.23
SciPlay Corporation (SCPL.O)	E (05/28/2019)	\$16.99
Take-Two Interactive Software (TTWO.O)	O (02/01/2018)	\$115.28
Trade Desk Inc (TTD.O)	E (10/18/2022)	\$56.39
Unity Software Inc (U.N)	E (11/27/2022)	\$29.42
Yelp Inc (YELP.N)	U (01/10/2019)	\$30.26

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# Morgan Stanley

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