Big Ideas in Tech for 2023: An a16z Omnibus

by [a16z](#)

This time of year, the floodgates open to a deluge of best-of lists and end-of-year recaps. But we at a16z have always been more interested in what's to come. We asked dozens of partners across the firm to spotlight one big idea that startups in their fields will tackle in 2023. From entertainment franchise games to the precision delivery of medicines, small modular reactors to loads of AI applications, here are 40+ builder-worthy pursuits for the year ahead, according to the a16z team.

Breakthroughs in Buying (Finally!)

Social commerce, discovery commerce, video commerce — these trends are inevitable, and 2023 will be the year it all becomes obvious. Social platforms will become a natural place for product discovery. And platforms will seek to ease the friction between inspiration → purchase intent → and completed

purchase. Whether short-form, long-form, or livestream, video is a fantastic way to sell things and teach consumers about a product's value proposition. This will birth an entirely new ecosystem where anyone can become a seller, and new companies can help everyday creators curate and sell products and services.

—*Connie Chan, general partner, consumer team (*[*@conniechan*](#)*)*

Labor Marketplaces Become Specialized

Almost 40% of Americans switched jobs during Covid, and many more are still looking to make a career change. Major industries are facing unprecedented labor shortages. Much of this turmoil has been absorbed by sectors that are operating with legacy tech, such as construction, manufacturing, hospitality, retail, healthcare, and education.

This creates a massive opportunity for companies that change the way companies hire and retain talent. For businesses, being able to source and vet qualified candidates is more important than ever, especially as most industries don't have a LinkedIn equivalent. It's likely that in 2023, a new wave of labor marketplaces will help employees build identity and reputation, connect directly with hiring managers, and get training and resources to build their careers.

—*Olivia Moore, partner, consumer team (*[*@omooretweets*](#)*)*

Mainstream AI Adoption: More *Fun* Than You Think

It often takes a user-first mentality for consumers to adopt the latest tech at scale — with AR, for example, users picked up on Pokémon Go and Dog Ear face filters. These products often look like toys, initially: imagine how an AR expert may have felt to learn that one of the most-used applications of the

technology would be to put beautification lenses on selfies! The same goes for AI. So many of the latest breakthroughs in AI are about enabling transformation between modalities, whether speech-to-text, text-to-images, or images-to-videos. People are just starting to play around with these technologies. In 2023, AI-focused founders will put user behaviors and psychology first to create products that can be readily embraced by everyday consumers.

—*Bryan Kim, partner, consumer team ([@kirbyman01](https://twitter.com/kirbyman01))*

Unlocking the "Third Place"

Ray Oldenburg coined the term "[third place](https://en.wikipedia.org/wiki/Third_place)," places that host "regular, voluntary, informal, and happily anticipated gatherings" outside of home or work. These used to be IRL community-gathering spots such as bars, coffee shops, churches, gyms, and clubs… But remote and hybrid work, as well as this generation's natively digital habits, have given way to an online-first era. So many interactions and first encounters occur online, whether it's over Zoom or meeting a like-minded friend with similar interests over Twitter or TikTok, or in a Discord group or a game. What are the next generation of tools and platforms that are built to serve consumers, community builders, and creators in the post-Covid, hybrid world? How can new technology such as generative AI create user experiences that facilitate deeper discussions and relationship building (between real humans — not bots!)?

—*Anne Lee Skates, partner, consumer team ([@anneleeskates](https://twitter.com/anneleeskates))*

Tech Reveals New Sources of Inventory

Next year will be the year of inventory in consumer commerce. The internet has enabled a new generation of entrepreneurs that are selling products on ecommerce sites and social/live-streaming platforms like Whatnot or TikTok. Many of them excel at building an audience, engaging their viewers, and

driving sales, but they don't want to be financing, manufacturing, and shipping their own products.

In 2023, I think we'll see a wave of companies that enable sellers to tap into alternative sources of inventory. The sky's the limit: that could be new or used products, products sourced directly from manufacturers, or products routed from retailers with overstock/returns. There's an enormous opportunity to build the "pipes" that connect sellers with this inventory. Bonus points if you allow consumers to score discounts or access inventory that they wouldn't normally be able to get their hands on.
—*Justine Moore, partner, consumer team (*@venturetwins*)*

Craigslist, Dismembered and Reinvented

Craigslist has long been the leading digital classifieds site in the U.S., but they stopped innovating (and stopped growing) many years ago. Now creative entrepreneurs are systematically ripping categories out of the platform by providing superior user experiences — think Airbnb for room-sharing and Uber/Lyft for ride-sharing. But a few ripe categories remain to be ripped, including blue-collar jobs, home services, and rentals.
—*Jeff Jordan, general partner, consumer team (*@jeff_jordan*)*

B2C Gets B2B Distribution

Facing poor unit economics and an impending recession this year, many direct-to-consumer companies cut their marketing spend. This lower absolute dollar spend, coupled with less competition for ads, led to decreases in consumer acquisition costs (CAC). As management teams ramp up in the coming year, we expect consumer companies to pursue B2B partnerships to drive non-inflationary distribution, avoiding the typical Facebook, Instagram, Google, and Apple "taxes." Our partner, Joe, recently

described this phenomenon as "[escaping hell's flywheel](#)."

By creating partnerships with set pricing, CACs become more predictable — and business becomes more sustainable. We've already seen early signs of this, such as Greenlight reaching new families via Chase, Hopper booking trips powering Capital One Travel, and Bilt achieving new card sign-ups through an alliance of residential property managers. We can imagine consumer businesses reaching white-collar employee bases via Gusto and Rippling; gig workers via Uber, Lyft, DoorDash, and Instacart; or young adults via colleges and military organizations. There are so many platforms to leverage that do not, themselves, want to be in the partner's specific model. —*Alex Immerman and Jamie Sullivan, partners, growth team ([@aleximm](#))*

Precision Delivery of Medicines

The past few years have brought us a wealth of new therapeutic modalities capable of achieving functions only dreamed of in science fiction novels — correcting faulty genes, curing inherited disease, imparting novel functions to our body's cells that even years of evolution haven't accomplished. However, medical utility of all these new technologies requires one common

trick: delivering them to the cells in the human body where they will work their magic.

We have recently witnessed a boom of creative academic research and innovative startup companies tackling exactly this problem. However, the field still struggles to safely and efficiently deliver these novel therapeutic modalities to the vast majority of organs beyond the liver, limiting therapeutic utility. Delivery has become an industry-stalling bottleneck.

In 2023 we hope to finally see a breakthrough in precision delivery that will unleash a landslide of queued-up therapeutic approaches to progress into the clinic. This advancement will be enabled by a shift from empirical screening-based discovery to rational design, incorporating big data and computational prediction. The decade of delivery is upon us.
—*Vineeta Agarwala, general partner, and Becky Pferdehirt, partner, bio + health team (*[*@vintweeta*](#)*) (*[*@beckypferdehirt*](#)*)*

Chemical-Induced Proximity

Nature controls the proximity of biomolecules like RNA, DNA, and proteins to control cellular processes.

A major way nature controls biomolecule proximity is through chemistry, a concept known as chemical-induced proximity. For instance, plants and microorganisms evolved to produce chemicals that often serve as survival or predatory mechanisms against competitors and function by inducing proximity between critical biomolecules.

Scientists have long leveraged the principle of induced proximity to study biological processes and more recently to build novel therapeutics. A new generation of proximity-inducing chemical drugs, such as PROTACs (protein degraders), have shown incredible promise in the clinic.

We've only begun to scratch the surface of proximity-inducing chemistry and in 2023 we expect continued breakthroughs in the field. We're on the lookout for molecules that can introduce or remove novel modifications to proteins, regulate gene activity, and target RNA directly.
—*Vineeta Agarwala, general partner, and Ben Portney, partner, bio + health team (@vintweeta)*

The Modern Bio Software Stack

As software "eats" every step in the life sciences value chain — from discovery to development to distribution of new medicines — the industry will have to continue engineering new processes at each step, in order to actualize the productivity gains made possible by machine learning. In other words, new tools are required. Today, bio companies developing new therapeutics and diagnostics are also building new tools with which to engineer biology out of sheer necessity.

If this trend plays out as we expect, and we're able to read, write, and execute biology, eventually there will be further specialization of labor between drug makers and tool makers. Drug makers will continue to focus their time, effort, and resources toward being the best at developing drugs — perhaps akin to original equipment manufacturers (OEMs) in the computer, automotive, and aircraft industries. Tool makers will focus on making the best tools.

The pandemic and the current macroeconomic environment are accelerating this trend toward engineering new tools. As approximately more than 300 biotechs trade at market capitalizations below the cash on their balance sheet, and the cost of capital continues to rise, life sciences companies have an even greater need for better software and data tools to conduct science more efficiently. The industry's appetite for science-native software-as-a-

service tools is accelerating.
—*Jorge Conde, general partner, and Jay Rughani, partner, bio + health team (@jorgecondebio) (@jayrughani)*

The Biggest Company in the World

The biggest company in the world will be a consumer health tech company.

This may sound crazy to some, but why shouldn't this be true? Four of the top five biggest companies in the world are consumer companies and healthcare is one of the nation's biggest industries.

Much larger, in fact, than the size of the *global* advertising industry in which consumer giants like Google and Meta operate. From that standpoint, the #1 slot *should* belong to a consumer health company.

We see two paths to a consumer health startup becoming the biggest company in the world:

The first is a vertically integrated path of building a "payvidor" (a combined payor and provider) that eventually owns most care. Imagine UnitedHealth Group but with the UX of Apple — who wouldn't choose this insurance plan and provider? The second is a horizontal path of building a consumer marketplace or infrastructure layer that enables all other care delivery companies. Imagine the Amazon or Visa of healthcare.

We'd go so far as to say there is infinite room to improve the consumer experience in healthcare — and build massive companies as a result. We expect consumer healthcare to be front and center in 2023.
—*Vijay Pande, general partner, and Daisy Wolf, partner, bio + health team (@vijaypande) (@daisydwolf)*

The Value-Based Care Stack

As we sit somewhere in the murky middle of the adoption curve and hype cycle of value-based care (VBC), we're unabashedly VBC optimists. We're also eyes open that many "value-based" models haven't delivered value yet. One major reason for this is that clinical and operational models from the legacy fee-for-service (FFS) world have been transplanted into value-based paradigms, resulting in the gaming of the system versus a reorientation of care models to be focused on value from the ground up.

VBC *done right* demands purpose-built approaches that will be built on a fundamentally different stack. This emerging stack will support new entrant value-based digital health players and incumbents alike around unique requirements to deliver higher-value care: data aggregation and activation; actuarial modeling, contracting, and adjudication; panel management; continuous care workflow support; and provider ecosystem integration around referrals, co-management, and network design to name a few.

If the [first generation of the Digital Health Tech Stack](#) was about enabling administrative and operational efficiency for virtual-first providers, the next generation will be about helping providers bear risk, and enabling payors to collaborate in a more integrated fashion with their risk-bearing provider networks. We see this stack emerging in many product phenotypes — from SaaS platforms, to solution marketplaces, to MSOs — to service a range of buyer segments and technical sophistication.
—*Julie Yoo, general partner, and Justin Larkin, partner, bio + health team ([@julesyoo](#)) ([@justin_larkinMD](#))*

Compliance as a Competitive Advantage

If "software is eating the world," it has not yet taken a big enough bite out of compliance. Post-Dodd-Frank, financial services companies face more than 50k regulations across dozens of federal and state agencies (and that's just in the United States). The existing and very manual compliance and risk processes are failing at both large financial institutions and at fintech startups supported by sponsor banks. Furthermore, while compliance is complex for businesses operating in just one geography, it's even more difficult to manage across multiple countries. As more global companies embed fintech, the need for global compliance and risk infrastructure increases.

In 2023, companies of all sizes will turn to software to solve their challenges. We expect to see more tools for sponsor banks to manage third parties; for fintech companies and companies embedding financial services to manage all aspects of risk and compliance; and more compliance infrastructure serving default global companies.

—Angela Strange, general partner, and Joe Schmidt, partner, fintech team

(*[@astrange](#)*) (*[@joeschmidtiv](#)*)

Tools for Stretching your Dollar

While we've seen significant focus and investment over the past 5+ years on innovating around the front-end of financial transactions, we'll see a market shift in 2023 toward building tools to better manage the often unseen (yet vital) back-office functions of running a healthy financial services business. With the backdrop of a challenging macro environment, a renewed focus on cash management, equity efficiency, and preserving capital markets relationships will spawn both the adoption and proliferation of a host of new tools and services to help companies better manage their financial health. Stretching your dollar is back in vogue (as are the tools to make it happen)!
—*David Haber, general partner, fintech team ([@dhaber](#))*

GPT Unlocks Credit Counseling

OpenAI — the ChatGPT interface in particular — is driving one of the most interesting new product cycles in fintech and financial services.

One way to think about this technology is that it unlocks labor supply at 10x a lower cost than humans. Previously, for example, the only cost-effective way to deliver credit counseling was to subsidize the human costs with high fees (either directly, or bundled into the cost of financial products) or to deliver a less personalized experience with an app. Since neither of these is a great solution, most folks have been left to fend for themselves.

The ability of ChatGPT to take input and deliver a near-human-quality credit counseling experience changes all of this. We expect to see this capability — and services like it — become available for subprime and early-credit consumers in particular. In that simple financial coaching could dramatically

improve many consumers' credit files, this technology could act as a counterweight to some of the negative macroeconomic factors currently affecting consumer credit, such as inflation, job loss, and depleted savings accounts.
—*Anish Acharya, general partner, fintech team (*[*@illscience*]*)*

The Infrastructure Stack for Business Banking

As [every company becomes a fintech company](), we have seen an explosion of fintech infrastructure companies: KYC/AML, data APIs, bank accounts as a service, issuer/processors, etc. Thanks to these companies, it is much easier to launch a new fintech company, and for software companies to embed fintech.

However, many of these infrastructure companies cater to consumer use cases, forcing companies tackling business use cases to continue to build some of their own infrastructure. In 2023, we expect to see more companies tackling the infrastructure layers needed to bring business banking into the digital age (at most banks, the business owner is still required to show up in person just to open an account!). These infra tools will also accelerate B2B marketplaces and software platforms adding financial services for their business users.
—*Angela Strange, general partner, and Marc Andrusko, partner, fintech team (*[*@astrange*]*) (*[*@mandrusko1*]*)*

The Race for "Know-Your-Everything"

In 2023, both new founders and existing startups will continue to vie for the most coveted spot within fintech infrastructure: the one-stop-shop for identity verification and onboarding. To date, Know Your Customer (KYC) software has been more developed than Know Your Business (KYB). That

said, given the latter's obvious pain points — from onboarding to credit decisioning — we expect the KYB ecosystem to mature. Currently, the challenges are especially onerous for cross-border use cases, as different data sets across geographies can compound the verification process. This need for better identity tools has been exacerbated by increased regulatory scrutiny on fintech companies, particularly around AML and fraud.

What might we see? First, we expect the leading players in KYB and KYC to each offer the other service. Much of the subcomponents and data from the KYB process overlaps with KYC. This is particularly true for businesses attempting to serve SMBs — since most components of sole proprietorship registration are entirely self-reported by an individual, they require more extensive KYC checks. Second, we'll see more proprietary analytics and identifiers. Many leading KYC startups aggregate hundreds of disparate data sources to provide comprehensive coverage, but few have been able to convert this data into a proprietary identifier. Finally, the identity verification players can vertically integrate by expanding more broadly into areas like onboarding and credit-related workflows.

—Seema Amble and Marc Andrusko, partners, fintech team ([@seema_amble](#)) ([@mandrusko1](#))

Fintechs Are Becoming Banks

With deteriorating credit performance in 2022, capital providers have tightened their requirements, making it more challenging for marketplace lenders to grow originations. Digitally enabled lenders are increasingly focused on access to stable capital sources, such as long-term forward flow agreements, warehouse facilities, and customer deposits.

SoFi and LendingClub have highlighted their decision to purchase bank charters for providing certainty and lower cost of funding. With customer

deposits on the balance sheet, they "control their own destiny" in an uncertain macro climate. By contrast, this environment has been less favorable to Upstart and other marketplace providers.

In 2023, we expect more digitally native lenders to pursue bank charters. In the current higher interest rate environment, marketplace lenders are offering high-yield accounts to collect deposits on behalf of their capital partners who in turn buy their loans. This strategy may be a first step toward building their own capital base. As these digital lenders look to become banks, what remains to be seen is how regulators will respond. That's always an open question…

*—Alex Immerman and Justin Kahl, partners, growth team ([@aleximm](https://twitter.com/aleximm))
([@justin_kahl](https://twitter.com/justin_kahl))*

Payment Infrastructure Opportunity In Latin America

Over the past decade, a wave of vertical SaaS companies — Toast, ServiceTitan, and Procore among them — empowered SMBs in the U.S. to run their operations more efficiently. Though the vertical SaaS revolution has not yet come to Latin America, we are seeing early indications that SMBs in the region understand the value of software.

For vertical SaaS companies in the U.S., offering integrated services such as payment processing and payroll was key to strengthening and monetizing their relationships with merchants. In Latin America, where there's a low willingness among SMBs to pay for software, these integrated services play an even bigger role for vertical SaaS players.

Hence, I see an opportunity for a white-label payment processor in Latin America. Until now, there have been very few players offering such services

with legacy technology; those that do are mainly focused on enterprises and large startups. However, there is currently an opening to serve high-growth, early-stage vertical software players (and later expand to a broader market). In addition, by taking advantage of new technologies such as NFC (near-field communication), which turns cell phones into point-of-sale terminals, startups can cut into the high cost of hardware that legacy players currently contend with.
—*Gabriel Vasquez, partner, fintech team ([@GEVS94](#))*

Embracing Large Language Models While Maintaining Trust

In 2023, fintech companies will need to strike a delicate balance between pushing the envelope by building with new technology rails such as Large Language Models (LLMs), but also maintaining customer trust. While potential use cases within fintech are still emerging, LLMs like GPT-3 and the upcoming GPT-4 may help businesses train datasets much more quickly and cheaply. In addition, they may finally be able to fully automate data-heavy and manual tasks, such as insurance claims processing or loan origination, that have only been semi-automated in the past.

But while LLMs can address some low-hanging fruit, more complex use cases will require reserves of user trust. When dealing with, say, fully automated investment decisions or automatic financial reporting for businesses with complex money flows, companies will need to balance these new services and experiences with potential skepticism from customers.
—*Sumeet Singh, partner, fintech team ([@sumeet724](#))*

FedNow May Be Just the Beginning

Skeptics of the highly anticipated launch of the [Federal Reserve's real-time](#)

[payment network, FedNow](#), point to the limited use of the existing networks in the U.S. The one key difference, however, is ownership: RTP and Zelle are owned by consortiums of the largest commercial banks in the U.S. Why will government ownership of a national real-time payment rail make a difference? It will incentivize third-party infrastructure built on top of payment rails, as has been the case across the world.

In Brazil, Nubank offers its customers the ability to pay via PIX with credit, creating an alternative to its own credit cards. In Australia, Zepto helps merchants issue and settle refunds in real-time, driving increased customer loyalty. And in Europe, Volt enables pay-by-bank (in real time) across national payment rails, a key necessity for cross-border ecommerce. These use cases and more are built on top of "public" payment infrastructure, which has not been possible in the U.S. until now.

A public payments infrastructure is an invitation to create new use cases, features, and functionality of real-time payments. Maybe now we can catch up to the rest of the world?
—*Santiago Rodriguez, partner, growth team*
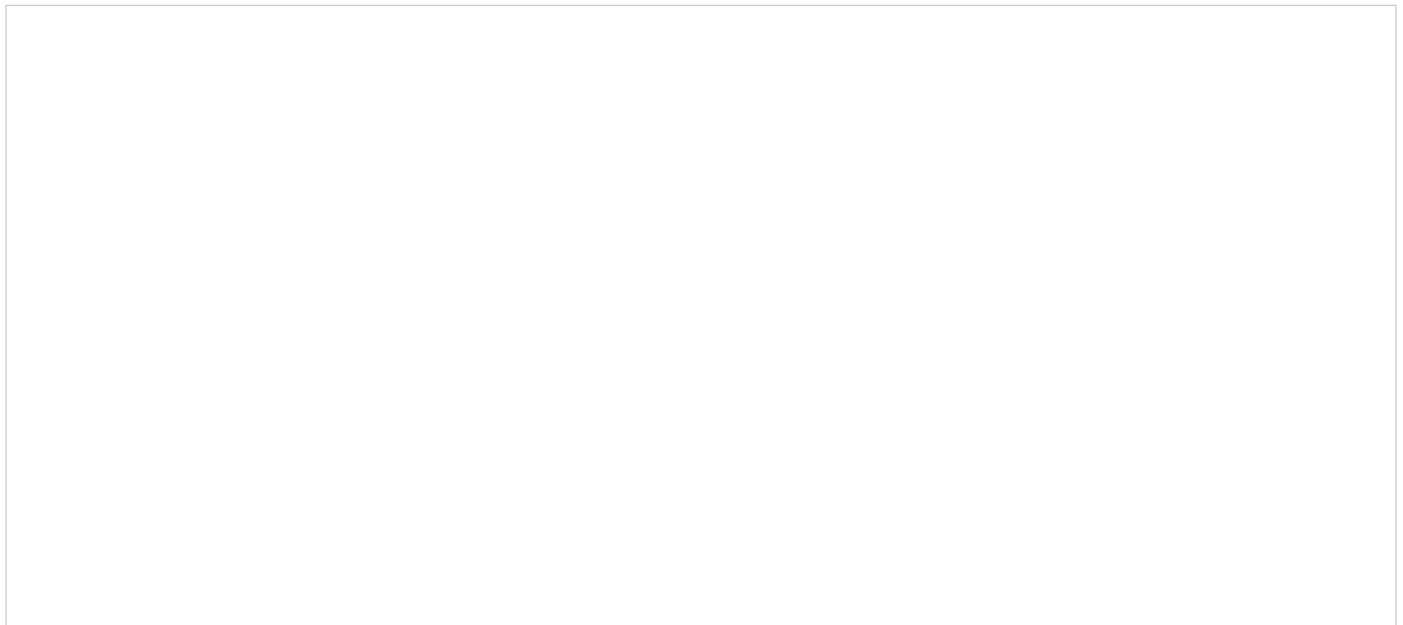
Web3 Games Persist — and Thrive

We're on the cusp of unlocking a new generation of web3 native games that will be fun, broadly appealing, and uniquely enabled by blockchain technologies.

It usually takes a few tries for developers to learn to build on new platforms. Take mobile games: Pokémon Go was one of the first true mobile-native games, enabled through features unique to smartphones, such as GPS and the integrated camera. Yet its prototype, Ingress, didn't launch until five years after the release of the iPhone in 2007. We can't rush the product cycle. I believe we'll see the first web3-native games emerge in the coming years, perhaps sooner than we think.

In the near term, there are also opportunities to extend existing game genres with open economies. In the past, the next big game often rose from player "mods" like DOTA (League of Legends) or DayZ (PUBG). Game modding is turbocharged with web3 composability, in which creators can leverage each other's assets freely with ownership and financial rewards automated by code.
—*Jonathan Lai, general partner, games team ([@tocelot](https://a16z.com))*

Production-Ready Generative AI for Every Type of Game Asset

The biggest revolution to hit gaming in 2023 will be the creation of production-ready generative AI models for all asset types needed to produce a modern game.

Games are currently the most complex form of entertainment, involving dozens of different types of creative assets combined in complex production pipelines. Asset types include 2D art, 3D models, textures, sound effects,

music, characters, animations, level designs, cinematics, and more. And each of these asset types has its own highly specialized production process, with dedicated tools and artists.

Generative AI today is getting the most attention for creating 2D images. But there's a [quiet revolution happening](): scientists are working on AI models for all asset types. 3D models. Music. Sound FX. Much of this work is still at the research stage, but we're seeing startups quickly forming around each model type with an aim of productizing the work.

By the end of 2023, it'll be possible to use a text prompt to generate virtually any asset needed to produce a game. "Sound effect of footsteps for a heavy woman in heels on gravel," "3D model of a futuristic battle tank with a laser gun." The effect of this will be to unlock creativity like we've never seen.
—*James Gwertzman, general partner, games team ([@gwetz]())*

Entertainment Franchise Games Will Explode

We are not past the days of entertainment franchise games (e.g., [Kim Kardashian]() or the K-pop supergroup BTS and its [many]() [mobile]() [games]()). In fact, I expect they'll become even more popular in 2023.

First, as generative AI decreases the cost of producing art and game assets (see [Stable Diffusion Tutorial]()), franchises can transfer their IP into games. Second, as the economy continues to place pressure on businesses, franchises will monetize their core users (games always monetize deeper player experiences). Lastly, games will not just be limited to a simple casual mobile experience; we will see more complex games combined with different properties, like Disney x MOBA or Kpop x Wattpad. Multiple genres of games will be commonplace. A single game with thousands of users won't be enough to be a franchise. Instead, thousands of different games will create a

franchise.

As games proliferate, game infrastructure will need a way to exchange assets seamlessly into a game. A decade ago, this was the animations and sprites made in Flash editor and dropped into games like FarmVille using ActionScript3. Whoever creates that system will be a core layer of the game infra stack and will allow developers to create more (and better?) games.
—*Andrew Lee, entrepreneur in residence, games team ([@ndrewlee](https://twitter.com/ndrewlee))*

Games Developed on Mobile, for Mobile

What will the next big UGC game creation platform look like? What will be the next Roblox? I believe we'll see more mobile-first game creation.

Say I've fallen in love with a racing game, but I want to swap out the car for Santa and his sleigh, add snow banks and Christmas trees along the road, and reconfigure the map. I hit "remix" and am presented with level and terrain-editing tools. I use generative AI to generate my Santa, then style transfer the game from voxel to claymation. Hit publish and share with my friend.

Seventy-two percent of Roblox sessions happen on mobile, yet creation tools are locked to a desktop client on PC, severing the flywheel from player to creator. Roblox Studio, the PC editor application, remains too technical for most users, which explains why less than 5% of players ever become creators. With AI-assisted and cloud-based tools, a new UGC mobile-first platform will emerge. This platform will have a discovery mode UX more akin to TikTok than Roblox or Netflix, delighting users immediately upon opening the app. Mobile game creation mode: unlocked.
—*Troy Kirwin, partner, games team ([@TKexpress11](https://twitter.com/TKexpress11))*

Games as Theater

"Red vs. Blue" was one of the earliest hits on YouTube. This 2004 web series birthed the style of "machinima" that uses manipulated in-game character models and modded camera angles to tell stories within video games.

Since these days of "hacking" in-game assets for the purpose of theater, Minecraft, Fortnite, Roblox, and GTA have all invested in tools and modes for creators. Games quickly became the canvas, the paintbrush, and the colors for young creatives.

More than a decade after its launch, Minecraft remains one of the most lasting generational games of its time, being the first identifiable IP to reach one trillion views on YouTube. This is largely due to the boundless nature of creativity of the IP, compounded by updated worlds, physics, and assets.

In the shift of the industry to F2P and Live Ops, developers have placed less of an emphasis on custom lobbies, spectator tools, and the idea of games as theater. As the concept of the metaverse evolves, I hope that developers in 2023 will shift back to this idea of launching games that focus on creative tools, features, and infrastructure as an integral part of their games' core loop.
—*Lester Chen, gaming creators partner, games team (*[*@chen*](#)*)*

Games Supplant Social Networks

In 2023, I expect games to take the reins from social networks in new and meaningful ways.

Games have always been strong social networks. Facebook and World of Warcraft both launched in 2004, and by the end of 2005, Facebook had roughly six million users and WoW had roughly five million. In each, long-term retention was caused by acts of reciprocity (pokes vs. guild gifts) and competition (vacation photos vs. armor sets). The longest-lasting games are

social networks because they turn players into a more sustainable source of content than generating more levels, monsters, and quest lines.

Today, games and social networks have become even more indistinguishable. Fortnite is built as a massively synchronous battle royale with a discrete winner, but it has become part of the zeitgeist not via balanced gunplay or map design, but because of self-expression via sharable/streamable avatars/emotes and team-based cooperation. This year, Ready Player Me inked [thousands of partnerships](#) with game developers to bring ultra-customizable avatars to millions of players. 2022 also saw the rise of Diablo Immortal, the first massively multiplayer online game (MMO) for millions of mobile-first gamers. In 2023, I expect players will spend even more time in games and virtual worlds hanging out and connecting with friends.
—*Joshua Lu, partner, games team ([@joshlu](#))*

Games as a Neverending Turing Test

It's not hard for a computer to deceive a human. From ELIZA to ChatGPT, computers have successfully masqueraded as humans. This phenomenon also occurs in games through the mass prevalence of "bots." Bots have historically been scripted procedures, but are increasingly becoming true neural network-based AIs.

As AI progresses and games grow larger, more complex, and more realistic, these bots increasingly convince humans. Think of the rumored concurrency bots in Words with Friends, the close-win bots in Call of Duty Mobile's onboarding, or the prevalence of cheaters/bots in chess.

The next generation of these bots will take "human-like" to a whole new level. Startups like InworldAI, ConvAI, or Charisma.ai are making in-game

agents that understand game state and have objectives, emotions, conversations, animations, and more. Imagine walking through the wilderness not knowing whether your clan's mage is a bot, building a town with strangers without knowing the humanity of the local farmer, playing a game of Diplomacy but not knowing if Turkey is an AI whose sole purpose is European domination.

In the year ahead, you may not know who's who anymore — and you won't mind. Games are good alone, but better together. Or so you think.
—*Jack Soslow, partner, games team ([@jacksoslow](https://twitter.com/jacksoslow))*

AI Native Games

Game development is one of the first industries to experience significant disruption due to generative AI. New tools are already allowing artists and writers to offload the initial (and mechanical) spark of creation to generative models and to refocus their efforts on editing and refinement.

But the AI innovations impacting players will be even more exciting than those that are benefiting developers. AI has continuously redefined what is possible in game design and gameplay experiences. I will always remember the initial frenetic excitement of Unreal Tournament botmatches, exploring the endless frontiers of Minecraft, and the unique thrill of a perfect Hades run — both the awe they evoked and the impact they had inspiring the next generation of games.

What will be possible with a new generation of games designed natively for AI? We'll see emergent, procedurally generated worlds, each populated with their own rich histories, inhabitants, and mysteries. There will be Interactive fiction where the stories continuously evolve through player choice, and are told through generative images, video, and audio. The possibilities are

endless, and what is merely possible today will soon be ubiquitous.
—*Justin Paine, business development partner, games team ([@justinspaine](#))*

Web3 Games Redefine Fun

Given the longer development cycles of games—anywhere from two to seven years — I expect the current bear market will separate the builders from the tourists. The strong web3 studios have realized that financial rewards, great art, and tokenomics alone aren't enough to drive a sustainable game over time. These games also need to be *fun*.

In the year ahead, developers will pinpoint what makes their games intrinsically fun — and why web3 is a necessary component. Speculation and trading is one form of entertainment (see Runescape or World of Warcraft or even Wall Street Bets), but the spectrum of fun in games is wide. Is your game focused on intense moment-to-moment team fights and strategic choices, like League of Legends? Or an extensive progression system, like Diablo? Simple, repetitive, yet enjoyable puzzles like Candy Crush, or a cozy decorative experience like Animal Crossing? Web3 game studios may go back to first principles as to what who game is serving, how to over-serve those players, and what role crypto has in their titles. Then they'll test, test, test to see if they've found the fun.
—*Robin Guo, partner, games team ([@zebird0](#))*

The Metaverse Goes Fashion Forward

Gamers know that character skins in games like League of Legends and Fortnite are an important form of self-expression as they become part of a player's identity. That's why character skins are big business, despite having no gameplay benefits.

Digital natives, Gen Z, and Gen Alpha demand that brands enable self-expression in the Metaverse. Of that group, 2 in 5 already believe that self-expression via fashion is more important in the digital world than the physical, and 3 in 4 say they will spend money on digital fashion.

Brands that lean in, like Gucci, will be rewarded by the hearts and wallets (both physical and digital) of consumers. And as physical brands go digital, more digital brands will go physical, creating even stronger competition and broader adoption. Brands that don't go all in will be left behind.

Consumers will demand interoperability across experiences in the Metaverse, so over time brands will favor platforms that enable them to wear their Nike shoes in different games and virtual worlds. Gen Z and Gen Alpha move seamlessly between the physical and digital worlds. The fashion brands that embrace this will win.
—Doug McCracken, marketing partner, games team (@dougmccracken)
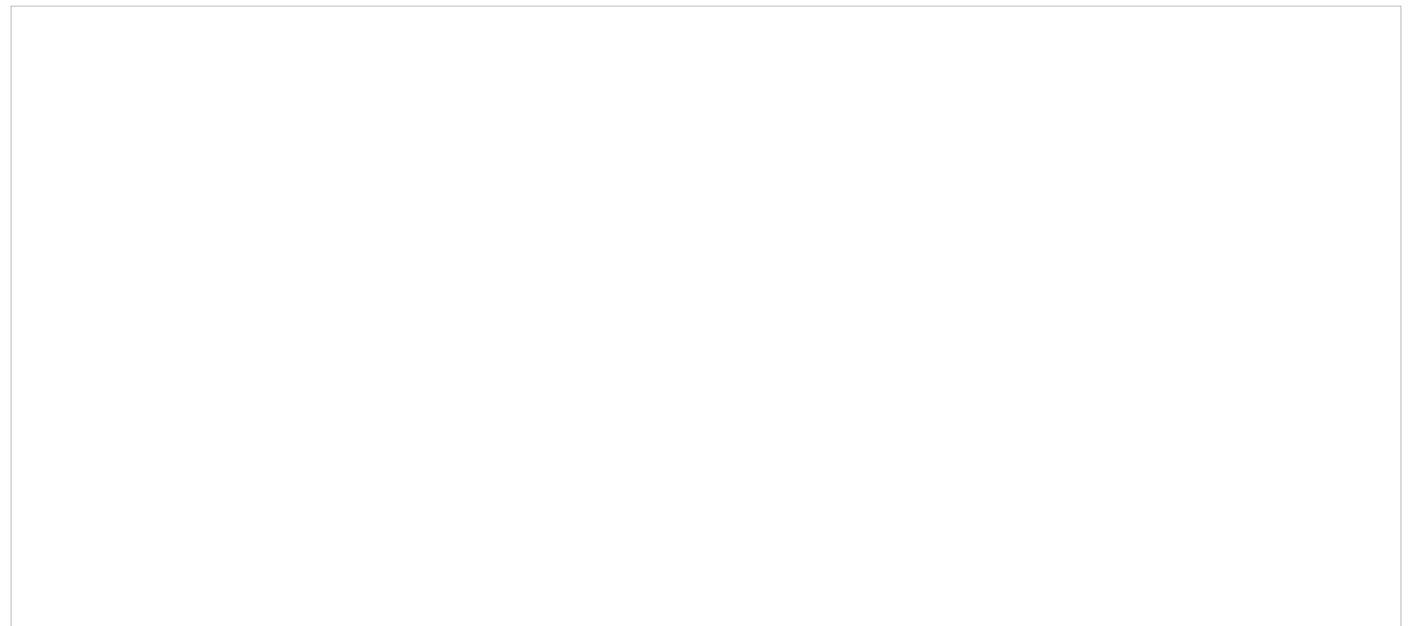
Overhauling the Space Supply Chain

Civilization's ancient past is segmented by advancements in mining and

metallurgy — the Stone, Bronze, and Iron Ages. In each period, success over your rivals was determined by your ability to collect resources and produce increasingly useful technology.

Today, we are in the Space Age, and the same rules apply. Space supremacy will be the measuring stick of industrial and military power for the foreseeable future. It's already supporting our digital economies and guiding our autonomous systems. But the true Space Industrial Base is much broader. We not only need to construct advanced rockets and satellites, but gather the materials and industrial capacity to do it reliably at scale.

Space does not begin at lift-off. A complex, global supply chain — from mining to launch pad — must be overhauled and secured within our global alliance networks. Beyond Earth, infrastructure must be built to service existing assets in orbit and power more ambitious missions to deep space. In 2023, the Space Industrial Base will continue to grow in size, birthing critical companies serving our nation's interests. At the heart of this resurgence, inspiring founders are pursuing difficult problems in materials, manufacturing, and space infrastructure.

—*Ryan McEntush, partner, American Dynamism team (*[*@rmcentush*](#)*)*

Small Modular Reactors Advance the Nuclear Renaissance

Though nuclear energy accounts for 20% of the US's electricity, it's commonly misconceived as a dangerous and non-viable option when it comes to adding reliable sources of carbon-free energy. But nuclear energy has been having a renaissance. With the Inflation Reduction Act earmarking $30 billion for tax credits toward existing nuclear reactors (a first for the U.S.), the timing is right to usher in new innovation in this space.

There are opportunities across the nuclear supply chain, from fuel sources to mining to manufacturing vendors and beyond. One emerging area that is particularly exciting is small modular reactors (SMRs). By leveraging advanced manufacturing techniques and modular design, SMRs can be quickly and efficiently mass-produced, bringing down costs. This can make nuclear energy more accessible for a variety of applications, including providing clean and reliable power to remote communities — or even, one day, in space. While there is still a way to go in reforming the regulatory frameworks for these types of reactors, SMRs and the broader nuclear industry are likely poised for growth in the year ahead.
—*Michelle Volz, partner, American Dynamism team ([@michellevolz](https://))*

Industrial Robotics Scale Vertically

We're likely to see robotics companies develop automation solutions for specific verticals, and scale to service multiple use cases within these industries, rather than performing a particular task across sectors. Verticals with jobs that are dangerous or constrained by high turnover — waste management, for example, or industrial food preparation — represent ideal targets for such automation.

There are a few reasons this approach is compelling. First, a vertical focus constrains the robotics problems to be solved. Thus, many companies can rely on off-the-shelf robotic hardware and focus their development efforts on grippers and other manipulators purpose-built for their specific industry. By narrowing the environments in which these robots will be deployed, these companies can shorten time to deployment and iterate faster. Secondly, constrained use cases mean companies can focus on engineering solutions that not only replace labor, but provide a net performance improvement over humans — a key driver for companies purchasing robotics solutions. Finally, an increasing number of robotics companies are focusing on flexibility and

ease of programmability. These solutions can enable robots to be reprogrammed for a set of use cases in one industry or facility type, as opposed to performing a single, industry-agnostic task.

This vertical focus can enable stronger moats for robotics companies. Long term, these vertically-focused robotics companies can either provide automation solutions for the industry or become a player in the industry itself.

—Oliver Hsu, partner, American Dynamism team ([@oyhsu](https://twitter.com/oyhsu))

Reshore and Restore: Bringing Everything Back Home

Wars, pandemics, extreme weather events, and epic infrastructure failures have pushed supply chains and power grids to the brink. In confronting these challenges, tremendous opportunity exists. A new class of entrepreneurs is developing solutions that address the fragility of supply chains, enable access to critical resources, resolve energy crises, and more. These builders are modernizing entire swaths of our economy that tech hasn't yet touched, while also accelerating the return of critical infrastructure.

To give an example, some startups are resolving global fertilizer shortages by repatriating fertilizer production and selling their feedstocks directly to farmers. This is just one of many instances in which startups are uniquely suited to address disruptions from Covid, climate change, and geopolitical conflict. After decades of sending everything offshore, we're bringing everything back home.

—Grant Gregory, partner, American Dynamism team ([@grant_gregory](https://twitter.com/grant_gregory))

The Industrial Economy Goes Digital

Construction, agriculture, transportation, and logistics form the backbone of the industrial economy, yet have been relatively unexplored by technology thus far. Recently, however, macro shifts — from structural labor shortages to generational turnover to forced digitization, post-Covid — have opened up new opportunities for startups to serve these industries' needs. Moreover, companies like Procore, Samsara, and Flexport have proven that it's possible to build large-scale, enduring businesses in highly complicated and regulated markets.

Many founders are taking note. We've already seen a kaleidoscope of approaches tackling these spaces, whether through labor marketplaces that ease worker shortfalls, procurement software that streamlines the sourcing of critical raw materials, or financial solutions that simplify transactions and invoices. I believe we'll see even more innovation enabling the digitization of our industrial economy in the upcoming year.

—Kimberly Tan, partner, enterprise team ([@kimberlywtan](https://twitter.com/kimberlywtan))

Generative AI Advances Beyond "Text to Image" to Complex Workflows

We're starting to see the next momentous platform shift in technology: AI is eating software. In 2022, much of this took the form of AI-generated images of dogs flying in outer space or AI avatars reflecting the best version of our self(ies), but in 2023 and beyond, the enterprise productivity implications will start to shine. AI will drive 10-100x performance improvements, showing companies that there is a new way to work — advancing from "text to image" to more complex workflows, such as "text to SQL queries" or, eventually, "text to excel modeling" and more. We're tremendously excited for the next generation of AI-native infrastructure and application companies to emerge, along with enduring existing companies that incorporate AI into their products. As AI becomes increasingly democratized and underlying models potentially commoditized, applications will need to differentiate on the basis of winning mission-critical workloads, as they did in the last great platform shift in moving from on-prem to cloud.
—*Sarah Wang, general partner, growth team ([@sarahdingwang](https://twitter.com/sarahdingwang))*

Strength in Value-Based Sales

As budgets tighten, software investments will come under increased scrutiny. Enterprises will look to do more with less and only allocate budget to those investments that deliver the highest value to the business. As such, we can expect to see retention rates, especially for product-led growth companies come under pressure. Only those companies that can demonstrate value to the business can be assured of their renewals. Companies that have invested in value-based sales motions will be better positioned in this regard.
—*Joe Morrissey, general partner, growth team ([@morrisseyjoe](https://twitter.com/morrisseyjoe))*

The Next Generation of SaaS Applications

Since the shift to cloud over a decade ago, first-gen SaaS platforms have become outdated. Meanwhile, user demands have continuously increased. In the coming year, I expect we'll see a new generation of SaaS platforms emerge to meet those heightened expectations for how software should work.

This is imminent for a variety of reasons: the tech industry has entered the mainstream, roles are better defined, employees are familiar with using enterprise software, and there is a proliferation of product metadata.

These solutions will be data-native; the user experiences will be 10x better, with embedded automations and intelligence that trivialize the time-consuming workflows we still perform manually today. In turn, these next-gen solutions are likely to compete with the first-gen systems of record that might appear engrained, such as Salesforce, Workday, Zendesk, and Anaplan.

—*Zeya Yang, partner, enterprise team (*[*@zeyayang*](#)*)*

Blockchain's Mobile Moment

How far or close are we to the "mobile moment" for crypto? There is a large group of blockchain users and others whose main access to the internet is through their smartphones, but which relies on centralized infrastructure — which is convenient, but also risky. Users have traditionally solved this problem by running their own nodes — a time- and resource-intensive endeavor that, at the very least, requires a constantly-online machine, hundreds of gigabytes of storage, and around a day to sync from scratch... not to mention special skills.

But more people are now starting to care about decentralizing access to blockchains for *all* users — even those who cannot run a node themselves. With the introduction of "light" clients that provide similar functionality to running a full node — such as Helios ([released by a16z crypto](#)), Kevlar, and Nimbus — users can now verify blockchain data directly from their devices. I'm hoping to see similar trust and decentralization improvements in other parts of the stack, such as event indexing and user data storage. Taken together, all of these can help achieve true decentralization for mobile frontends.
—*Noah Citron, engineering partner, crypto team ([@noahcitron](#), @ncitron on Farcaster)*

Zero Knowledge, Multi-Party Computation, and Post-Quantum Crypto

Zero knowledge systems are powerful, foundational technologies that hold the keys to blockchain scalability, privacy-preserving applications, and much more. But there are a lot of tradeoffs between prover efficiency, proof succinctness, and the need for a [trusted setup](#). It would be fantastic to see more constructions for zk-proofs that fill the gaps in the multidimensional

space of these tradeoffs. For me, it would be most interesting to see whether trusted setups are required for constant-size proofs (and constant-time verification), which would further justify the need for more transparent trusted setup ceremonies.

We also need better constructions for threshold ECDSA (elliptic curve digital signature algorithm) signatures. Attaining thresholds removes the need to trust a single signer, which is why threshold signatures are important for multi-party, distributed computation on private data and have several applications in web3. The most interesting threshold ECDSA signatures would be those that minimize the overall number of rounds — including the pre-signing rounds where the message is not known yet. Finally: As new post-quantum signatures near the end of standardization, per NIST, it would be great to explore which of these could be made friendly to aggregation or thresholdization.

—*Valeria Nikolaenko, research partner, crypto team (@lera_banda)*

Developer Onboarding for Zero Knowledge

Zero knowledge systems have been a long time coming. In recent years, they moved from theory to practice, but in 2022 it felt like we turned the corner on *developer onboarding* for ZK. Specifically, we saw the proliferation of educational materials and the maturation of high-level programming languages (such as Noir and Leo) that made it easier than ever for engineers to start writing ZK applications. I expect these developments, along with continued theoretical advances, will lead to an influx of application developers, given how significant zero knowledge is to so many use cases. Putting things into the hands of developers often leads to unexpected new use cases; I'm excited to see what comes next.

—*Michael Zhu, engineering partner, crypto team (@moodlezoup)*

VDF Hardware

Verifiable Delay Functions (VDFs) are an exciting [cryptographic tool with many applications](#), from verifiable lotteries to [leader election](#) to preventing front-running. But the biggest catch has long been hardware implementations, which are needed to have confidence that attackers can't compute the VDF faster. I'm excited for the first generation of VDF hardware to be available, paving the way for practical deployment.
—*Joseph Bonneau, research partner, crypto team ([@josephbonneau](#))*

Fully On-Chain Games and Autonomous Worlds

What if you could create a game world that could not be taken down or censored, had no need for servers, and could live far beyond any of our individual (or even organizational) lifetimes? For the first time ever, we can. We are at the very beginning of crypto-native, fully "on-chain games," or — as others prefer to call its superset — "autonomous worlds," built on top of blockchain technology.

Whatever you call it (and the lexicon is still forming!), the nascent movement toward maximally decentralized games offers new affordances that make it possible to actually build these games online. Specifically, the ability to put a game's entire state and logic on a publicly verifiable, censorship-resistant, and decentralized blockchain... as well as advances in [on-chain procedural generation](#), which not only overcome [constraints](#) like storage, but are essentially "a trick to compress a complex world into an executable." What new games, and gameplay, become possible that were never possible before? Are such games still... games?
—*Carra Wu, investing partner, crypto team ([@carrawu](#), @carra on Farcaster)*

Non-Transferable Tokens

I much prefer the term "non-transferable tokens" over "soulbound" tokens (a term borrowed from gaming by Vitalik Buterin [for NFTs](#)); these tokens are for cases where it *doesn't* make sense to transfer NFTs. I'm excited to see the various web3 applications that will be built on top of not just this primitive, but also with decentralized identifiers and verifiable credentials. While the discussion of these primitives usually revolves around decentralized identity, there are many other applications to be explored as well: For instance, tickets, digital <> physical, reputation… and much more ahead.
—*Michael Blau, investing partner, crypto team ([@blauyourmind](#), @michaelblau on Farcaster)*

Decentralized Energy

How can we [apply the decentralization ethos to energy](#)? For instance, power grids are dated, centralized, and face several other issues like high upfront capital expenditures and misaligned incentives. There are great opportunities to build microgrids and storage and transmissions networks, by solving issues such as high capital expenditures and disparate incentives solved through [tokens](#). There are also burgeoning markets for renewable energy certificates (REC), and carbon credits on-chain. I'm excited to see builders continue to expand what's possible in this category of decentralized energy coordinated by blockchains.
—*Guy Wuollet, investing partner, crypto team ([@guywuolletjr](#), @guy on Farcaster)*

For more trends, reports, and resources on crypto and web3, visit [a16zcrypto.com](#).

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