2023

Fidelity Labs

Future Forecast Report

Opening Narrative • DAOs • Digital Humans

Digital Nomads and Crypto • GAI • NFTs

Technology Convergence • Zero-knowledge Proofs

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Foreword

Over the past 12 months we have seen several themes emerge in the ways people, all across the globe, are embracing new technologies and using them to shape their lives.

As the world tries to make the transition from the COVID era into a post-pandemic future, we see these themes being reflected in the broader expectations and behaviours of the population. The Fidelity Core Innovation team has the exciting challenge of identifying which of these themes will drive the largest impact on the asset management industry, and the clients and customers that it serves.

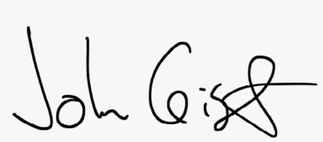
This edition of the Fidelity Future Forecast Report focuses on the overlap of socio-economic and emerging technology themes that our researchers believe will persist and bring transformative change to the way our business is done.

We dive into topics ranging from the rising influence and impact of decentralisation and their related assets to the way we will increase customer engagement via digital humans. We also look at the increasing impact that Artificial Intelligence is bringing via the discipline of generative A.I.

In this report, we also highlight how various emerging technologies are converging at different stages of maturity to create unique capabilities, opening up exciting avenues. We even explore what the impact and application of these themes might feel like through the eyes of a hypothetical person named Alice, walking through a day in her life.

How we apply and leverage these themes is limited only by our creativity and risk appetite. As we explore the very asymmetric equation that drives these themes, we aim to highlight the scale and scope of opportunities that they represent. Being able to participate in, and take advantage of this emerging ecosystem will determine the winners in the new world that is rapidly evolving in front of us – and we must do this in the context of an increasingly shrinking timeframe that it now takes for themes to reach maturity.

We hope this report not only informs the reader about what is on the horizon, but also provides ample provocative thought to explore and imagine a new world of possibilities ahead.



John Gist
Global Head of Fidelity Labs

Prasad Chandrasheker
Global Head of Emerging Technology Strategy

Opening Narrative

Morning

Alice wakes shortly after sunrise, with her alarm clock set to a personalised wake-up time, informed from biometric feedback from her smartwatch. With a quick yawn and a stretch, she puts on her slippers and pads off to the bathroom to freshen up. Feeling fully awake now, she pours herself a cup of coffee. As a longtime coffee lover, she **bought token shares** of her favorite coffee brand, granting her a slice of the company profits as well as a vote on company direction. Drinking coffee is great but being able to affect company policy is even better.

Before she starts her day, Alice jumps into the **Metaverse** for a quick workout. She started doing this several years ago when Covid hit and got hooked on virtual exercise with friends. With a small gesture her **Apple XR glasses** darken, and her field of view is now a virtual gym room, overlaying her living room floor. After an intense 15 minutes doing dance cardio games with her friends, Alice takes a quick shower and is ready to tackle her work.

(Image from: Waka coffee)

Still donning her lightweight XR glasses, she checks the status of a **Distributed Autonomous Organisation (DAO)** she's working on while munching on a bagel, made from vertically farmed wheat. After flipping through a few new project proposals, Alice decides she already has enough work in her pipeline and decides not to join any new proposals.

Work for Alice doesn't really feel like work. With a **$50B market worldwide**, Metaverse gaming provides her with a steady income and growing customer base. She does some Metaverse-scaping and is also an NFT artist, but **she doesn't work for any one company or agency**. Instead, she joins projects that interest her and need her creative talents, mostly DAOs. She likes working this way because her compensation depends on her **effort and productivity, not hours logged**. She survived the bubble of "over-priced JPEGs" and has created her own environmentally focused brand with big company partnerships. If she's passionate in a project, she'll invest in the DAO by buying tokens herself. Participating in DAOs allows her to have a say and choose her own projects, mostly ESG and Sustainable Development Goal (SDG) ventures.

With her income supplemented by her digital art and DeFi projects, she earns enough to **donate** a share of her profits to SDG projects that she collaborates with. She also makes in-game objects bound to NFTs that she can sell or rent to players who like her style and align with her mission.

The rest of her profits she invests in a widely diversified portfolio, from her own personalized basket of ESG stocks and income-earning fixed assets, to tokenized real estate shares of the new Olympic stadium being built for next year's games. Tokenisation and purposeful NFTs, bound to real-value items, have helped her grow her wealth independently.

(Image from: Juliet Angus)

Midday

She looks out the window to peek at some of the new construction several blocks away and takes another long sip of her coffee, savoring the view.

She only just moved into this condominium a few months ago and she got a great deal on the place since it is a new development. She had been searching for a while, walking virtually through several other properties that had **digital twins (DT)** viewable in the Metaverse. This property had all the amenities she was looking for, so she signed the lease and made the transaction in just a few minutes, exchanging her digital currency for the digital deed NFT painlessly.

Being an appreciating property, her apartment-NFT is used as collateral on crypto-backed loans, which she deposits into high yield accounts and investments, the proceeds of which pay her home-loan interest and then some.

Alice finishes her coffee, takes her last bite of the bagel, and cleans up.

(Image from: Fortune)

Occasionally Alice meets up with team members in the Metaverse where they review progress on their current projects in an immersive virtual simulation. After their meeting ends, she teleports to the gourmet food world and picks out a meal from the hundreds of **virtual shops that offer real-world delivery** in less than 15 minutes. The purchases in the metaverse are automatically deducted from her digital wallet.

After lunch she participates in a Q&A panel, an event only offered to holders of her NFTs. By attending, her fans get **air-dropped exclusive NFT items** that they can quickly resell on the secondary market or use in their own digital works.

Alice chooses to use non-fungible tokens as vehicles for her work because they provide the most flexibility and value, both for her and her fans. She can receive royalties on what she creates long after it is sold and can even link her NFTS to real world goods as well. Her fans, in turn, can also have rights to the NFTS they purchase and be eligible to receive additional benefits as owners.

Afternoon

(Image from: Dezeen)

To cap off the workday and keep tabs on the value she creates, as well as what she invests in, Alice teleports to ***Metastreet***, the immersive investment world created by Fidelity. As she enters the virtual space, Metastreet receives the latest information from her digital wallet and sends updates her **Financial Digital Twin**.

Her financial digital twin is a virtual representation of her that has all her spending habits, saving rates, income, and other financial behavior aggregated into a model to help Alice make good decisions about her current finances and future trajectory. All the data is instantly rendered and displayed in a gallery, with each investment represented as 3D art and exhibits.

As she roams the virtual halls, Fidelity's Digital **Human Advisor** walks with her, examining her portfolio and discussing suggestions. Alice's advisor guides her through making adjustments and rebalancing - all of which take place **immediately with no cost and with instant settlement** on the blockchain.

Evening

Now that she's done with her work for the day, Alice does some shopping in the Metaverse. She can teleport to the virtual mall and check out her favorite brands and try on outfits **using her own lifelike avatar model**.

All her sizing and preferences she can share at will from her Soulbound NFT ID, allowing access only to the portion she needs for transactions. In fact, this is how she does much of her shopping, including tonight's meal. Later in the evening Alice spends some time at a virtual concert for her favorite artist. Her concert tickets grant her a certain level of access, including a meet and greet with the performer **as well as keys to unlock special music tracks and NFT collectables**, in part redeemable for real-world items.

After a long, fun day with colleagues and friends, **Alice** unplugs from all her gear but for her biometric ring and **dreams of a new day and new things to accomplish**.

(Image from: Rolling Stone)

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DAOs

Decentralized Autonomous Organizations allow quick startup and collaboration of teams focused on creative or financially focuses goals. With a framework that leverages the best of blockchain, DAOs have great potential for speed, streamlined operations, and present strong advantages in transparency and accountability.

Author: Matt Twigg

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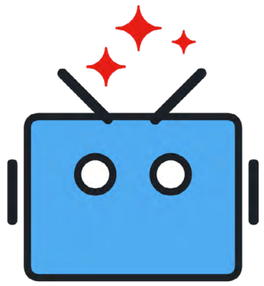

Digital Humans

Digital humans are chatbots with added personality and the human touch. A digital human can provide emotional connection, showing support through its actions, tone and body language. A dedicated digital human can offer users information, advice and much more in various fields.

Author: Cindy Sun

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Digital Nomads and Crypto

Even before the pandemic, living as digital nomads was gaining popularity. Now after more than 2 years of adapting to remote working, more people are empowered to choose this location-independent, technology-enabled lifestyle. Among these digital nomads, a significant group of them are moving into crypto-related fields, which are often being called crypto nomads.

Author: Miya Huang

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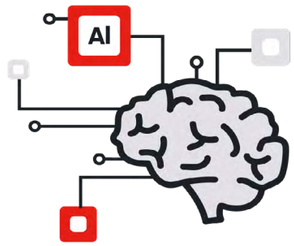

GAI

Generative AI is considered as one of the most promising advances in the world of AI. We demystify this term in our report, discuss its fast evolving ecosystem, explore areas of opportunities and dwell on some important considerations for enterprise adoption.

Author: Rahul Jain

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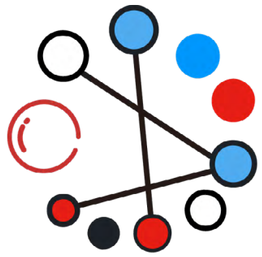

NFTs

NFTs present a unique opportunity to both tokenize assets and utilize blockchain technology to deliver utility and value. As the dust settles from the 2022 Crypto Winter, we look ahead to the real value NFTs can bring investors and their portfolios.

Author: Matt Twigg

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Technology Convergence

Convergence has been around for centuries, however, today technology convergence is bringing about a paradigm shift not only in how humans live, but also in humans themselves. A deeper understanding of this phenomenon, and the resultant emerging technologies is critical for businesses to fend off threats and capitalize upon opportunities arising in the hyper changing milieu.

Author: Mukul Kumar Saini

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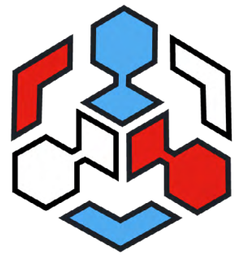

Zero-knowledge Proofs

Zero Knowledge Proofs are a rapidly maturing technology, that offers the potential for significant increase in data security, to increase the proliferation of DLT based systems. While enabling users & organisations to adopt new approaches to control and secure their data.

Author: Ben Brophy

Matt Twigg
Fidelity Labs Senior Manager

1

DAOs

Decentralised autonomous organisations

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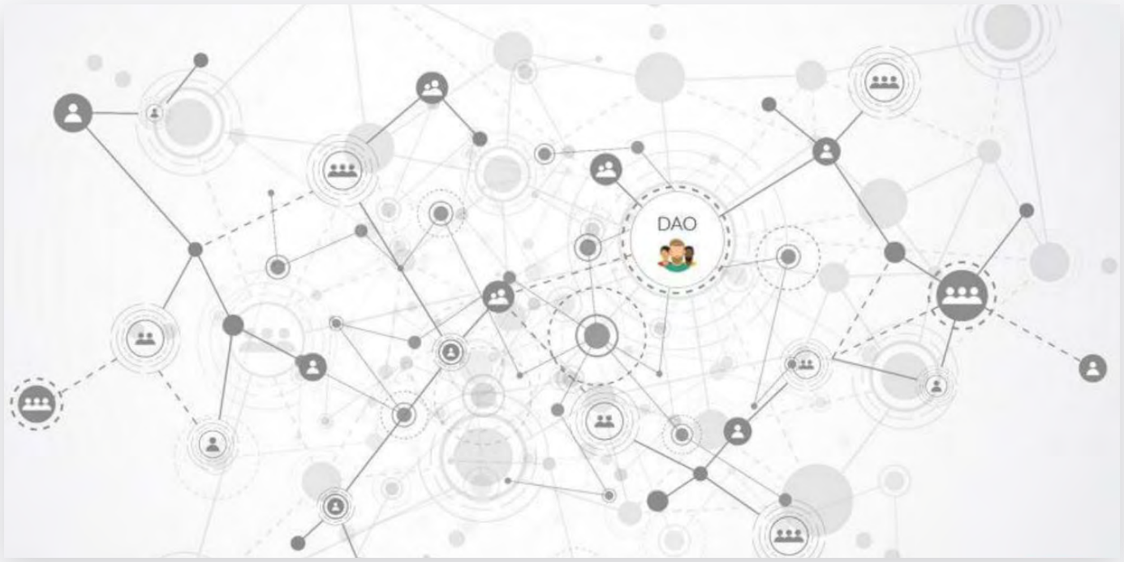
So what exactly is a DAO?

(Image from: Vitaly Tennant)



A decentralised autonomous organisation (DAO) is so-called because there is no centralised governing authority. This removes bottlenecks, mitigating the influence of any central group that could affect democratic distribution of its ownership and other attributes.

A DAO is also autonomous, meaning that encoded rules are followed and executed without manual intervention, assuring transparency. As they encourage participation by incentivising shareholding via buy-in tokens, DAOs allow users to unite in communities and immediately work together with very low overheads. DAOs are being used for venture capital (VC), decentralised finance companies and investment groups where agility, innovation and distribution of control and risk are fundamental.

How does the technology work?

Satoshi Nakamoto's work on creating a virtual currency brought us blockchain. Vitalik Buterin took that a step further and created ethereum. He had a specific purpose: to create decentralised apps (dapps) and smart contracts. The latter are sets of rules embedded in code on the blockchain in a simple if-then-else format, facilitating high levels of automation with reliable replication and scaling.

DAOs have their own digital currency used for payment or collateral, with an eye to openness, flexibility, transparency, accountability and ease of governance. Transparency and accountability are key to smart contracts and make DAOs possible – and desirable – by creating a simple, easy-to-manage framework where usage of funds can be more democratic and incentivised.

What are the benefits?

Governance

DAOs provide access to a decentralised environment where incentives are aligned among the many stakeholders from a governance and organisational viewpoint. Conventional hierarchies are partially or completely replaced by a system of incentives arising from stake ownership that directs participants' interests towards the benefit of the community, ensuring that stakeholder behaviour aligns with the desired outcome.

As a result, an ecosystem of decentralised organisations has emerged providing access to a wide range of financial services while reducing or completely removing barriers to entry. This promotes financial inclusion. Everyone is accountable, with skin in the game. This encourages positive outcomes.

One of a DAO's most attractive features is how they allow an efficient model of governance that scales well. As well as making organisations quicker to set up, by using smart contracts DAOs provide additional ways of governance and management. These include:

- Organisational policies, processes and documentation can be embedded in smart contracts, reducing overheads and increasing automation.
- Members can vote with tokens on proposals and changes, including the DAO's management.
- Multi-signature methods can be used to authorise, validate and perform significant changes, ensuring impartiality.
- DAO governance facilitates an 'org of orgs' structure, allowing the formation of subgroups and ad-hoc teams as needed.

DAO treasuries

(Image from: NFT news)

DAOs have treasuries as well as governance rulesets. If the DAO aims to raise funds, it will often do so by creating and selling a native token, which members buy to participate in its work and potential success. Tokens can be used to pay for and support whatever project or operation DAO members wish.

Treasury transparency makes it easier to see what gets funded, making it harder for anyone to manipulate the tokens and their use. The most recent DAO treasuries have multi-signature wallets that provide better security by requiring a number of people in the DAO to hold keys authorising significant changes. A multi-sig wallet could contain five keys, of which three holders must be present to authorise an action. This is conducted by smart contract rules, so execution is almost immediate once consensus is achieved and funds can be used to pay for approved initiatives.

How we can use DAOs

Investment and venture DAOs

Users can pool resources to invest in things normally far beyond their reach, while mitigating individual risk. DAOs range from groups of dedicated sports fans such as Krause Hause, which plans to buy a minority stake in an NBA team, to MetaCartel – an investment DAO focused on early-stage dapps, working like a VC with investors looking for profits in funding new businesses.

Venture DAOs are being formed as agile, lightweight replacements for more traditional VC firms (which have slowed substantially in 2022). A VC DAO allows a wider variety of investors who would not otherwise have the resources, access or scale of venture capital companies. The DAO's decentralised structure also allows all token holders a say in what investments are made. Investment DAOs could also provide a unique way to allow traditional investors to access and participate in non-traditional asset classes, creating highly diversified portfolios.

Social DAOs

Social DAOs are based on community and the pooling of intellectual or artistic resources. People come together to build and promote shared cultural values and projects. Bored Apes Yacht Club is a prime example, with a strong social community centred on a Web 3.0 brand.

Developer DAO is another social DAO, focused on bringing together like-minded individuals to discuss and collaborate on Web 3.0 projects. In both cases community creation was the primary driver: they can trace their roots to online forums where people came together over shared topics and experiences.

(Image from: Bored Apes Yacht Club)

Collector DAOs

Collector DAOs harness the power of gathering large numbers of users to acquire high-value assets that would otherwise be out of reach. They allow partial shares in assets such as fine art, collectables and hard-to-acquire items.

The Constitution DAO was one well-publicised example, focused on pooling resources to obtain an authentic copy of the US Constitution.

Service DAOs

Service DAOs focus on cultivating and coordinating developer talent for the DAO project marketplace. In service DAOs we can see blockchain credentials being used to identify individuals and locate skills, as imagined in an ideal Web 3.0 economy.

The Metaverse DAO is one example, as is States DAO in South Korea.

Social networking and media DAOs

DAO structures can also facilitate the formation of media 'companies' where users can create content, making it easier for people to come together on projects, pooling their resources.

Bankless, which has numerous social, Web 2.0 and Web 3.0 presences, is a group of people who joined up to focus on the emerging crypto-enabled economy and business opportunities with high-quality video and audio content.

Decrypt DAO is another media DAO focusing directly on letting users determine the content they want to see produced.

(Image from: Decentralized Pictures)

Entertainment DAOs

Interactive media – from 'choose your own ending books' to storytelling games and movies – allow people to influence the outcomes for their favourite characters. With entertainment DAOs, users can direct characters and plot development. Entertainment DAOs give token holders a say over the characters in games, movies and 'books'.

Decentralized Pictures, founded by Roman Coppola, uses the democratic process of DAOs to allow members to vote on which projects to finance and to award the best productions.

Who's who in the key application areas

Venture capitalism

- MetaCartel Ventures provides community-funded grants for early start-up dapps
- DuckDao supports early-stage crypto investments

(Image from: Duck DAO)

Governance

- Aragon DAO makes it easier to set up DAO governance with open-source tools
- Enzyme Finance, formerly Melon Protocol, uses Aragon to govern fund management
- Moloch is an open-source DAO optimised for treasury functions and proposing new DAOs
- Colony uses ERC20 tokens and facilitates DAO set-up in 90 seconds

Finance-focused

- MakerDao supports more than 400 financial apps and is growing
- Uniswap is a protocol for decentralised crypto trading, borrowing and lending
- SwissBorg allows users to invest in cryptocurrencies with maximum efficiency, using the product Smart Engine. It provides a way to generate income with Smart Yield
- Aave is a versatile ecosystem for decentralised finance (DeFi) apps. Governed by a DAO, it demonstrates the speed and flexibility of such organisations
- Compound is a protocol that enables users to earn interest on crypto
- Indexcoop offers crypto indexing. If it branches into traditional equities it could prove disruptive

What are the opportunities for asset management?

The DAO management structure has unique qualities that could interest asset management industries. Using incentivised voting and blockchain distributed ledgers, teams could not only expand the decision-making process but also provide clear accountability and transparency. This could drive efficiency. If a product is successful, clients could have complete confidence in the process and people involved. Investors have gravitated towards passive investing to reduce costs, some having lost faith in active investing. A DAO structured product could incentivise higher performance for contributors and attract demanding investors.

> What excites me about DAO is the opportunities it creates to push the boundaries of [investment] solutions co-creation, from onboarding clients' desires to organising our internal resources to deliver those solutions
>
> **- Luc Froelich, Fidelity Global Head of Digital Assets -**

DAOs can allow investors access to unique assets for diversification. With the 2022 market exhibiting unusually high correlation of previously divergent assets such as equities and bonds and even precious metals, investors have been seeking other options. Investing in hard assets such as fine art, haute horology and unique real-estate opportunities have so far provided better and more stable returns. But many investors cannot access these markets and products. A DAO can provide an easier way to manage the fractionalisation, purchase and custody of specialised assets.

Investment products and services that use DAO structures and smart contracts will be able to take advantage of distributed ledgers. Not only are investment decisions and actions recorded on the chain for transparency and accountability, but on-chain transactions and settlements are rule-bound and immediate, greatly reducing settlement times, the need for reconciliation and slashing costs. Many operational processes that are managed manually today can be coded into a DAO via smart contracts.

Cindy Sun

Intelligence Analyst

2

Digital Humans

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Taking chatbots to the next level

Chatbots can offer businesses 24/7 access and scalability at low cost. But they are inflexible – usually just simple decision-tree models. What will take chatbots to the next level is the digital human, driven by conversational artificial intelligence (AI) technology.

The 'digital human' concept was brought to life by Hollywood in 2009 in James Cameron's science-fiction epic Avatar, with its ground-breaking visual effects. These were picked by up video game studios.

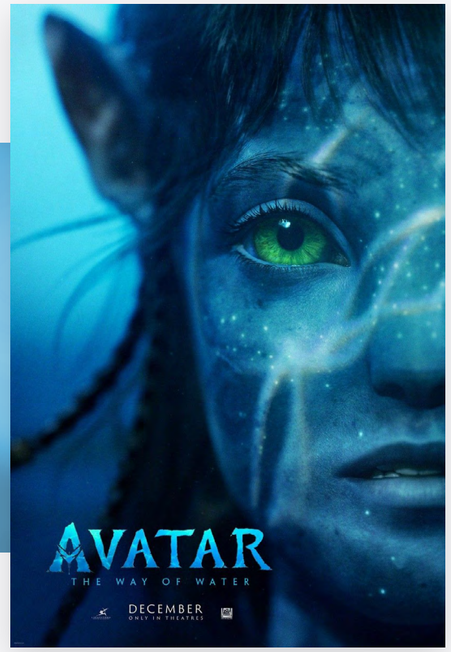
Digital humans are chatbots with added personality and the human touch. According to the *Harvard Business Review*, 'our research across hundreds of brands in dozens of categories shows that the most effective way to maximise customer value is to move beyond mere customer satisfaction and connect with customers at an emotional level.'

A digital human can provide this emotional connection, showing support through its actions, tone and body language. In fields ranging from health care, banking and finance to telecommunications and customer experience, a dedicated digital human can offer users information, advice and much more.

What is a digital human?

A digital human is a virtual AI avatar designed to have conversations with real people in an incredibly human-like way. They depend on a complex combination of technologies that include:

(Image from: Avatar the way of water)



- AI to sort input and supply feedback: the AI helps digital humans answer many questions when interacting with and assisting people.
- Natural language processing (NLP) to understand voice management: NLP is the branch of AI that enables computers to recognise spoken words and text in the same way as people.
- Advanced 3D-modelling to repeat expressions of human emotion with precision: this enables better understanding of the human-computer interaction and reinforces emotional communication between the system and users in the dynamic 3D painting system.
- Natural language generation so the digital human can respond via voice: this allows machines to evaluate and understand imperfect human writing or talking.

Where digital humans can step up

Digital influencer

A digital influencer is a character created by computer software. It is given a personality and acts on social media platforms as an influencer. Behind the digital influencer are real creators developing and shaping content. They choose how a digital influencer looks, dresses and acts. Digital influencers can do anything human influencers can, but with more control and engagement. Unlike AI-driven digital humans, digital influencers are controlled by humans.

One example is Miquela Sousa – better known as Lil Miquela. She is a digital avatar that started as an Instagram influencer. She has worked with top fashion brands such as Prada, Dior and Calvin Klein, released a single (2017's Not Mine) and a music video, Hard Feelings, which debuted at Lollapalooza's 2020 online festival. She collaborated with Samsung in its 2019 #teamgalaxy campaign, teamed up with real-life supermodel Bella Hadid for a Calvin Klein advert and has even been listed in The Times list of Most Influential People on the Internet in 2018.

Digital assistant

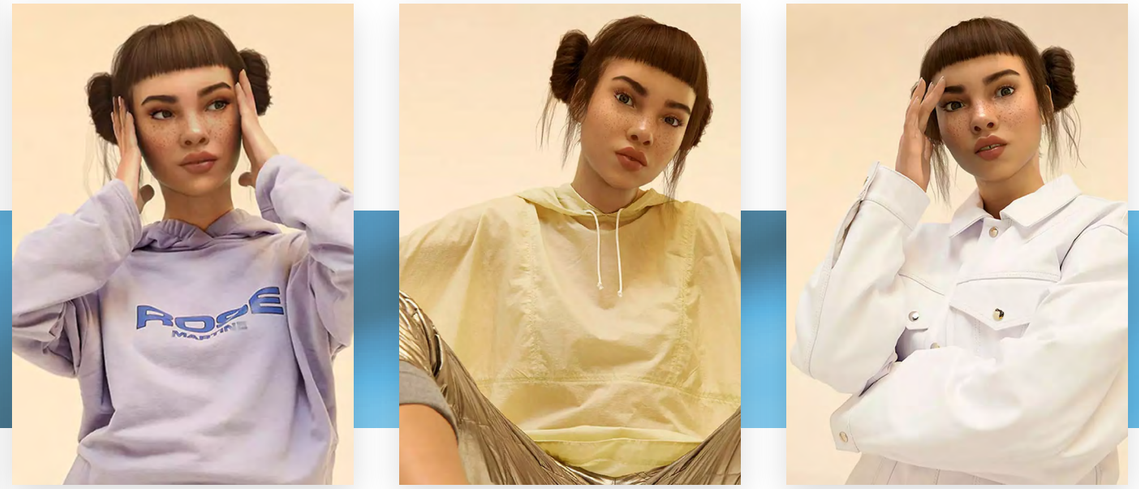
A digital assistant pulls data from different sources and contextualises it. It uses AI and machine learning (ML) to understand and learn preferences based on a user's actions, then makes recommendations. Working with a digital assistant becomes a personalised experience tailored to a user's needs.

A college entrance examination digital assistant is already reported to have been used in China. During the exams, a digital assistant provides candidates with full-process services, including intelligent college entrance examination recommendations, important node reminders and intelligent chat companionship, among other things.

A digital assistant can also provide seamless guide services. In 2021, a multilingual digital assistant guide was launched in Japan. It helps users navigate easily from the subway to a shopping mall, and then to specific shops to find special offers. As well as benefitting customers, it opens up business-to-consumer opportunities via advertisements and helpful information that can be precisely located both outdoors and indoors.

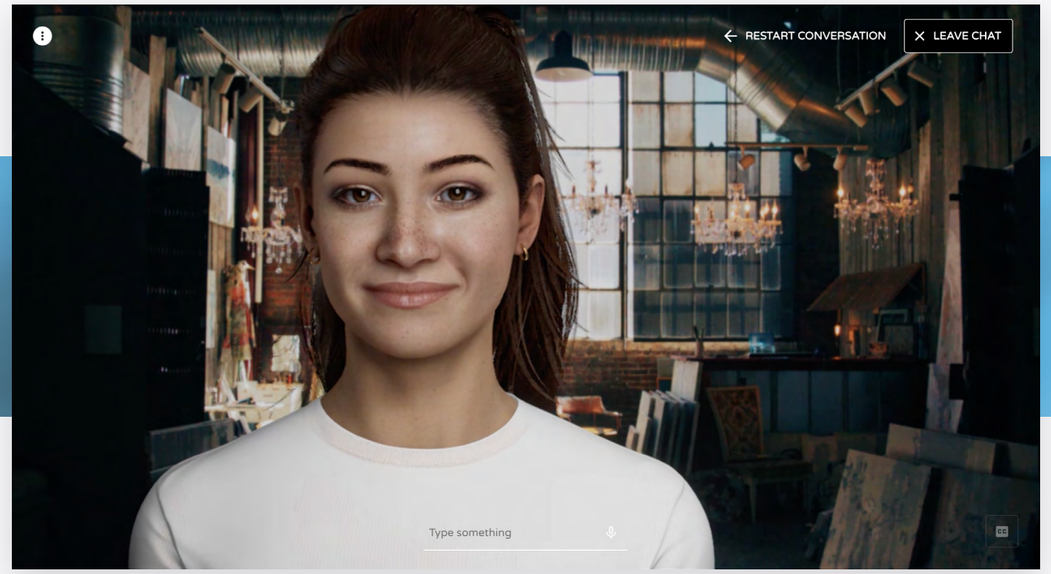
Employee self-service digital assistants are also gaining popularity. Instead of having to track down the right forms and access multiple websites, employees can use them for tasks such as updating their profile or checking their vacation allowance in a more natural way than provided by existing chatbots.

(Image from: Highsnobiety)



Financial adviser

(Image from: UNEEQ)



AI in today's banking and financial services sector is embodied by the use of digital humans to make digital banking more approachable. Institutions no longer have to choose between scalable, low-cost digital channels or highly engaging human customer service – chatbots and self-service or real people. Instead, they can offer the best of both with a digital human.

In 2019 an AI-powered virtual employee heralded a new way of providing financial services in China. It offered risk assessment, financial consulting and investment advice. In the 5G environment, these advisers can work on various devices such as mobile phones, smart watches and cars, making banking more convenient and inclusive. Via conversational AI, a digital financial adviser can replicate human-to-human customer experiences.

What challenges lie ahead?

- **Privacy -** Digital technology allows vast amounts of data to be collected and stored, including private information about individuals or organisations. It can be very difficult to keep this data safe. Even a single breach can put vast amounts of private information into the hands of criminals, terrorists, business rivals, foreign adversaries or other malign actors. Making sure digital humans respect people's right to privacy and maintain their rights over their data will be challenging.
- **Promoting the 'healthy and orderly development of society' -** Deterring scammers, misinformation peddlers and other harmful actors remains an ongoing challenge, especially on platforms where interactions take place in real time. However, any data the platform collects via interaction with a digital human will be tied to users' real-life identities.
- **Comprehension difficulties -** Digital humans are improving every day but can still struggle to understand questions when there is background noise, if a query is complicated or people have an unusual accent.
- **Ethical concerns -** Creators of digital humans should strive to include input from a range of people and data to avoid bias and promote diversity and inclusion.
- **High costs of creation -** As AI is updating every day, hardware and software need to be updated simultaneously to match these developments. As AI involves very complex machines, the creation costs are huge, as are those involved in repair and maintenance.
- **Out-of-box thinking -** Conversational AI uses ML to learn from historical data, spot patterns, make decisions and adapt to continuously improve algorithms. But machines can only react properly to those topics in which they have trained. Anything out of the ordinary can cause them to crash or give irrelevant outputs. This could be a major drawback.

How does this translate into business opportunities?

Digital assistance

Organisations can use digital assistants to interact with users, providing better services and saving money. Businesses are also finding many benefits, especially in improved efficiency and better assistance for employees and customers. Using digital assistants to handle routine helpdesk or customer service requests will enable businesses to provide improved services. By taking care of redundant tasks or shortening the time spent on essential tasks, digital assistants free staff for more mission-critical work.

Brand ambassador

Some financial companies have also started exploring opportunities in the metaverse. At the end of 2021, a Chinese bank launched an AI virtual brand officer to attract young people at the marketing and customer acquisition level. Even in real life, a company can embody its brand with the look, voice and personality of a digital brand ambassador who represents its values. Enabling clients to engage with the ambassador as part of their customer service experience could also improve loyalty.

Portfolio manager

As highlighted in technology consultant Gartner's digital me trend, a digital human twin is the digital version of a real person. It exists in both the real and virtual worlds. In one recent example, the digital human twin of a Swiss bank's chief economist presented insights to high-wealth clients both personally and at scale. There is an opportunity to create digital human twins for portfolio managers, investment directors and other similar specialists involved in client engagement. Given how busy portfolio managers can be, this could become important for providing quality interactions with clients. A digital portfolio manager could be available around the clock to provide 'face-to-face' experiences for clients. Digital portfolio managers would be available through a range of channels including the web, in-office kiosks or other emerging interaction points such as holograms.

(Image from: Sina finance)

What could this mean for asset management?

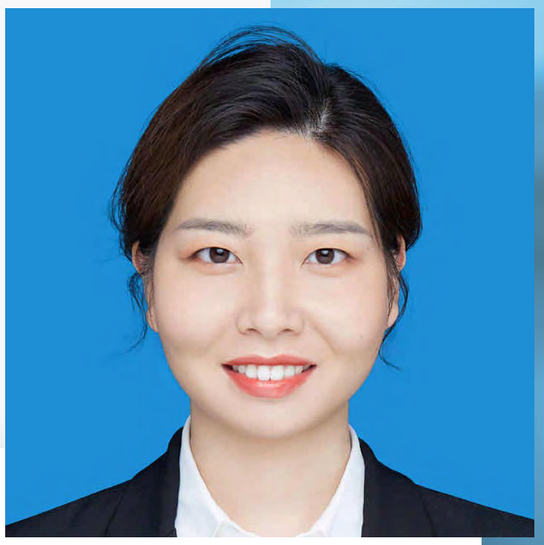
Rapid leaps in technology mean interaction between humans and the digital world will only increase, providing new opportunities to develop customer experience.

> Chatbots have been used everywhere. Digital humans could be a way to differentiate us from competitors by providing a more future-facing product. The opportunity for a digital human adviser is to maintain customer engagement, while ensuring the servicing cost isn't adversely impacted
>
> **- Nomizu Eisuke, Fidelity International Limited Head of PI Business Development in Japan -**

A digital human adviser could:

- Engage clients in broad structured conversations, offering general advice about market conditions, the latest thought leadership articles and marketing material, rather than about their individual circumstances.
- Enable the collection and transcription of customer information to assist future discussions with a human adviser in client servicing or acquisition.
- Answer standard questions and relay general website content relevant to clients.
- Proactively inform clients about the latest news, content or communications.

This could augment our advisory services, maintaining personalised advice and customer engagement, while keeping servicing costs to clients under control.



Miya Huang

Innovation Intelligence Lead

3

Digital Nomads and Crypto

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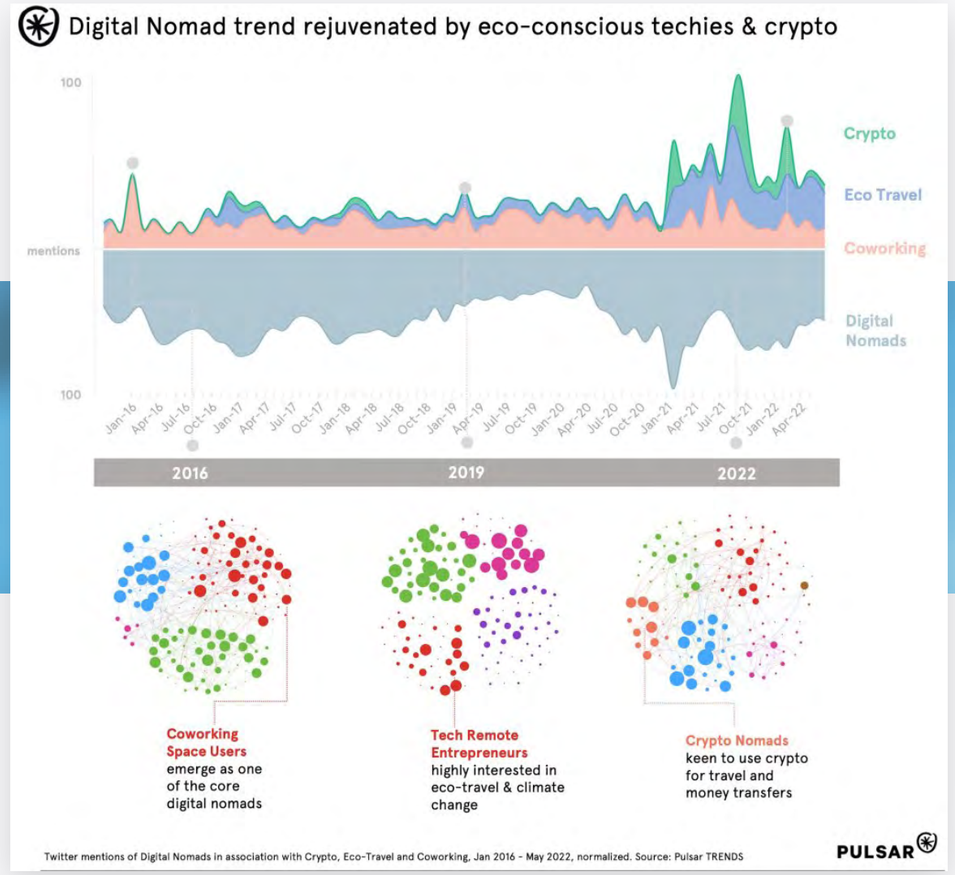
Meet the new tribe of remote workers

Imagine a world without borders, where you can travel, work and live everywhere; where the whole globe is your home and office and the journey never stops. This is no longer a dream. Thanks to continued advances in technology and a workplace culture reshaped by Covid-19, more people can ditch the nine-to-five office routine for a nomadic lifestyle. They can work remotely while travelling the world as full-time employees or freelancers.

Many today falsely connect the origins of digital nomadism to the pandemic, but this isn't a new concept. It was first defined in a 1997 book called The Digital Nomad. Its authors foresaw a lifestyle of exploring the world while working remotely via digital tools. The pandemic simply shifted it from a fringe lifestyle to a viable option for all generations, roles and industries. Currently, there are some 35 million digital nomads worldwide. With more and more countries luring this tribe of remote workers with special visas and tax benefits, it is predicted that by 2035 a billion people could be living and working this way. This could rise to one-in-three employees in the global workforce in just over a decade.

(Image from: Honeybook)

(Image from: Pulsar Platform)



Today, as developments such as the metaverse, Web 3.0 and burgeoning crypto projects lead to the next level of virtual and decentralised society, we are seeing a significant new group of digital nomads emerge – the crypto nomads. As the updated version of digital nomads, crypto nomads are crypto-savvy people, relying on cryptocurrencies to fund their lifestyles and grow their wealth. Crypto even enables some to take a step further, accessing some of the best work opportunities worldwide in the fast-growing blockchain sector, even setting up their own businesses in pro-crypto countries.

How the nomads fit with crypto

The blockchain industry has experienced startling growth in recent years, showing its potential to revolutionise both the financial system and traditional employment. Digital nomads tend to be future-facing – more likely than non-nomads to be early adopters of technology to gain a competitive edge at work. Blockchain technology is a natural fit for nomads seeking borderless freedom while navigating the financial challenges of their roving lifestyle. As more innovative use cases emerge over time, this technology will play an increasing role in improving the experience of such individuals.

(image from: Dribbble)

Borderless currency for digital nomads

Flexibility and freedom are two principles underpinning the nomadic lifestyle that align with the core values of cryptocurrency. Using money can be troublesome for a digital nomad. It's not usually feasible to open multiple bank accounts in different locations, given the paperwork and residency requirements. It's not unusual to read in digital nomad forums about users being locked out of bank accounts. Cryptocurrency provides an alternative to traditional banking. It is borderless with no middlemen, so digital nomads can receive and make payments in almost real time with minimal fees.

Paying employees in crypto has become a hot new benefit as companies bid for younger global workers who want a foothold in the crypto economy. A survey from the job platform Humans.net shows that 18% of remote workers prefer salaries in digital currencies such as bitcoin and ethereum rather than fiat. A further 11% are happy to be paid partially in crypto. A study by freelancing site Freelancer.com also found that 25% of digital nomads already use cryptocurrencies for payments, with bitcoin the most popular. An increasing number of cryptocurrency-oriented freelancing sites already offer payment in bitcoin and other altcoins. Reddit's Jobs4Bitcoins is one of the most active places to find work paid in cryptocurrencies.

(image from: Coingate)

Once cryptocurrency served only niche purposes in the crypto community itself. Today it can be used for essentials such as hotels, meals and mobile data, as more merchants start accepting crypto payments. A recent Deloitte report found that 73% of merchants plan to integrate crypto payments within three years. Digital payment service providers such as PayPal, Stripe and Revolut continue to integrate crypto, making it easier for businesses to facilitate crypto payments for remote employees, digital nomads and the businesses they work for.

Crypto becomes a globally recognised investment vehicle

(image from: Ageist)

Digital nomads can be higher-than-average earners with greater potential for saving, as increasing number of them are skilled knowledge workers. Many also choose to locate in places with a lower cost of living compared to their earnings rate.

Despite high volatility, crypto is gaining traction as a globally recognised asset class, especially for younger investors looking beyond traditional investments such as stocks and bonds. The younger generations are also leading the way in the digital nomad movement, with Millennials accounting for 44% and Gen-Zers 23% (However, older age groups are still well represented). Those modern nomads also have changed ideas about assets and investment. Cryptocurrency is completely virtual and location-independent, making it the perfect asset for a digital nomad's investments.

Beyond cryptocurrency, the blockchain ecosystem is expanding with developments like NFTs (non-fungible tokens), DeFi (decentralised finance) and the metaverse. These offer lucrative investment opportunities and revenue streams that break the barriers of traditional financial systems, which resonates with the adventurous mindset of digital nomads. Take content creators – one of the most popular jobs for digital nomads, as an example. Creators can now use NFTs to engage with fans around the globe and earn recurring income through NFT trading, renting and royalties.

Work in the age of decentralisation

The nomadic lifestyle is especially well suited to the crypto industry, which is naturally decentralised and distributed across the globe. The global scale of blockchain technology and explosion of the crypto job market attract an increasing number of people from nine-to-five corporate jobs to careers in the crypto space that are not geographically or culturally limited. Blockchain companies have been among the earliest adopters of remote jobs and digital nomadism. According to research by BanklessTimes.com, 36% of blockchain-related positions are remote-based, more than double the global average of 16% across all employment sectors.

DAOs (decentralised autonomous organisations) has been one of the hottest emerging spaces in the crypto world. DAO offers a revolutionary organizational structure that enable businesses to access a global pool of talent and capital. Working in DAOs allows for considerable flexibility craved by digital nomads. Instead of working for one employer on a 40-hour week, working hours can be spread across several DAOs remotely and asynchronously. As the Web 3.0 ecosystem evolves, so too are the ways in which like-minded people can connect and expand their careers worldwide.

Regulations also have a role in allowing the 'Crypto Bros' to push past borders and build communities outside their home jurisdictions. Crypto's technology and philosophy is global, but the regulations governing it vary greatly from country to country. People tend to move to countries with crypto-friendly environments to undertake their projects. These countries and cities benefit in turn from a global talent pool, which nurtures the crypto scene and attracts investments. As more countries gradually legalise digital currencies, the future is bright for crypto nomads.

What's ahead for crypto nomads?

Living and working as 'citizens of the world' with permissionless money may be the crypto ethos with most appeal for digital nomads, but we are still in the infancy of travelling the globe using crypto. It takes time and research to open a cryp-to wallet and start using or investing in cryptocur-rency. The collapse of crypto-related companies 'one after another' has made 2022 a rough year for crypto, shaking investors' confidence and even sending some roving workers back to the office. There is still no solid regulation in place. Taxa-tion can also be tricky for digital nomads relying on cryptocurrency, with different rules in different countries. Therefore, living and travelling using crypto and crypto alone can be challenging.

(image from: Shutterstock)

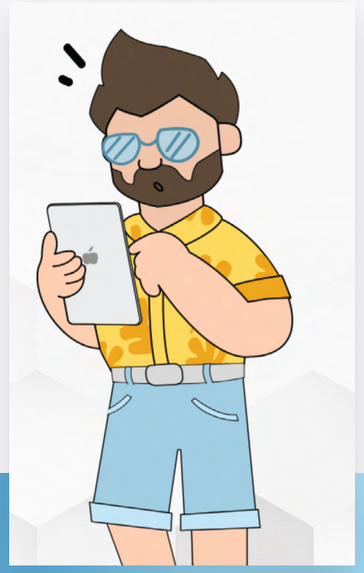
Cryptocurrency adoption on a global scale won't happen overnight. But with each pass-ing year, the world seems more accept-ing of it. More and more digital tools are emerging to bring people into the digital asset world, with enhanced experience and ownership. The wave of centralised finance (CeFi) failures will only make the industry and crypto community believe even more in the importance of regulated and transpar-ent players. As the larger blockchain space matures together with the higher degree of decentralization, transparency and shared ownership that come with Web3, many fu-ture jobs are still to be discovered. Many will be recruiting 100% remote teams to align with their philosophy of decentralisa-tion.

What could this mean for asset management?

The world has changed post-pandemic. Organisational cultures have been permanently rewritten, with remote working now the new normal. Digital nomads and wannabes face different needs, challenges and opportunities compared to non-nomads, especially when it comes to retirement saving. They are less likely to have a pension plan forced upon them by an employer. Some nomad-focused financial firms are starting to offer globally portable retirement saving products to cater for globally mobile clients. As the nomadic working lifestyle grows, it is likely to have a major impact on how people view and access financial and investment services. So financial institutions must think about how to offer new ways to allow for this evolving workforce to build wealth as they move from country to country.

Meanwhile, cryptocurrency and other digital assets are becoming more present in the mainstream economy, playing an increasingly important role in helping people choose to live and work wherever they want. Despite the recent market turmoil, we shouldn't confuse market fluctuations or bad actors with the potential uses of digital assets and the technologies underlying them. The recent crashes in CeFi platforms proved the advantages of DeFi in terms of transparency and customer protection. Yet DeFi volume and activity remain relatively low compared with traditional financial platforms. As more and more nomads get paid in crypto and hold digital assets, there are huge opportunities for trusted players to facilitate the synergy between existing financial networks and digital assets, providing customers with more everyday utility for the emerging asset class along with enhanced security.

(image from: Pensions for nomads)



24/7 online access to your accounts, wherever you are

Rahul Jain

Head of
AI Center of Excellence

4

GAI

Generative artificial intelligence

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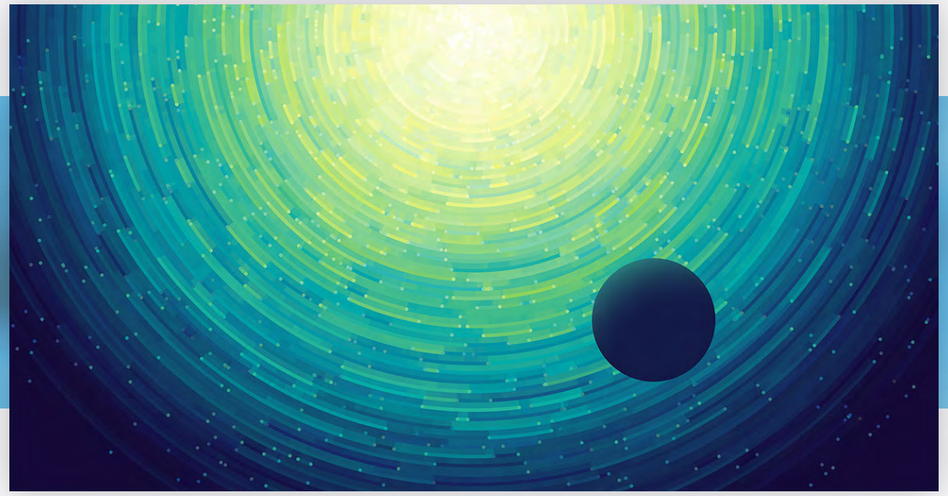
Taking AI beyond mere analytics



(image from: Inspiration Grid)

We're getting used to artificial intelligence (AI) that analyses data. Using supervised or unsupervised machine learning (ML), it can predict customer churn, recommend a product, sort customers into different categories, predict sales and even forecast the weather.

But while each of these problems is different, in none of them does AI generate a new data point. For example, it can decide if an email is 'spam' or not, but won't create a new email.

That's where generative AI (GAI) comes in. It is a branch of AI that can generate data rather than simply analyse it. This data could be images, audio, videos, texts, software code and so on.

GAI allows us not just to analyse input, but to generate new data matching the original domain. Such machine-learning models can generate images from text, images from another image, change the domain of an image, generate voice from text, generate text from voice, generate code, generate poems, generate blogs – and much more.

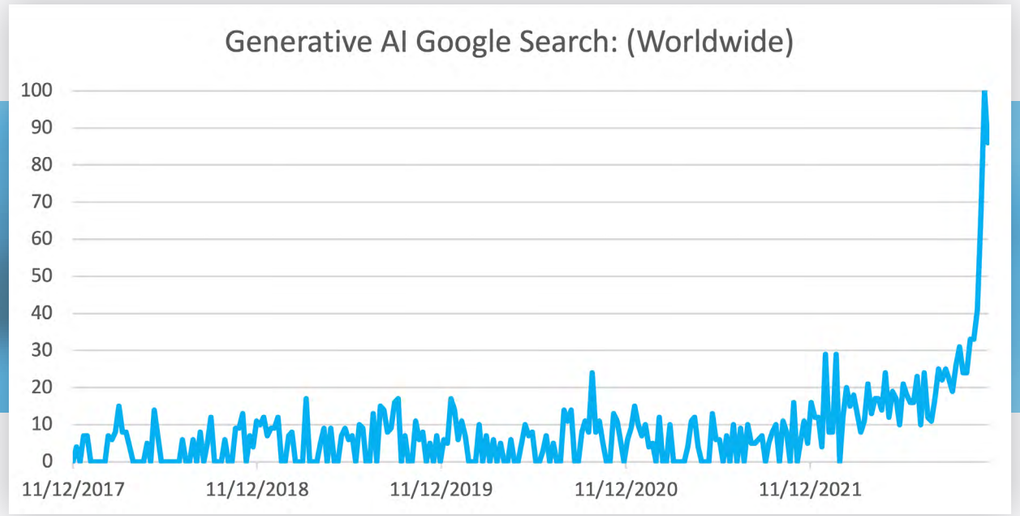
Other examples of usage could include:

- Imagining and generating a human pose
- Transferring data across domains, for example converting a day image to a night image
- Generating video based on prompts
- Generating artificial/synthetic data

(image from: Artstation)

The growing global interest in GAI

Google Trends searches over the past five years show the rising global interest in GAI:



(Source: Google)

This has been sparked by the capabilities demonstrated by closed-source and open-source GAI models:

- By 2025, generative AI will account for 10% of all data produced.
- Tech consultants Gartner predict that 20% of all test data for consumer-facing use cases will be synthetically generated by 2025.
- The number of publications relating to generative adversarial networks (GANs) rose by 36% in 2021.
- Gartner listed GAI among its top 12 strategic tech trends in 2022, although it sees it as having reached Inflated Expectations in the hype cycle.

(image from: Gartner)

Gartner Top Strategic Technology Trends 2022

How the technology is evolving

The evolution of GAI has been made possible by deep generative models, namely:

- Autoencoders
- Variational autoencoders (VAE)
- Generative adversarial networks (GAN)
- Derivatives of GAN (CycleGAN, BigGAN etc.)
- Diffusion models

However, many recent breakthroughs have been enabled by deep-learning models called diffusion models (for example OpenAI's DALL-E 2 and Stability.ai's Stable Diffusion).

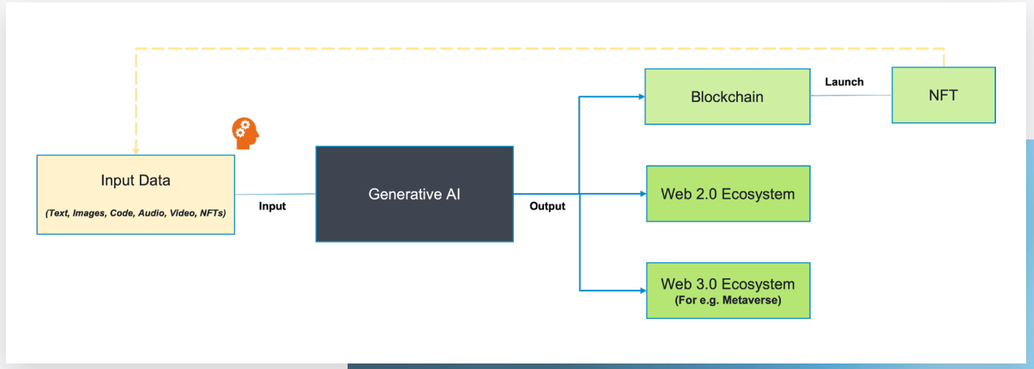
Their fundamental goal is to mimic human cognitive abilities. However, most existing models have only one ability and can operate only on one specific domain.

Multimodal models are AI systems that can learn and operate concepts in different domains and multiple modalities, by combining models. These operate in the same way as human cognition.

GAI is a key contender for multimodal AI model, encompassing a wide set of domains from computer vision to speech generation. Google Research's Douglas Eck believes the next big thing is to build language models into other AI models. Raia Hadsell, a research director at DeepMind, has also stressed the importance of multimodal generative AI systems combining audio, language and vision.

It's hard to predict exactly when the first multimodal models will arrive, but we expect them in the near future – and they will be game-changers.

GAI could drive technology convergence across the Web 3.0 and blockchain ecosystem. This is something to watch for as all three technologies go mainstream. This infographic gives a conceptual view:

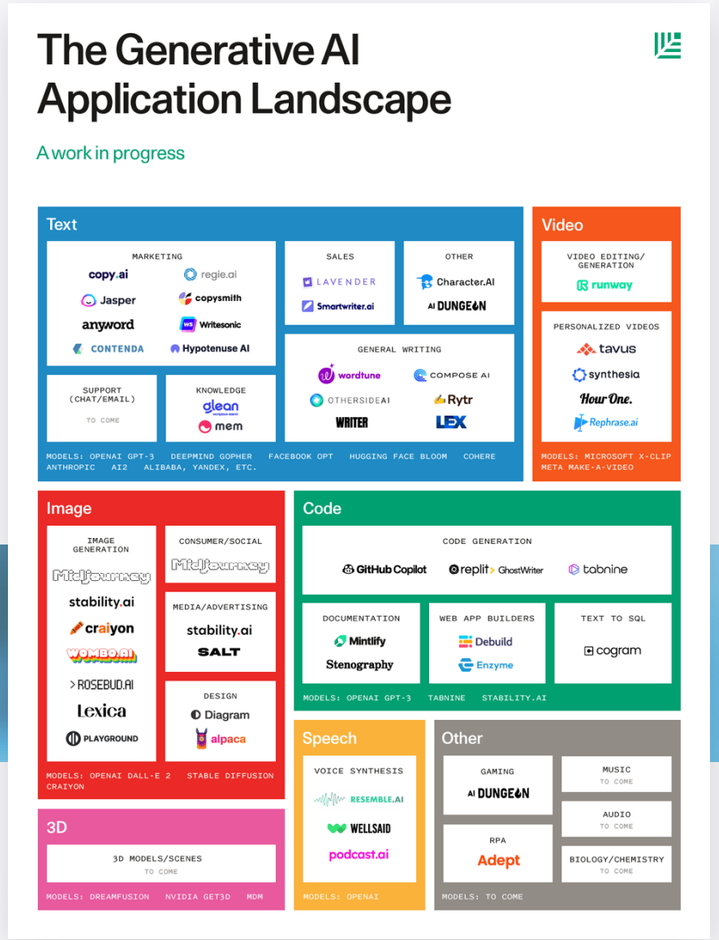


A conceptual view of GAI-enabled technology convergence

When to adopt?

The near-magical capabilities of text-to-image AI models (such as DALL-E 2 and Stable Diffusion) and text-to-text AI models (such as GPT-2, GPT-3 and, more recently, ChatGPT) have caught the public imagination, triggering a wave of start-ups focusing on delivering applications built around similar AI models.

The application landscape seen in this infographic illustrates the vendor/creator ecosystem:



(Image from: Protocol)

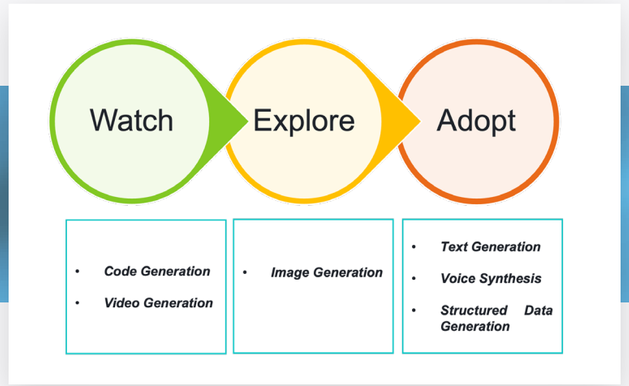
Much progress has been driven by closed-source models, but open-source versions of state-of-the-art models (such as Stable Diffusion) are catching up. The important call is whether to become an early adopter or wait for the field to mature.

The scale of funding available to promising start-ups in this space is interesting, with unicorn evaluations common.

In a fast-evolving landscape, deciding which model to adopt will require clarity of vision. Clearly, an enterprise's needs could be limited to only a few elements of GAI. Therefore we propose categorising GAI models/applications in three broad categories:

- **Watch -** This includes GAI elements that are exciting, but which may not have immediate use cases/examples. One interesting new domain is code generation. The opportunity to automate software generation presents unimaginable opportunities.
- **Explore -** This includes elements that are exciting and mature, with use cases/examples. Some experimentation may be needed to see how they align with our needs.
- **Adopt -** These elements have matured, with real-life use cases. This category addresses pressing business or technology needs and we may actively want to adopt them.

An illustrative grouping is shown below:



Please note this is not a reflection/comment on the quality of available solutions, but more a balanced view of our needs and priorities.

What challenges lie ahead?

As the popularity of GAI increases, the need to address issues pertaining to it will also grow. We must match its benefits with understanding its risk profile. The risks include:

- **Security -** As cybersecurity becomes more of a threat, with phishing, vishing and other fraudulent activity, GAI could potentially trick users as it can resemble real photos and voices.
- **Data governance -** Creating synthetic data could bring data privacy concerns. For example, using generative AI in financial services involves collecting an individual's private information. Tracing and auditing the data used to train the models and for the generated data itself are other important issues.
- **Ethics -** If the GAI model has been trained on data scraped from the internet, the outcome could be biased, unsafe or offensive. For example, certain religions may be offended if GAI were to create an image of their deity or switch the gender of deities.
- **Ownership -** Generative models rely on large amounts of real data for training. Who owns the generated data? There are also concerns around the ownership and rights of outputs from the generative model (especially with images and audio).
- **Explain ability -** It can be more challenging for the GAI to explain its output, so an unstable outcome may result.
- **Regulation -** By 2024, the EU will have legislated for compulsory 'watermarking' of AI-generated artefacts. The European Commission has also proposed amendments to include AI systems that 'generate outputs in the form of content (generative AI systems), predictions, recommendations or decisions, which influence the environments it interacts with'.

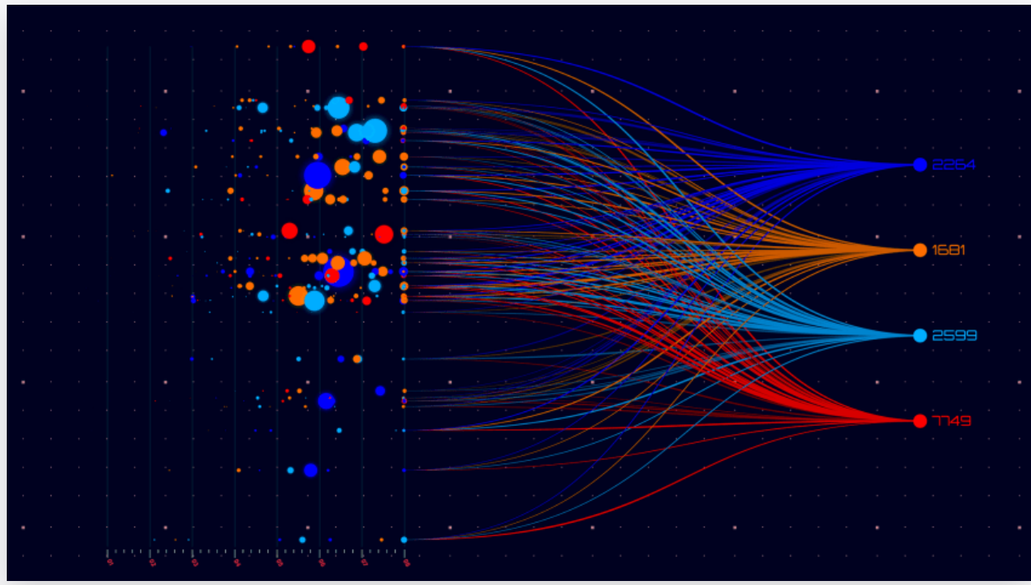
Early adopters of GAI will have to develop appropriate controls for these issues.

Where will GAI be most useful?

As the pace of innovation accelerates, it's hard to rule out any possibility for GAI. This makes adoption both easy and difficult at the same time. But we see two areas with huge potential for enterprises and where we expect large-scale adoption:

GAI for tabular data

Please note this is not a reflection/comment on the quality of available solutions, but more a balanced view of our needs and priorities.



(image from: Shutterstock)

Relevant uses include:

- Synthetic data to address data gaps
- Synthetic data to meet the data requirements of AI and ML models
- Synthetic data for better fraud detection
- Synthetic data for dealing with ethical issues in AI and ML

Generative AI for text data

This includes sub-domains such as generating text from text and generating text from speech. An excellent article by Forbes lists many potential uses [Source]:

- Summarising documents, research notes, legal contracts
- Accurate question-answering systems for information retrieval
- Generating fund performance reports
- Automating minutes of meetings
- Translating documents and speeches into different languages and converting those in speech format for more global consumption in native languages

Case studies

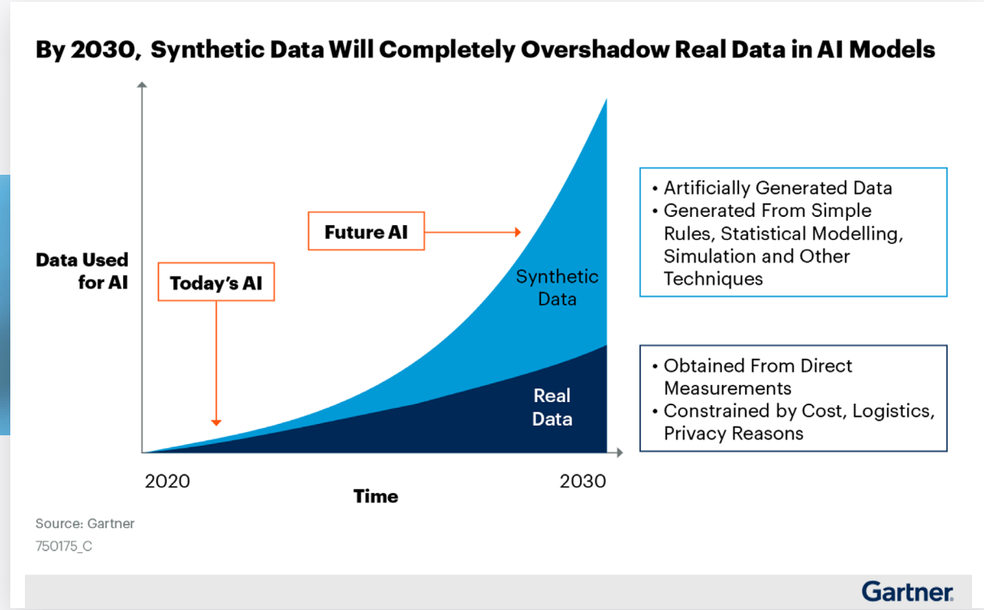
Here are two examples of GAI technology addressing problems faced by our business.

Case 1: Using GAI to generate synthetic data

The need for good data is constrained by the various controls that cover its use. These could be commercial, geographic or regulatory. That's why we are examining the generation of synthetic data. Using GAI technology to do so has huge potential for Fidelity.

Gartner suggests that over the next decade this approach will dominate how AI will develop.

(image from: Gartner)



At macro level we believe synthetic data could play an important role in:

- Accelerating innovation and sharing data with fintechs for rapid evaluation.
- Reducing the time taken to innovate by unlocking access to sensitive data faster – sharing more data more easily with partners (for example, providing test data as a service to clients).
- Implementing synthetic data as part of FIL's data strategy to use a statistically equivalent representation of real production data that is safe to share internally and externally.

Our exploration of using AI and machine learning to generate synthetic data was initiated in Q4 2020. We focused on using open-source libraries to generate a synthetic version of a single-table data structure. This early prototype helped us understand the benefits and limitations of generating synthetic data. A parallel exploration of marketplaces suggested nascent activity, but where only a few niche vendors could offer commercial solutions.

By 2022, as our capability matured and we synthesised more datasets, we gained much better understanding of using GAI to generate synthetic data, its risk profile, pitfalls and gotchas.

We need to match the benefits of synthetic data with understanding of the risk involved in using it. Simply put, these are:

- Suboptimal synthetic data
- High-quality synthetic data
- Risk of leaking personally identifiable information (PII)

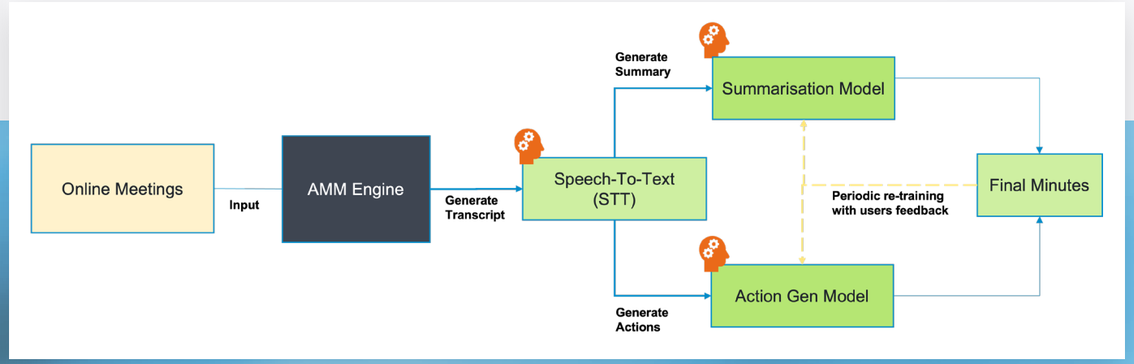
These risks can be mitigated with appropriate controls, but further residual risk could still exist and would need appropriate management.

Obtaining the initial synthetic-data capability set is just the beginning. Integrating it into our overall control frameworks will take continued attention and effort.

Case 2: Using generative AI to automate writing meeting minutes

Writing meeting minutes is tedious and time-consuming, especially where formal minute-writing is required. It's an interesting problem for two reasons. First, solving it would be hugely convenient in terms of time and effort. Second, it's a good convergence of multiple GAI techniques.

Currently, the work of professional minute-takers can typically take two or three times as long as the actual meeting [Source]. So how can GAI solve this? We explored using GAI models to automate the generation of minutes. This infographic shows a conceptual view of the solution:



We believe that an AMM (automated meeting minutes) solution could play an important role in:

- Reducing minute-taking time, allowing practitioners to focus on value-added activities
- Allowing key points and decisions to be followed up more easily
- Increasing productivity by generating summaries of the meeting that easily

communicate its outcome

Our exploration of using AI and machine learning to generate minutes began in Q4 2021, with a focus on using open-source libraries to:

- Use speech-to-text solutions to generate transcripts
- Use large language models (LLM) to generate summaries of meetings
- Use LLM to generate the minutes

This early prototype helped us understand the benefits and limitations. A parallel exploration of marketplaces suggested nascent activity, with only a few niche vendors offering commercial solutions.

Using AI and machine learning is a fast-developing, bleeding-edge technology. We found several issues, namely:

- A sub-optimal STT solution for generating meeting transcripts
- AI models generated sub-optimal summaries
- User feedback for AI is critical

(Image from: Vicarious)

The road ahead

We are excited to see how GAI can help shape our personal and professional lives and how we can leverage it to better serve our customer base. We believe the pragmatic approach is to balance the risks and rewards. This sweet spot will be unique for everyone who adopts this technology.

Matt Twigg

Fidelity Labs Senior Manager

5

NFTs

Non-fungible tokens

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The irresistible rise of the NFT

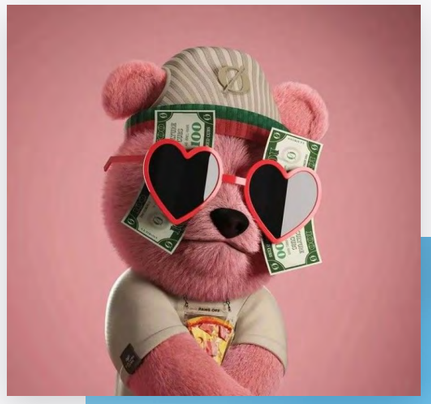
Non-fungible tokens, or NFTs, first entered the public consciousness with the multimillion-dollar sale of digital artworks by artists such as Beeple and his ground-breaking NFT, Crossroads.

Originally designed to create, transfer and verify digital ownership, they have since opened the door both to new asset classes and for improved liquidity in more traditional assets. As they develop, they are proving a powerful tool for financial products, as well as for the protection of confidential information.

Let's start with that unfamiliar word 'fungible'.

Fungibility simply means that one item can be swapped for another without losing any monetary value and with no detrimental impact on the holder. For example, one ten dollar bill can be changed for another, or even 10 one dollar bills without any alteration in value. When traded for goods or services, its value remains the same.

But the holder of non-fungible assets cannot swap them for another equivalent item – it's unique. A painting has a market value thanks to its provenance and authenticity. But one cannot swap two different paintings and preserve an identical value – each is one of a kind and lacks fungibility; they cannot be exchanged for an identical item as none exists. This is where much of the value of NFTs lies – in provenance and scarcity.



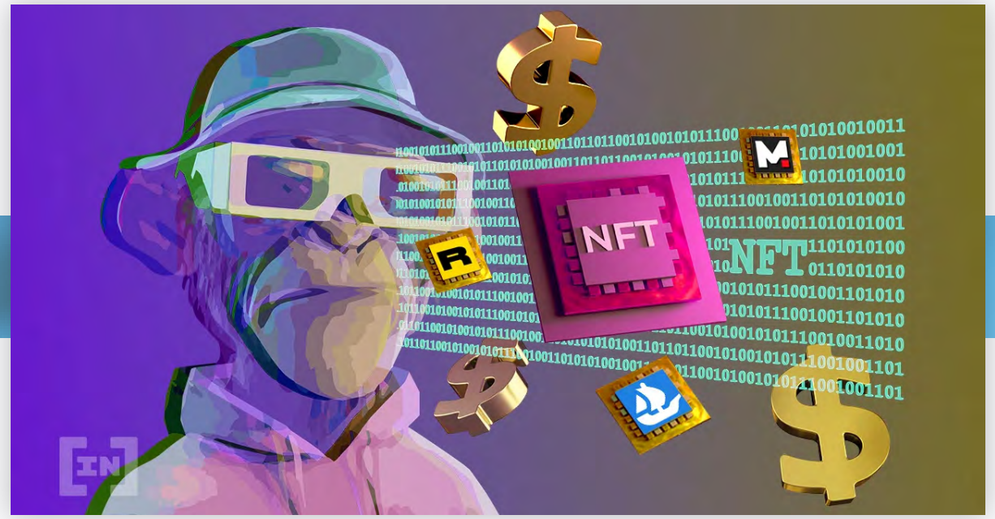
(Image from: Pinterest)

How does the technology work?

NFTs are digital tokens that represent physical or digital assets, such as a piece of digital art or a fraction of virtual or physical real estate, using unique IDs and metadata stored on the blockchain. This data increases transparency and clarifies authenticity, ownership and provenance in a highly efficient way. That is what make NFTs so useful for financial products.

The asset is represented within the token, which describes its various attributes, digital or real. With tokenised assets, the NFT is functionally the ledger entry of key details about the item, such as its creator, name, type, ownership, provenance and so on, written in smart contract data. As it is non-fungible, the token cannot be changed arbitrarily. The act of recording it on the blockchain allows full transparency about the asset and its qualities, enabling more efficient validation with fewer overheads.

How to use NFTs



(Image from: beincrypto)

NFTs can be linked to physical assets, making them more liquid for trading and providing authenticity and certification. With physical assets, such as tokenised physical real estate, the token's value is bound to the value of the asset it represents.

When NFTs represent virtual assets – which can range from virtual real estate to virtual sneakers –their true value is harder to determine and is often driven by sentiment. But the expansion of the metaverse will provide a growing alternative reality with its own societies, ecosystems and economies that will make NFTs more useful.

As NFTs mature, utility is increasingly sought-after. Now the initial hype of acquiring digital art has died down, the focus is on what the token can do for the holder. NFTs can grant voting rights, special event access, physical items, community access, breeding (combining two or more NFTs), and burning or merging (reducing supply and thereby increasing value), as well as fractional ownership.

What challenges do NFTs pose?

Regulatory and legal

There is debate over whether NFTs are securities. If collectable art is not a security, why should NFT art be a security? But if we fractionalise digital art to sell pieces to other investors or use the NFT in a decentralised finance (DeFi) app to secure a loan, that looks much more like a tradable security. Contract law is another area of concern. Many NFTs have no terms and conditions and those that do often fail to adhere to contract law.

The copyright of digital art also needs examination. NFT buyers get a licence, not a copyright, and often a limited one. Even then, it may not be well-communicated or understood by all parties.

Storage

For purely digital items, NFTs point to the remote file storage where the item is held. To increase resiliency and prevent loss, the InterPlanetary File System (IPFS) is used, providing extensive redundancy. This can confuse new owners, but is similar to the freeport system used with art and other collectables where owners do not take physical possession of the item. Storage is another challenge for buyers in that what they 'own' is stored off-chain and both linkage and storage (of digital assets) are vulnerable to technology failure or hacks.

Freeports
(Image from: itsartlaw)

What business opportunities do NFTs offer?

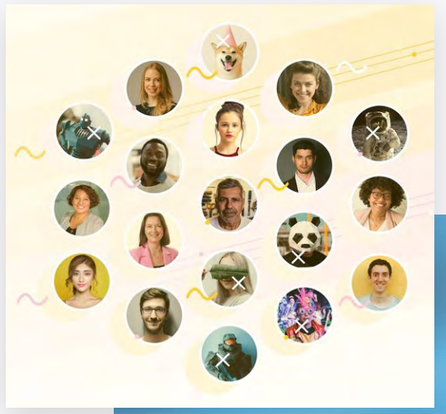
NFTs and community

NFTs are increasingly used as social identifiers. The way they distribute ownership allows people to shape communities by voting with their input and funds. With Web3 and NFTs as a symbol of affiliation, people can use the liquidity of NFTs to influence the direction of communities, feeling welcome and that they are making a difference.

Identity and personal record-keeping

Soulbound tokens (SBTs) are a form of NFT that cannot be traded or sold. They can be used for identification and verifying the holder's personal history. Medical records, educational qualifications and CVs can all be stored on SBTs. They could contain a combination of a user's ID and other key attributes, such as their address and a secret. Anchoring the SBT to the holder's secret would link these items to the owner exclusively and irrevocably. Where traditional NFTs and tokens are all about transfer and transaction, soulbound tokens are not to be traded. They use the proof of humanity (PoH) attestation, which relies on the Turing test, web of trust attestations and other verification methods.

(Image from: Kleros)



Creator economy

Art was once the preserve of the wealthy. Collectors often had to commission a painting or pay high market prices for existing works. NFTs can make art available to larger audiences.

They also give creators much more control over the sale and use of their art. When a traditional artist produces work there are usually several intermediaries, such as galleries or record labels, between them and the customer. They can be locked into contracts that limit their access to royalties or control over how their art is used.

NFTs change this. Because they are smart contracts, the rules on how the artwork is used or traded onward are written into the code. Beeple's record auction of the Crossroads NFT granted him an extra 10% in royalties when it was resold, automatically executed by the smart contract.

Collectables, events and value extension

NFT-native digital art such as CryptoKitties, Bored Apes and CryptoPunks are the most visible NFT collectables, but other uses might seem more familiar. NBA Top Shots and NFL All Day are extensions of sports trading cards. Louis Vuitton and Gucci are building metaverse presences to strengthen their brands, using NFTs as prizes. Customers are more likely to buy items offering an experience. NFTs can make this easy, increasing sales and brand loyalty.

(Image from: NBA Top Shots)

Real estate

NFTs allow innovative access to both virtual and physical real estate. Decentraland and Sandbox are the main virtual worlds where one can buy virtual real-estate plots. In Decentraland, virtual 40 x 40km plots can be purchased as an investment or rented out. Major brands such as JP Morgan, Coca-Cola, Fidelity and Dolce & Gabbana have entered Decentraland and early landowners can earn significant rental income by providing space for brands to set up virtual storefronts, while brands benefit from customer engagement.

Physical real estate is relatively illiquid yet remains the second-largest asset class behind debt. To increase liquidity, it can be fractionalised via NFT tokenisation. Rather than marketing a large commercial property for $100 million, 1,000,000 tokens could be sold at $100 each. Each token will have all relevant data – such as appraisal, income, occupancy, expense and cap table – recorded on the chain. This is available for investors, banks and regulatory bodies, increasing transparency and reducing overheads and service costs. As the NFT is readily viewable on the blockchain, any prospective investor can determine exactly what the investment is worth to them.

Tokenising institutional-grade real estate via NFTs is an efficient route for individual investors. Jones Lang LaSalle (JLL) Japan is looking at tokenisation as a way of adding liquidity to the real-estate market. Tokenisation brings tangible cost benefits for actual real-estate holdings. Rather than investing in REITs (real-estate investment trusts) by streamlining management, improving liquidity and the automation provided by smart contracts. Investors have more options, bypassing traditional mechanisms such as hedge funds, which take a significant percentage of the property value. By using tokenisation all the normal processes remain, with the added advantages of the distributed ledger and smart contracts.

Authenticity and tracking

Logistics NFTs can be used to verify the manufacturing, point of origin, transport and authenticity of merchandise. IBM's Food Trust uses NFTs to provide assurances about the date and origins of products. All parties on the blockchain can access the data and be sure of its safety and authenticity.

What could this mean for asset management?

Almost any organisation or management structure can be created and run as a decentralised autonomous organisation (DAO). Where increased transparency, accountability, automated contract execution or distribution of funds is necessary, a DAO can streamline the process. One area that can benefit greatly is settlement efficiency. With a distributed ledger system. There is no need to reconcile separate books, which could significantly speed up processing. JP Morgan demonstrated this with its Onyx blockchain for repo transfers. NFTs and tokenised assets offer greatly increased liquidity, as KKR's recent offering using the Avalanche blockchain shows.

> In line with the benefits of blockchain, [NFTs] will allow us to have direct access to end customer rather than relying on a middleman. In addition, [NFTs] should enable significant cost reduction on the settlement function of the industry as settlement will now be T+few seconds vs. T+3 days currently
>
> **- Fidelity research analyst and PM Edward Tajima -**

(Image from: Medium)

SBTs could streamline know-your-customer (KYC) processes. Using the blockchain, institutions can track identities, assets and transactions by validating a user's SBT. Processes would be faster and more efficient, benefiting both the company and our low-risk customers.

> NFTs will fundamentally change the way we create assets, understand our clients' behaviour and create new mechanisms for us to embed and exchange value. The dynamic nature of this technology is presenting opportunities, from new forms of identity, enabling asset managers to create a new way of managing on-chain risk, to future portfolios with NFTs assets
>
> **- Ben Brophy, Fidelity head of blockchain -**

NFTs and fractionalisation open a world of new products and alternatives in a market where many seek increased yield or greater diversification. Tokenised physical real estate managed by NFT smart contracts could be more efficient than traditional REITs. NFT real estate or collectable art could become novel asset classes in a well-diversified portfolio.

Using tokens as tracking tools can streamline shipping, medicine, food supply and safety. With all information recorded via NFTs, the immutable and transparent nature of the blockchain allows assets to be easily tracked, reducing due diligence burdens and the risk of fraud. This could greatly streamline KYC protocols and reduce overheads, further enhancing the opportunities provided by NFTs in asset management.

As take-up of NFTs increases, clients will look for responsible custodians to protect their investments. Trusted partners such as Fidelity International can build on our infrastructure, name and reputation to provide services to customers seeking extra peace of mind.

Mukul Kumar Saini

Emerging Technology Analyst

6

Technology Convergence

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Why tech convergence is the mother of invention

Convergence has been around for centuries. A good example is Thomas Edison's invention of the electric light bulb. This did not come about on its own, but because filament technology, vacuums and, of course, electricity were all available. It was how these combined that lit up the world.

Today, technology convergence is bringing about a paradigm shift not only in how humans live – by changing industries, businesses and polity – but also in humans themselves.

Tech convergence – along with mathematics, the systems approach and high-speed computing -- allows us to better understand the natural world, creating unprecedented opportunities to develop human abilities and address Earth-sized challenges. We shall be able to record the impact of internal agents such as bacteria and external stimuli such as pollutants at cellular level inside our bodies, enabling us to forestall medical issues. Future buildings could heal their own cracks, suck up dangerous toxins, including atmospheric carbon, and even generate biofuels. Most of these possibilities will probably be realised through businesses big and small.

This converging technology revolution will transform sectors from financial services to space exploration. For instance, banks could morph from being money lenders to data and intelligence lenders, building on transactional data – which arguably gives better insight than online behaviour. Asteroid mining could become to corporations what the California and Klondike gold rushes were to individuals.

Convergence will help businesses map a path towards rapid growth. This will mean reshaping industries and business opportunities, powering new areas for customer and business value.

For example, MIT spin-off Accion is commercialising a thruster-on-a-chip technology that generates a new ion-energy drive with a theoretical limit of 10,000 newtons per metre squared. Cellbricks is a German start-up producing mini-organs, currently for drug development. These systems can be integrated into organ-on-a-chip technology to stimulate the activities, mechanics and physiological responses of an entire organ. Both represent industries that did not exist a few decades ago and are now growing significantly.

(Image from: Bloomberg)

The underlying dynamics of convergence

What is it?

Simply put, technological convergence means bringing together previously unrelated technologies, often in a single device or connected ecosystem, to create a new solution to an unsolved challenge. Chiefly this refers to the synergistic combination of NBIC – the combined fields of nanoscience and nanotechnology, biotechnology and biomedicine, information technology and cognitive science. These four foundational sciences go beyond digital technology. The phenomenon is driven by vast amounts of data, high-speed computing, ubiquitous connectivity and artificial intelligence (AI), which is itself an example of tech convergence.

As well as examples quoted throughout this article, here are a few NBICs in action:

- AI = IT + cognitive science
- Exoskeleton = bio tech + nano tech + robotics
- Internet of Things (IoT) = IT + cognitive science
- IoT devices as independent economic agents = IoT + AI + blockchain

Convergence is a blueprint for innovation. But it is not just about taking over or expanding existing marketplaces. It is also about creating completely new ones by combining building blocks that are at different stages of maturity and evolution. The market for IoT machine translation did not exist in the 1950s, when the technology was first conceived. But the development of machine learning (ML) and natural language processing (NLP) developed a new market, which is now seeing significant growth.

New and maturing technologies work alongside existing building blocks to create something new. That is the very essence of how things converge to create a new possibility.

How and where it occurs

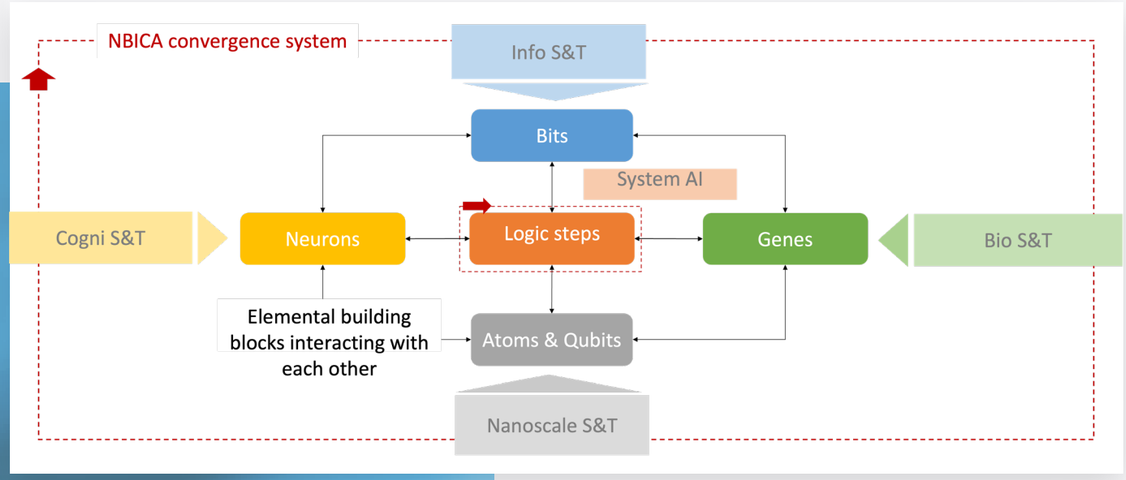
Tech convergence originates within a science and technology system, where one or more of the technical inputs – NBIC technologies – interact. But for a converged technology to develop requires both functional and commercial inputs.

The functional input will identify a context or problem that can be reimagined; the commercial input will ensure that an engineered solution, using the design-build-test-learn (DBTL) cycle, is offered to the market in a financially and economically viable way.

Let's take one example:

NBIC science and technologies converged to create a brain-machine interface (BMI) that could directly plug into the nervous system via the brain, retina, spinal cord or peripheral nervous system. It uses a nano-fabricated algorithm to convert signals from the neuron of a target area of the brain into a machine-friendly signal. This can help paralysed people overcome their disability to interact with the world around them. That was the functional input.

Infographic: Convergence S&T system built from five elemental building blocks – atoms/qubits, genes, bits, neurons, logic steps
(Source: National Science Foundation, an independent agency of the US government)



Now companies such as Nuralink, BrainCo, Emotiv and Kernel are working to commercialise the BMI.

With the BMI, contextualisation was intuitive, but the act of reimagination can sometimes prove harder for disruptive technologies.

Distributed ledger technology (DLT) was on the market for several years before entrepreneurs teamed up with domain champions to imagine applications beyond cryptocurrencies. Now Usizo, a South African crowd-funding platform, uses it to connect to blockchain-enabled smart meters in underfunded schools, allowing donors to pay the electricity bills. This also helps develop markets for renewables.

Another way to look at the origination and development stages of converging technology is as a convergence-divergence cycle. First, science and technology come together to create a new technology. Then the emerging technology finds different applications across industries or ends up creating completely new ones.

A host of skill sets and competencies are required for the cycle to function, calling for diverse talent:

- Scientists
- Emerging tech experts
- Domain champions
- Engineers
- Entrepreneurs

(Image from: BrainCo)

It is difficult to find this combination in one place. So where does convergence occur? Given the variety of talent and nature of technologies, there may be no single type of organisation that can champion it. But some key trends are worth noting:

- Universities seem to pioneer the early explorative stages of convergence technology, sometimes creating hybrid disciplines.
- Many large industrial firms or academic institutions that hold patents form business ventures to commercialise them.

Ultimately, for different forms of convergence to emerge will require one or a combination of the following:

- Crises – necessity is the mother of invention
- Funding (usually via research grants or venture capital)
- Participating academic institutions and research centres
- Government incentives
- Large corporation R&D/innovation
- Start-ups to take advantage of the ecosystem

What opportunities lie ahead?

Opportunities here are limited only by imagination, a functional input and appetite for risk. When new capabilities and paradigms can be created by recombining technologies, it really becomes a game of permutations and combinations. We must identify and address needs that are underserved or not even acknowledged.

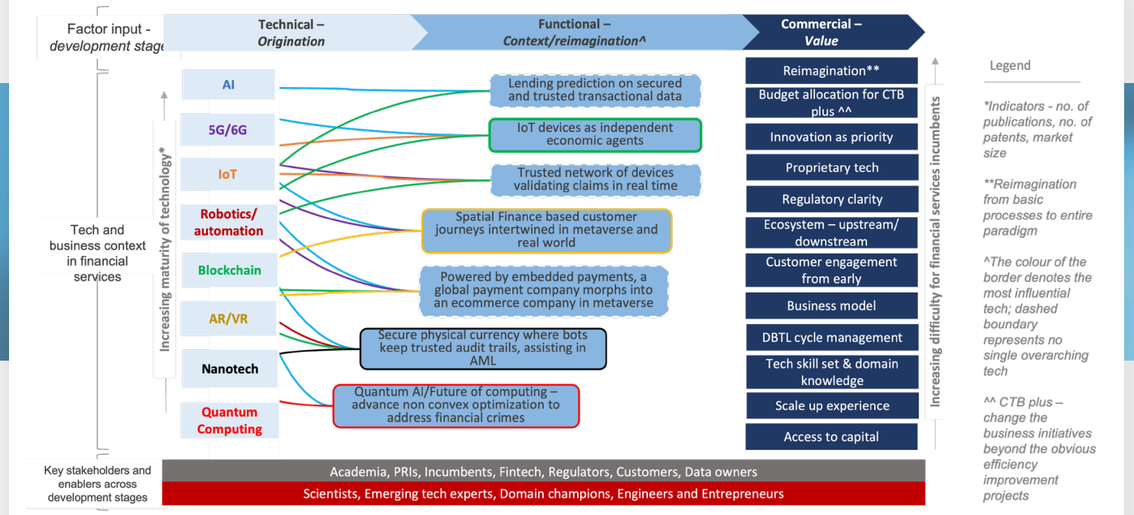
Often success will depend on commercialising the new capability. This will require appropriate partnerships between actors within the ecosystem, such as public research institutions, academia and industry.

The following technologies are relevant to the financial services industry and not only result from convergence, but may combine in novel ways to create new possibilities:

- **AI -** Elements quite commonplace and mature. Yet areas such as language models and generative AI are evolving at pace.
- **Virtual reality/augmented reality -** Experiences are not the same anywhere. These technologies are evolving to optimise form factor, battery life, computing power and costs.
- **Distributed ledger technology/blockchain -** The immutable and shared nature of the register has appeal beyond its current use for cryptocurrencies.
- **IoT -** While not seen as directly relevant to financial services, its potential for all things sustainable makes it a key player.
- **Robotics/automation -** The ability to automate things remains core to digitalising an enterprise.
- **5G/6G/connectivity -** The importance of connectivity and its near ubiquity make it important. Elements of a hyper-connected world can help deliver interesting services to customers.
- **Quantum computing -** This new era of computing can exponentially speed up complex computations, but is still in its early stages.

The convergence process and a few of the novel possibilities it presents, such as quantum AI or IoT devices as independent economic agents, can be visualised in this infographic.

Infographic: Technology convergence relevant to financial services space, suggestive reimagination/use scenario and challenges for incumbents
(Source: An analysis of Fidelity International's emerging technology strategy team)



The consequences of technological convergence are very different for start-ups and more established players. While nimbler fintechs have a problem-solving orientation, incumbent or larger established players struggle to embrace digital technologies, let alone the technology emerging from convergence. This makes the task of choosing future R&D directions even more perplexing.

Commercialisation – or delivering value from technology convergence – requires the current paradigm to be reimagined. The keys are openness to new relationships, making innovation a corporate priority, continued budget support, scrutiny of the business model and the right combination of techno-commercial skill sets, among other things.

That means accepting a certain level of discomfort and realism about where your company is falling behind and what needs to change. It also requires a commitment to being bold and trying things in radically new ways.

And what are the challenges and risks?

Such a journey is not without challenges or risks. Any financial services organisation must pay heed to them, given the heavy regulations it has to meet and customer trust it must maintain. These are some key pointers for the road ahead:

- The reach and dual-use characteristics of many of these technologies raise ethical, moral, social and governance considerations that society has yet to address.
- Converging technologies, because of their digital nature, operate in cyberspace. Thus cybersecurity is essential to protect populations and personal data.
- Unforeseen challenges may arise from environmental issues or deepening social and economic inequalities. For example, female consumers and executives are more proactive about metaverse usage and initiatives, yet women are still locked out of leadership roles in the metaverse economy.
- Patents are intended to encourage innovation and research investment, but can also stifle innovation, limiting access to critical genetic information.

What does this mean for Fidelity International?

Completely new technologies are uncommon. Very few emerge, given the scale of change that has already taken place. However, discovering synergies among emerging technologies can propel a company into the upper echelons of leadership. The key is to think at the intersection of technologies, then focus relentlessly on value to the customer, potential cost savings or new revenue and alignment to overall company strategy.

A new technological paradigm may emerge from incremental convergence rather than radical innovations and scientific breakthroughs. Also, the dynamics of interdependence between paradigms play a significant role in determining technological development paths.

Preparing for this shift via a judicious balance of exploration through internal R&D/ innovation efforts and a careful mix of external partnerships, is no longer an option but an imperative. It is necessary not only for developing a competitive advantage, but also to remain relevant in a new order increasingly determined by technology prowess.

(Image from: zedge)

Ben Brophy

Head of
Blockchain Center of Excellence

7

Zero-knowledge Proofs

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How a new maths concept can enhance online security

Security and privacy are among the biggest concerns for anyone embracing blockchain and Web 3.0 services. Now a new mathematical concept is emerging that can offer great advances in this field zero-knowledge proofs or ZKPRs.

These are a type of computer-assisted mathematical proof that allows an event to be confirmed or proved without actually knowing what it is. A mathematical proof is an argument or evidence for a mathematical statement. It demonstrates that the stated assumptions logically guarantee the conclusion.

Fundamentally, ZKPRs use this process to allow someone to access services without ceding control of their private data. This allows us to change how we approach and manage personal data privacy. Using ZKPRs, we can share highly sensitive personal data with third parties while at the same time enhancing our personal and business security. A ZKPR is proved by using tests performed by a verifier on the submitted proof. These query the proof until there is sufficient probability that it is real, and the individual really has the relevant secret information.

(Image from: DZone)

How it works

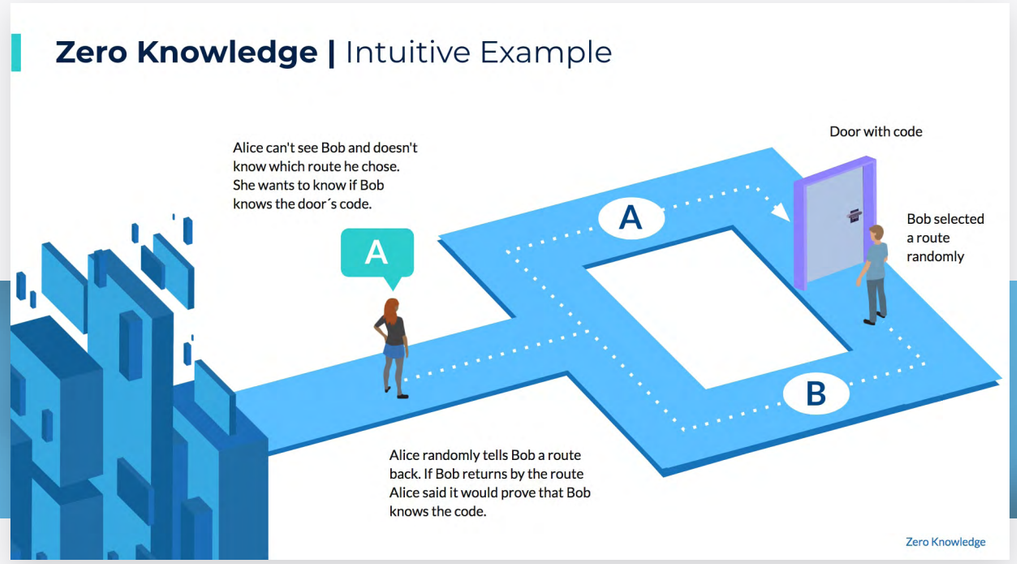
A valid ZKPR must meet certain criteria that ensure it:

- Genuinely shares zero knowledge
- Cannot be tricked by dishonest individuals
- Always works if all parties are honest

These features are known as completeness, soundness and zero knowledge. To take each in turn:

- **Completeness -** means that if the prover and verifier act honestly and the verifier's inputs are valid, the protocol must return true. If these requirements are met, the proof can be accepted.
- **Soundness -** If the input for a proof is in any way invalid, there should be no way the protocol can return the statement as true. Were it to do so, this would invalidate the proof as the prover could mislead the verifier by providing deliberately invalid inputs to make the verifier assume something is true. If the proof is sound, a lying prover should not be able to trick an honest verifier (except within a tiny margin of probability). This is why ZKPRs should be as simple as possible. A simpler protocol allows fewer vectors of attack.
- **Zero knowledge -** is the fundamental building block of these proofs. It should allow knowledge only of whether an input is true or false, and nothing else. This is to make sure the verifier cannot derive the data input by the prover.

(Image from: BBVA)



'The cave of Ali Baba' practical example.

Suppose Peggy (the prover) and Victor (the verifier) stand outside a room with two doors, labelled A and B. Door A is open but B is locked with a keycode. Peggy enters through door A. Then Victor, who remains outside, chooses randomly which door he wants her to exit through and shouts it out. If Peggy knows the code, can open either door and come out through whichever one Victor wants. If she doesn't, she can only exit if Victor chooses door A, the one through which she entered. This lets Victor conclude whether Peggy knows the keycode without her actually revealing it to him or anyone else.

However, if a third party observes the proof – or if Victor records it – it may be convincing to others. To prevent this, a pseudo-random number generator is often used instead of a physical coin flip to choose which doorway Peggy must use to exit. This lets her prove her knowledge without revealing it, so long as she and Victor don't collude.

What's the role of computer-assisted proofs?

A computer-assisted proof, also known as a formal proof, is carried out using a computer program to verify a mathematical argument or theorem. Formal proofs are increasingly common in mathematics and computer science as they can help ensure the correctness and rigour of complex mathematical arguments. In a computer-assisted proof, the computer checks the logical steps of the proof, rather than generating the proof itself.

How does this relate to blockchain?

Computer-assisted proofs can help ensure the security of blockchain technology in several ways.

(Image from: Medium)

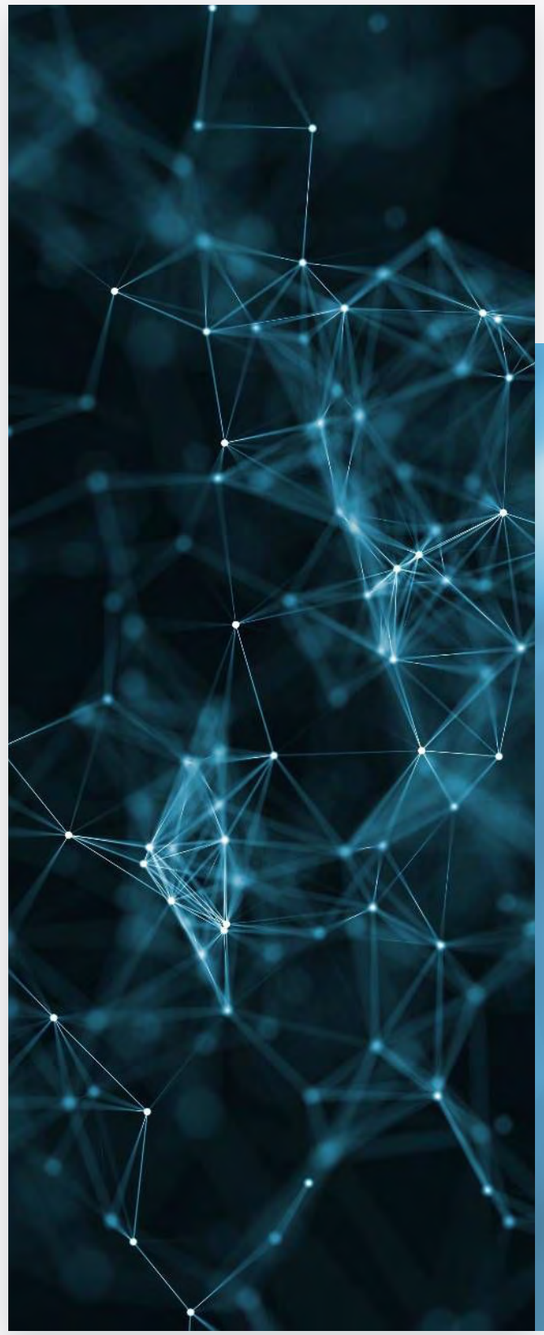
First, formal proofs can help verify a blockchain system's underlying algorithms and protocols, ensuring they are correct and error-free. This can ensure the blockchain's security and reliability, as well as its ability to accurately track and verify transactions.

Second, formal proofs can help ensure the security of smart contracts, which are self-executing contracts with the terms of the agreement between buyer and seller written directly into lines of code. Smart contracts are common in blockchain technology and using formal proofs can help ensure that the code is correct and free of vulnerabilities.

Overall, computer-assisted proofs can improve the reliability and security of blockchain technology, making it more viable and trustworthy for a wide range of applications.

What problems will this fix?

(Image from: zedge)



Computer-assisted proofs can help ensure the security of blockchain technology in several ways. First, formal proofs can help verify a blockchain system's underlying algorithms and protocols, ensuring they are correct and error-free. This can ensure the blockchain's security and reliability, as well as its ability to accurately track and verify transactions.

Overall, they are a powerful tool that can help solve some of the challenges facing blockchain systems, including privacy and scalability.

What does this mean for Fidelity International?

Identity management

Authentication can be carried out without one party having to reveal specific sensitive parts of their identity. The individual or entity can prove who they are without passing personal data to the verifying party. This ensures they retain control over their personal or commercial dataset, while simplifying the process by which information is shared.

(Image from: Pinterest)

Scalability

Scalability is something Fidelity will always examine when deciding whether to adopt a solution. The more scalable an offering, the more flexibility we have when considering how to deploy it. ZKPRs greatly enhance scalability as they need significantly less data to confirm information about transactions.

(Image from: Data Science Central)

Privacy

The blockchain is highly transparent for a good reason. Anti-money laundering (AML) is much easier when you can see every transaction on the chain. However, this transparency is not always a positive benefit for Fidelity. ZKPRs allow Fidelity to prove we have said or done certain things while omitting details that we don't want made public.

For example, if we wanted to prove we had invested in a crypto start-up but didn't want to disclose how much, we could use a ZKPR. Similarly, if a customer wanted to prove to a third party that they were over a certain age, they could use a zero-knowledge proof to do so without revealing their actual age. The user can prove their claim without risking their personal privacy.

Where will ZKPRs be most useful?

Traditional finance (TradFi)

One potential use for ZKPRs is to show proof of reserves. Revealing reserves can expose potentially confidential and commercially sensitive information. For example, if Fidelity held stablecoins, or a specific cryptocurrency, proving these reserves, wallets and client relationships may not be possible without revealing proprietary financial information. ZKPRs would allow proof of reserves to be verified on the blockchain without revealing confidential data.

Decentralised finance (DeFi)

The emergence of decentralised applications (dapps) – services developed and managed by decentralised autonomous organisations (DAOs) – is bringing challenges concerning the provision, use and storage of personal, product and on-chain transactional data. ZKPRs will enable the issue of tokens, treasury management and client data to be completed with encrypted data.

Another key area is scalability for blockchains. ZKPRs can address the current challenges for blockchain systems in processing and storing large datasets. This can make systems challenging to scale. ZKPRs reduce the amount of data that must be processed and stored as users can prove they have certain data without it being revealed or transferred.

Acknowledgements

Our work would not be possible without the contributions of our team. We are a diverse group spread across multiple locations around the globe. Our diversity of culture, age, and experience help us to identify the trends that are most disruptive and deserving of our attention.

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FIDELITY LABS SENIOR MANAGER

Matt Twigg is a researcher and innovation evangelist. Focused on the connection of customer and company, Matt investigates the convergence of emerging technological and social trends to help us understand how we can disrupt ourselves and position ourselves tactically and strategically in a rapidly evolving market. Matt is based in Tokyo, Japan.

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INTELLIGENCE ANALYST

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John is charged with leading Fidelity Labs, an internal incubator that explores new and disruptive business ideas. Based in Hong Kong, John has over 15 years' experience across geographies and industry sectors, giving him a unique perspective on how to apply creative solutions to Fidelity's current and future problems.

Disclaimer

Fidelity Labs is a future looking emerging trends research team and a technology team, which utilises specialists from across Fidelity International to develop a 'house view' of the key trends we believe provide the greatest opportunities for Fidelity, its customers and the broader industry.

https://fidelityinternational.com/innovation-at-fidelity/

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