



AI x CRYPTO

An **Outlier Ventures** Thesis

We find ourselves at the beginning of exploring the potential of combining Artificial Intelligence and blockchain technology, and we are already discovering incredibly exciting opportunities and use cases.

There is a strong, natural fit between the two technologies, due to their relationship with data. However, there is also a sense of urgency in combining them as we look to address the shortcomings of both technologies as they are starting to fall into the hands of billions of users.



JASPER DE MAERE

Research Lead at Outlier Ventures



AI x Crypto | Base Camp


An **Outlier Ventures** Accelerator

The convergence between AI and blockchain technology is finally materializing. Join us in building out the new AI x Crypto vertical. Applications are now open.

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EXECUTIVE SUMMARY





Web3's promise of decentralization faces challenges around data privacy and misinformation.

Addressing these challenges requires merging AI's analytics with blockchain's security.

Moreover, with Web2's interface integrating Artificial Intelligence, Web3 must similarly adapt to meet evolving user expectations, to ultimately bridge the gap between Web2 and Web3.

AI x CRYPTO

THE CONVERGENCE TECHNOLOGY STACK

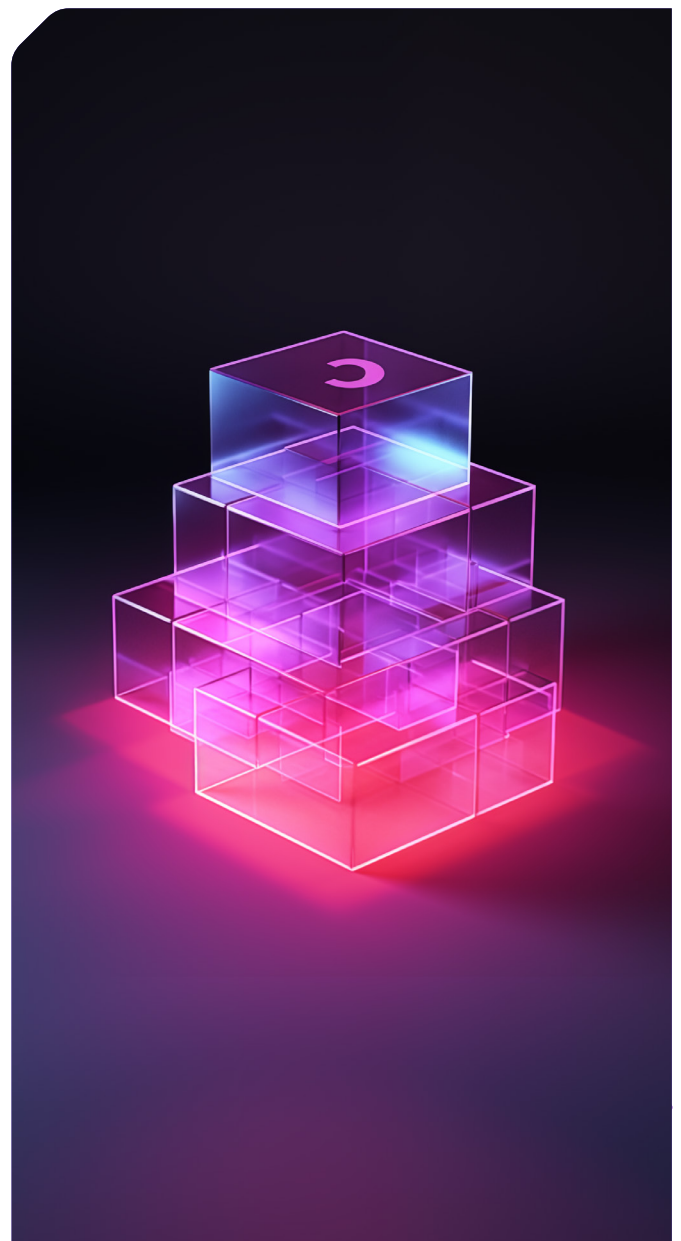
The convergence between AI and blockchain technology is finally materializing. More driven by necessity than opportunity, both technologies are joining forces. **At Outlier, we believe it is time to get serious about building out the AI x Crypto vertical.**

After decades of parallel development, Artificial Intelligence (AI) and blockchain technology are finding mass adoption, and these innovations are now falling into the hands of millions of users.

We are currently observing the intersection of AI and blockchain—an exciting development we previously referred to as convergence, [as discussed in 2018](#).

The convergence is not happening by accident. Instead, we believe there are key drivers that are currently accelerating this trend:

- The current state of the internet today is broken.
- Web2 is integrating AI capabilities, Web3 needs to follow suit.
- AI and blockchain have technological limitations. The solution going forward lies in joining forces.



Understanding the root causes behind a trend unlocks key insights into its direction and longevity.

DRIVER BEHIND THE CONVERGENCE

SHORT TERM



User expectations

Web2 is integrating AI capabilities into applications, changing the expectations of UX/UI. Web3 needs to get series before the gap in UX/UI between both becomes too large to bridge

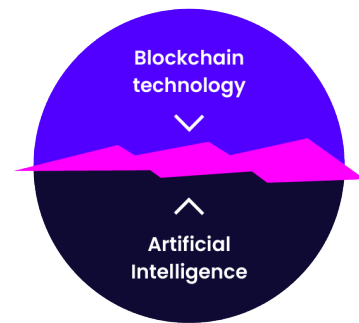
Fixing the internet

The current state of the internet is a mess. Only a combined effort of AI and blockchain can salvage it.

Technological Limitations

Driven by adoption, the limitations of AI and blockchain are becoming visible. Both are looking at each other for solutions.

LONG TERM



Convergence Technology Stack

A technology stack in which blockchain and AI blend together. AI-enabled front ends provides intelligent, adaptive user interactions, leveraging advanced algorithms for analysis, generation, and decision-making. This is integrated with a blockchain-enabled back end, ensuring data integrity and security through a decentralised ledger system.

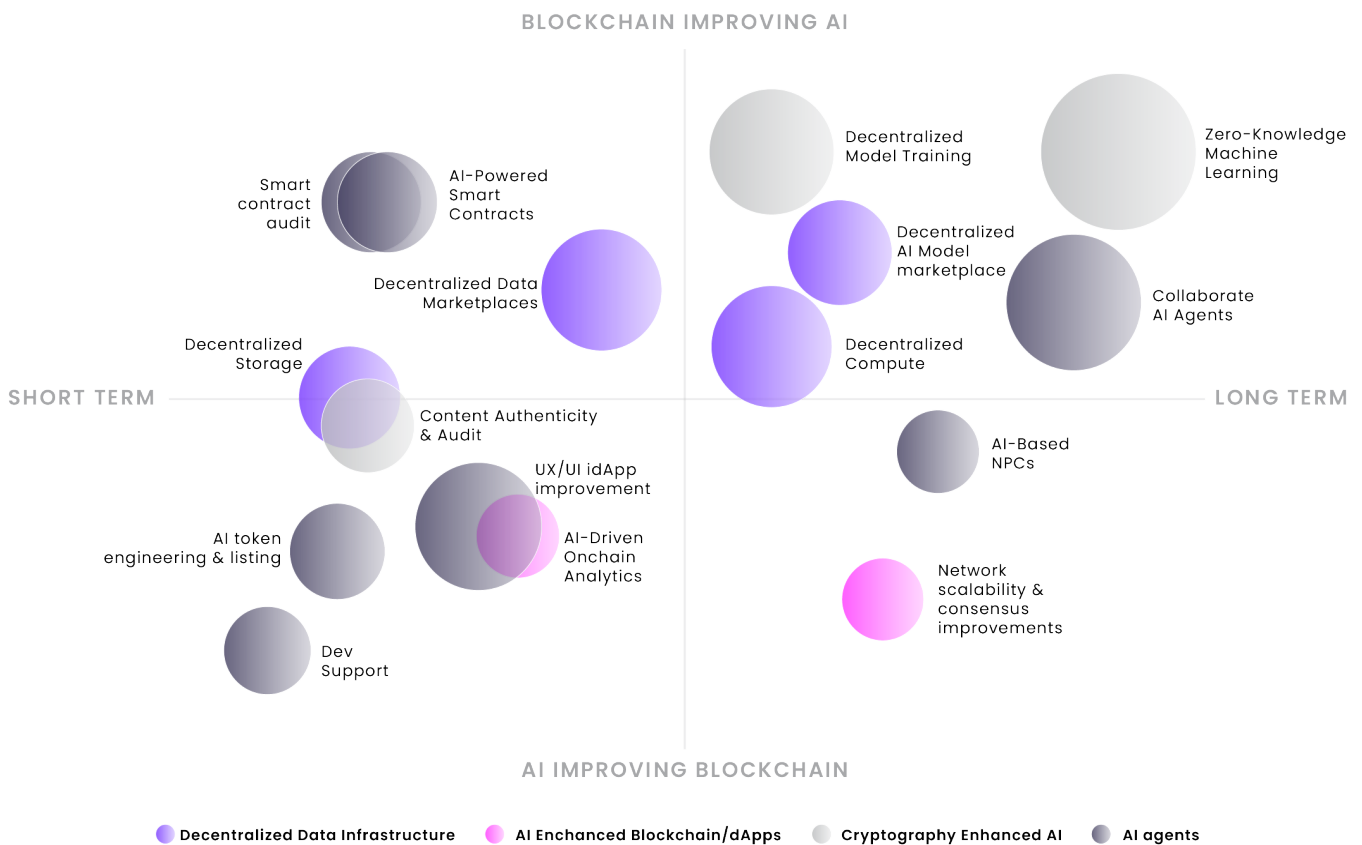


THE ECOSYSTEM

There is currently a lot of exploration happening at the intersection between AI and blockchain.

In the short term, we see AI enhancing blockchain's efficiency and security, while blockchain is bringing transparency and decentralization to AI. The trends occurring over the long term are of a more transformative nature. In this piece, we map out the ecosystem across two dimensions:

- **Time** - How long until the trend will be mature.
- **AI x Crypto** - Which technology is using the other for improvements.



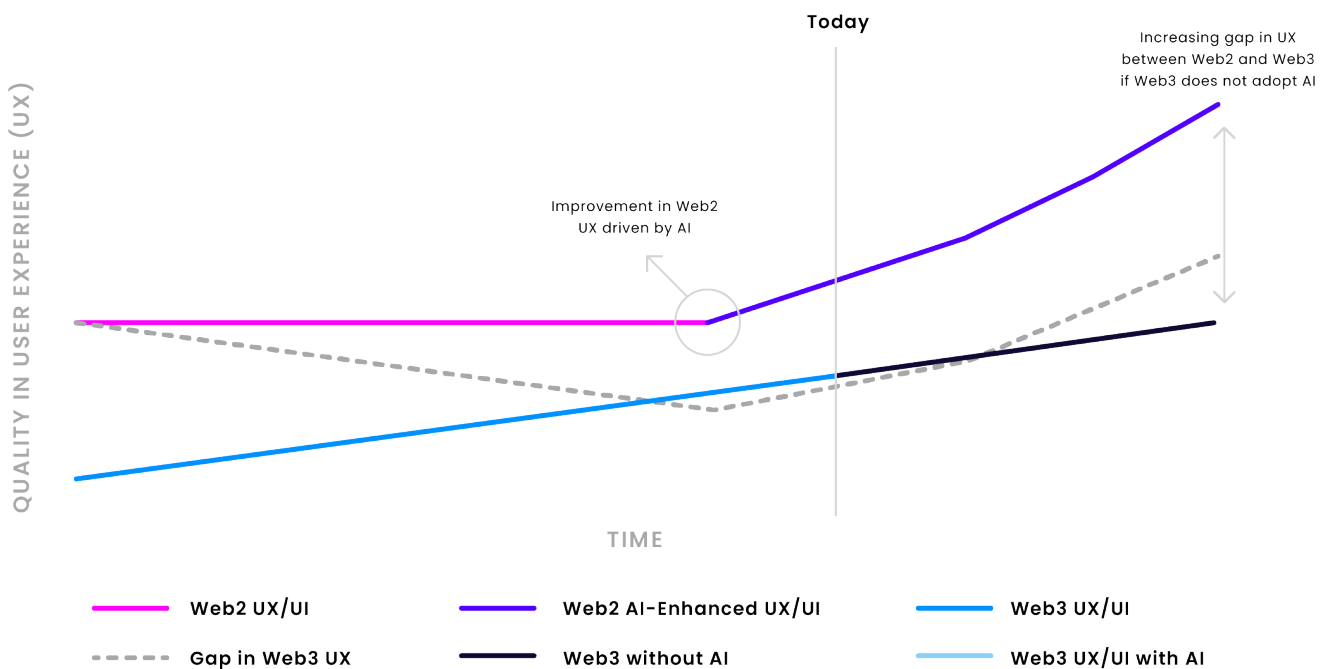
USER EXPECTATIONS

The integration of AI in Web3 is becoming crucial to keep up with changing user expectations set by the increasing AI functionality of Web2 interfaces. Big tech integrating AI into Web2, reshapes user

expectations of application UX/UI. In order to stay competitive, Web3 must adopt AI into its front-end design. Without this, Web3 risks falling behind, limiting potential adoption by Web2 users.

Embracing AI is not just an improvement for Web3, it's necessary if Web3 wishes to remain a viable option for users.

WEB2 AND WEB3 USER EXPERIENCE



FIXING THE INTERNET

The internet was promised to re-shape the way we communicate, interact and operate within society.

But more than four decades after its creation, the internet is far from what it was initially promised to be.

We see four structural issues with the internet today:

- Lack of data privacy and security.
- Misinformation and information overload.
- Algorithmic biases and central control.
- The Indistinguishability & impact of bots.

Web3 promises a decentralised internet where users have control over their data and transactions. In order to achieve this, we need to overcome these structural issues that are plaguing the internet. Blockchain technology and AI are both very promising but each lacks in specific areas, preventing them from solving all these structural issues by themselves. The solution, instead, resides in the convergence of these two elements. AI forming the front-end, while blockchain technology could form the back-end, creating a unified tech stack.

We believe that this is the only way to fix the internet.



FROM THE FRONT TO THE BACK

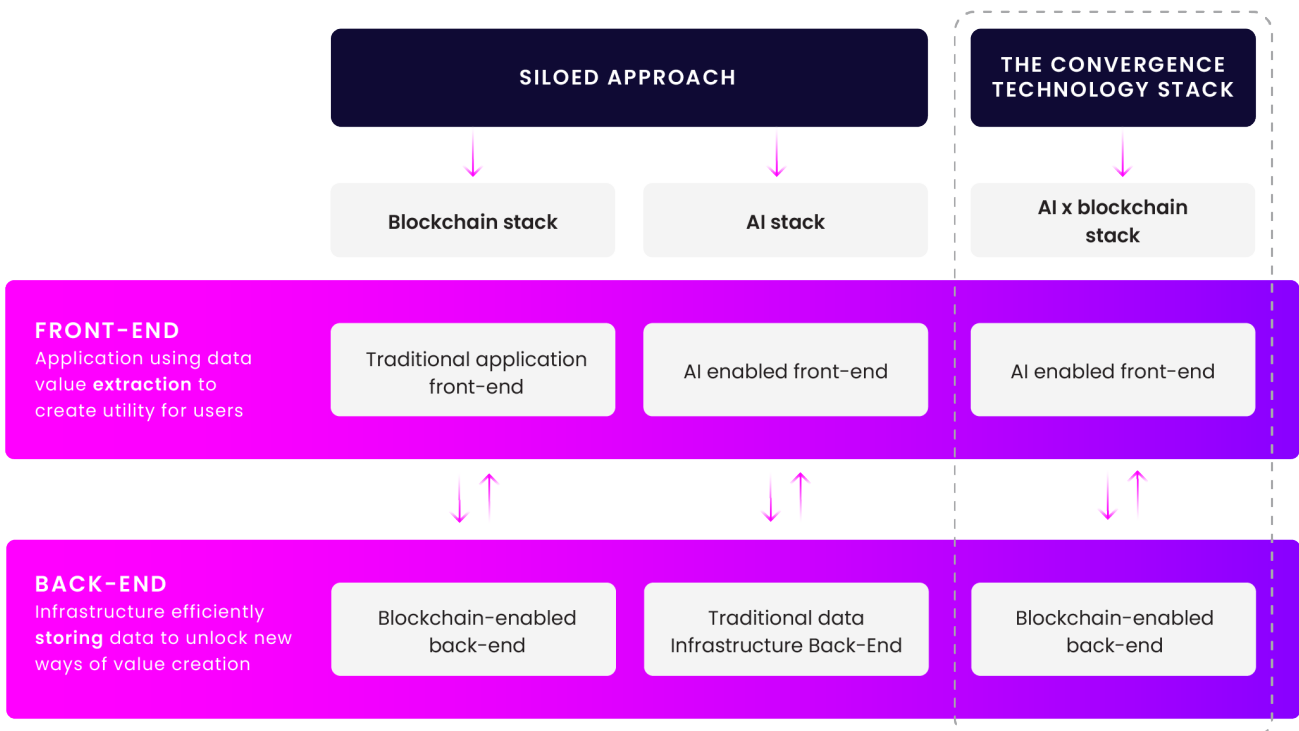
While AI has been transforming the front end with its advanced, intelligent interfaces, it remains reliant on conventional back-end data storage.

This poses limitations such as data breaches and privacy concerns.

Similarly, blockchain greatly enhances back-end data integrity with its decentralised ledger system but often pairs with less dynamic, conventional front ends.

The convergence of AI and blockchain addresses these technological challenges:

AI's innovative front-end capabilities merge with blockchain's secure and transparent back-end infrastructure. This synergy leverages AI's ability to interact with and analyse data in new, groundbreaking ways, while blockchain's robust back-end architecture ensures data security and decentralization, creating a more efficient, secure and user-centric digital environment for data to be stored and used in.



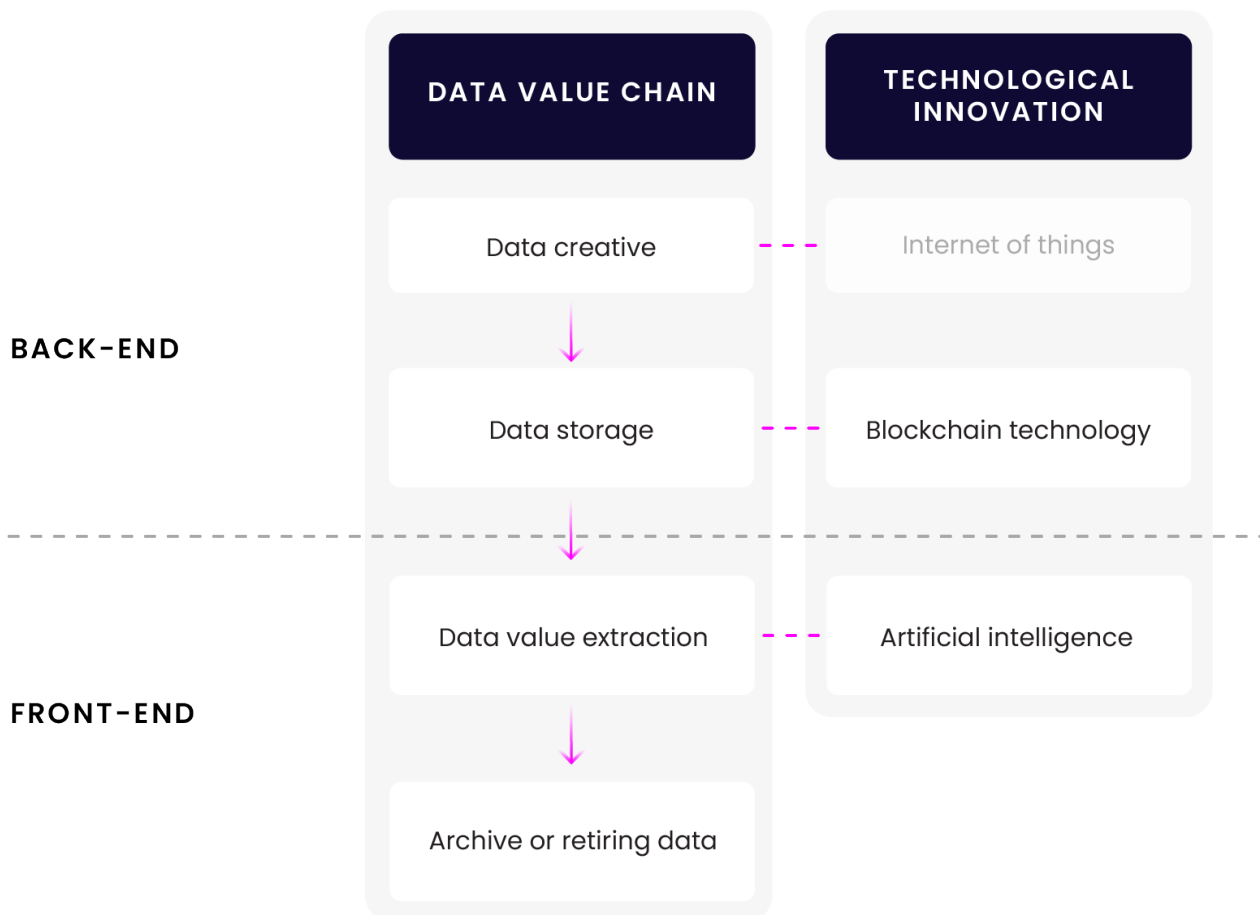
IT'S ALL ABOUT THE DATA

The convergence between AI and blockchain sounds difficult but becomes logical when thinking about the fundamental asset both are dealing with.

AI and blockchain technology form a synergistic relationship, fundamentally grounded in their reliance on data.

Blockchain technology is about storing data. AI is about increasing value extraction from data.

By virtue of their proximity in the data value chain, both technologies are converging, driven by the economic demand to extract more value from data, which is an increasingly important asset in the age of information.



CONTENT TABLE

1. What Is Driving The Convergence?
2. Fixing the internet
3. User expectations
4. Technological limitations
5. The Convergence Technology Stack
6. It's All About Data
7. The Ecosystem

WHAT'S NEXT?

In this piece we answer three fundamental questions about the intersection between AI and Blockchain technology:

- What forces are driving the convergence between AI and blockchain technology?
- What makes both technologies synergistic and how will the convergence technology stack look like?
- What are the different fields of application where we see AI and blockchain technology coming together?

1. WHAT IS DRIVING THE CONVERGENCE?

TLDR – WE GOT YOU

The convergence technology stack is one where AI and blockchain harmoniously operate alongside one another.

The synergies find their root in the fact that both deal with data. Blockchain stored data, AI extracts value from data.

The synergies pave the way to improve existing applications in the fields of AI and Blockchain. On top, the convergence of the tech stack unlocks new potential use cases, of which we only started to scratch the surface.

We believe there are currently three driving forces between AI and blockchain converging:

1. Web2 is rapidly integrating AI capabilities, changing the UX/UI expectations of users.
2. The internet has structural issues that need fixing.
3. Blockchain and AI have inherent technological limitations which need to be overcome.

WE ARE EXCITED ABOUT AI AND BLOCKCHAIN TECHNOLOGY COMING TOGETHER IN WHAT WE CALL THE CONVERGENCE TECHNOLOGY STACK.

This convergence is not happening by accident. Next up we discuss what we've identified as the key driver behind this trend. This is not an exhaustive list of drivers. As narratives and technology change, so will

the drivers. Nonetheless, understanding the current drivers is key in understanding future trends, opportunities and risks as this technology continues to evolve.

1.1 – THE DRIVERS

After decades of parallel development, the convergence of AI and blockchain is materializing.

This new technology stack, incorporating features from both, is what we call the convergence stack.

The Convergence Technology Stack of AI and blockchain offers a transformative value proposition: it enables highly secure and intelligent systems that are both trustworthy and efficient. This integration promises unprecedented levels of automation combined with robust data integrity, paving the way for innovative solutions in various industries.

Ultimately, it sets the stage for a future where complex decision-making is both data-driven and securely decentralised

1.1.1 – FIXING THE INTERNET

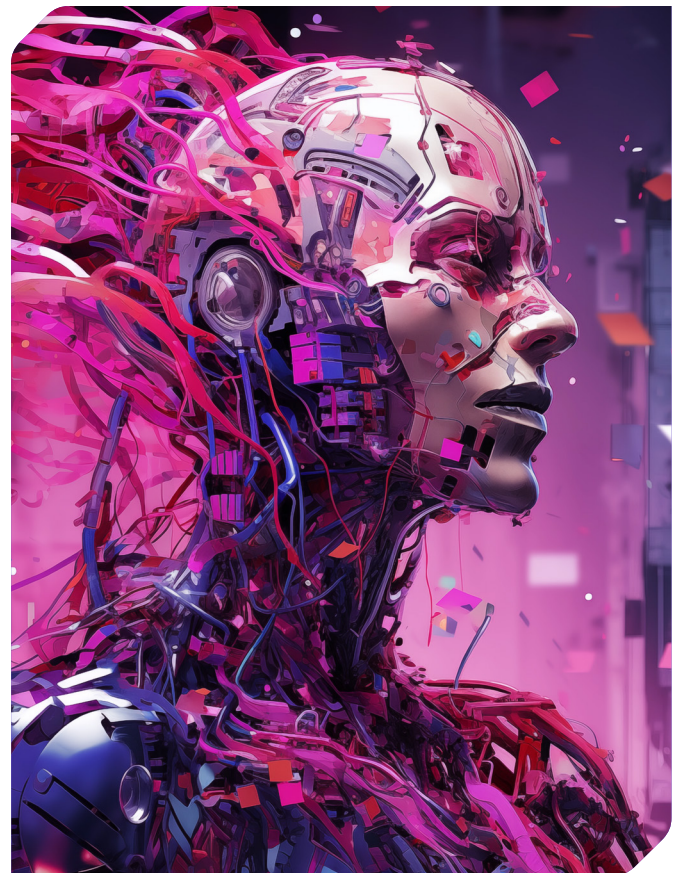
The current state of the internet is a mess that needs fixing.

The Web2 version of the internet is far from what was promised in the last century. Today it is plagued by structural issues like compromised data privacy and security, an overload of information paired with

widespread misinformation, algorithmic biases under centralised control, and the significant influence of bots on public discourse. These challenges collectively undermine the reliability and integrity of the digital space, ultimately affecting its users.

ONLY A COMBINED EFFORT OF AI AND BLOCKCHAIN TECHNOLOGY CAN SALVAGE IT.

More about it [here](#)



1.1.2 – USER EXPECTATIONS

Big Tech and Web2 are integrating AI capabilities into applications, changing the expectations of user experience.

The integration of AI and Web3 is becoming crucial to keeping pace with the changing user expectations set by the increasing AI functionality of Web2 interfaces. As big tech integrates AI into Web2, it reshapes consumer expectations for functionality and interactivity in its applications. In order to stay competitive, Web3 must adopt AI in its front-end design. Without this, Web3 risks falling behind in terms of user experience, hindering adoption. Embracing AI is not just an enhancement for Web3, it's necessary if Web3 wishes to remain a viable option for users.

WEB3 NEEDS TO GET SERIOUS BEFORE THE GAP IN USER EXPERIENCE BETWEEN BOTH BECOMES TOO LARGE TO BRIDGE.

More about it [here](#)

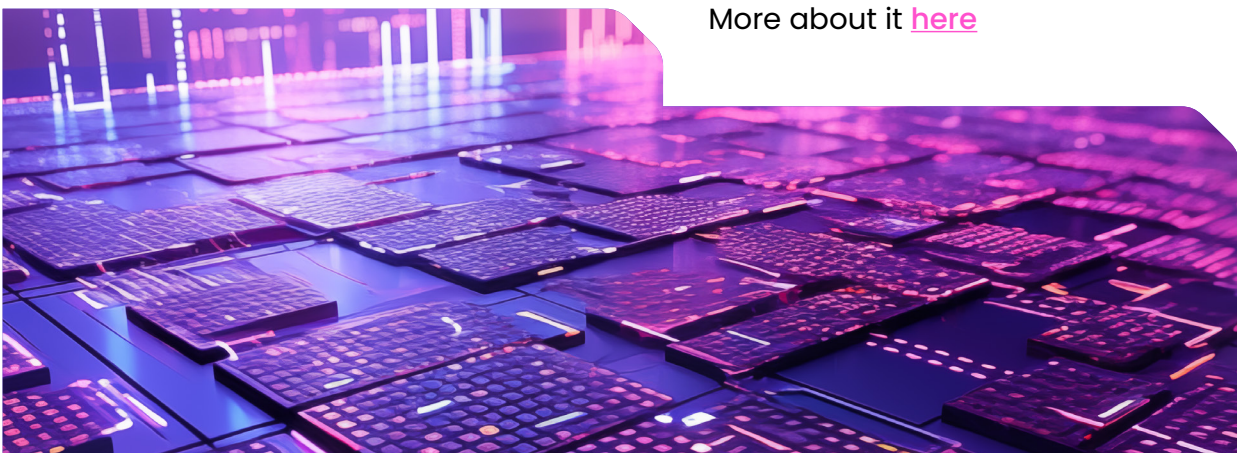
1.1.3 – TECHNOLOGICAL LIMITATIONS

As AI and blockchain start to find mainstream adoption, the fundamental limitations of each technology is becoming visible.

AI and blockchain, while revolutionary in modern data management, face unique challenges as their real-world applications grow among consumers, revealing limitations rooted in their core architecture and algorithms. These inherent constraints are becoming more apparent, underscoring the need to address specific issues within each technology. As they evolve and become more integrated into everyday use, it's crucial to tackle these challenges to fully realize their transformative potential and ensure their continued relevance and effectiveness in the digital age.

AI AND BLOCKCHAIN SHOULD LOOK AT ONE ANOTHER FOR SOLUTIONS TO THE LIMITATION OF THEIR TECHNOLOGY. THEY ARE NATURALLY COMPLEMENTARY AS BOTH DEAL WITH DATA.

More about it [here](#)



2. FIXING THE INTERNET

TLDR – WE GOT YOU

The internet today is far removed from what was promised by techno-optimists at the end of last century. We believe there are four structural issues with the internet that need to be solved:

- Data privacy & security
- Overwhelming & misinformation
- Algorithmic bias & central control
- Indistinguishability & impact of bots

Blockchain technology and AI are not able to solve these structural issues by themselves. A combination of AI and blockchain technology is required to solve all these issues and finally bring us closer towards a Web3 reality.

Despite the initial promise of a globally connected and empowering space, the internet remains deeply flawed.

Falling short of its idealistic vision. centralised control, privacy breaches, and uneven access; these are just a few things that have marred the internet's landscape, overshadowing the freedom and knowledge-sharing it once pledged to offer.

The dream of a truly open, decentralised, and user-centric internet is yet to be achieved. Leaving users in a digital world that is far from the utopian vision it was once believed to be.



2.1 – THE ISSUE

For users, the Web3 promise is one where they can read, write and own the content on the internet.

Web3 promises a shift from centralised authority to a decentralised model, empowering users with more control over their data and interactions. It aims to offer enhanced privacy and security through blockchain technology, reducing risks of data breaches and unauthorized exploitation.

Today's Web2 internet is still a place with a lot of shortcomings.

Blockchain technology is touted as the solution to many of the existing problems by bringing trust and the decentralization of power to the internet.

Blockchain technology is pitched by many as the silver bullet that will solve fundamental structural issues plaguing Web2.



From the perspective of the internet user today, we believe there are four structural issues plaguing the internet, preventing it from moving into Web3:

DATA PRIVACY AND SECURITY

The internet heavily relies on users feeling confident that their personal data is safe and their privacy respected. Breaches in security and privacy can lead to a range of problems, from identity theft to large-scale data manipulation.

OVERWHELM AND MISINFORMATION

Users frequently encounter an overwhelming amount of information, making it difficult to navigate and discern what is trustworthy. The spread of misinformation and fake news is a significant problem, particularly on social media platforms, where sensational or false content often gets amplified, leading to confusion and misinformation.

ALGORITHMIC BIAS AND CENTRAL CONTROL

Algorithms used by major technology companies can significantly shape the online information users encounter, distorting perceptions and creating biases. Centralised platforms have control over substantial portions of online content, and users' interactions with what they see have the potential to foster echo chambers. Bias may arise from various factors, whether intentional or not, stemming from the algorithm's design or the coding, collection,

and utilisation of data for algorithm training. Individuals within these central systems create algorithms that can contribute to a lack of diverse viewpoints and also be used to influence opinions.

INDISTINGUISHABILITY AND IMPACT OF BOTS

Bots can distort online discussions, manipulate social media trends and influence public opinion. Their ability to operate at scale and mimic human behaviour poses challenges to the authenticity and integrity of online interactions and information. It's also increasingly more difficult for users to distinguish between bots and humans.



2.2 – THE SOLUTION

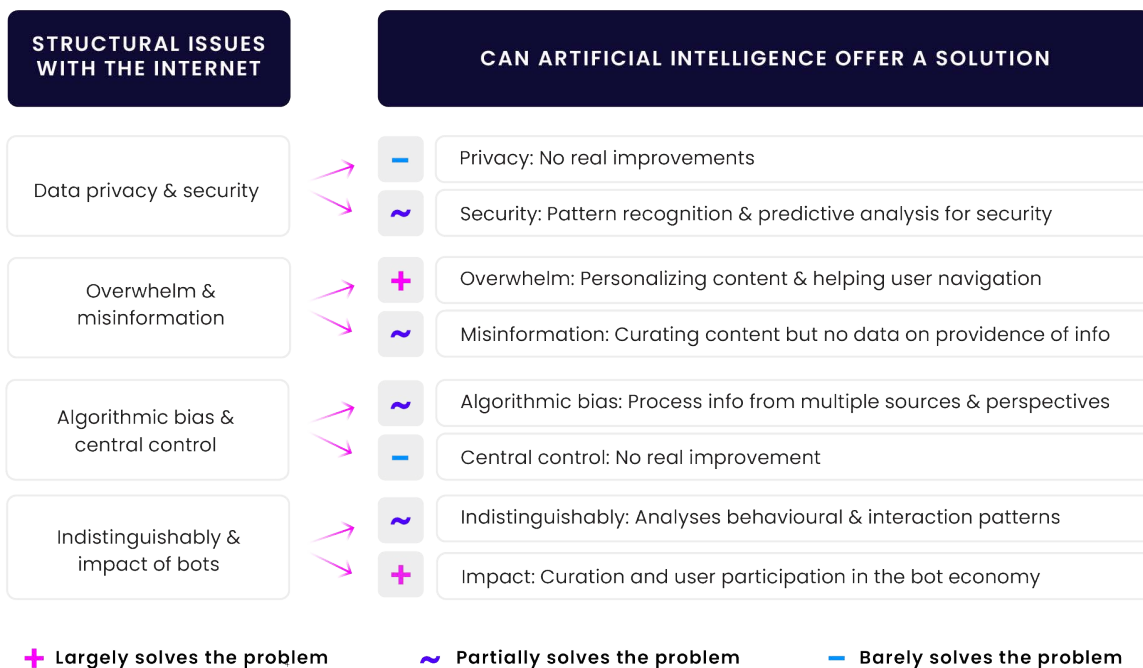
2.2.1 – BLOCKCHAIN TECHNOLOGY

So far, the Web3 narrative has been mainly underpinned by blockchain technology because of its inherent features of decentralization, transparency and immutability.

While the technology is promising, there are still limitations around scalability, UX and data validation. Comparing the value proposition of blockchain to the structural issues of the internet, we believe blockchain only offers a partial solution.

Below is an overview of how blockchain technology performs as a potential solution to the structural issues of today's internet:

The exhibit below shows how blockchain is doing a good (+), partial (~) or bad (-) job at solving the structural issues of the internet



2.2.2 – ARTIFICIAL INTELLIGENCE

Increasingly, AI is also underpinning the Web3 narrative.

With its capability to analyse large datasets efficiently, automate complex processes and provide intelligent decision-making, AI

will become a crucial part of Web3’s future. Comparing the value proposition of AI to the structural issues of the internet, we believe AI, much like blockchain, only offers a partial solution.

Below is an overview of how AI performs as a potential solution to the structural issues of today’s internet:

The exhibit below shows how AI is doing a good (+), partial (~) or bad (-) job at solving the structural issues of the internet

| STRUCTURAL ISSUES WITH THE INTERNET | CAN ARTIFICIAL INTELLIGENCE OFFER A SOLUTION |
|-------------------------------------|---|
| Data privacy & security | + Privacy: No real improvements |
| | ~ Security: Pattern recognition & predictive analysis for security |
| Overwhelm & misinformation | - Overwhelm: Personalizing content & helping user navigation |
| | ~ Misinformation: Curating content but no data on providence of info |
| Algorithmic bias & central control | ~ Algorithmic bias: Process info from multiple sources & perspectives |
| | + Central control: No real improvement |
| Indistinguishably & impact of bots | ~ Indistinguishably: Analyses behavioural & interaction patterns |
| | - Impact: Curation and user participation in the bot economy |

+ Largely solves the problem
 ~ Partially solves the problem
 - Barely solves the problem



2.2.3 – THE CONVERGENCE

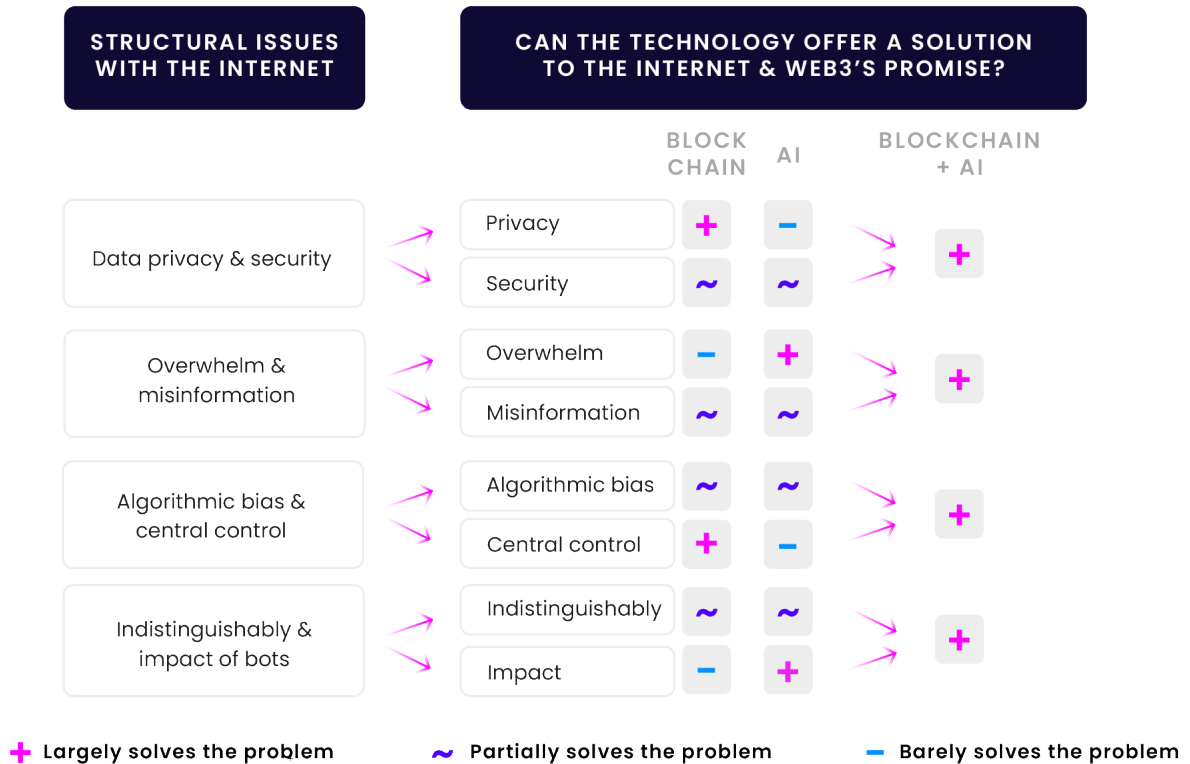
AI and blockchain technology cannot solve all structural issues plaguing the internet by themselves.

However, when combined, they have the ability to overcome these hurdles.

As seen below, shortcomings by one are covered by the other technology, illustrating how complementary both are.

When both only partially solve an issue (~), we believe that a combined effort, leveraging one another’s strengths, can overcome the issue.

The exhibit below shows how a combination of AI and blockchain can solve the different structural issues of the internet



Below we share how blockchain, in combination with AI, tackles each of the four structural issues:

It is important to note that we don't look at the current state of the technology. Instead we look at the fundamental value proposition:

DATA PRIVACY & SECURITY

- **Privacy** - Blockchain brings privacy enhancing capabilities like Zero-knowledge (Zk) technology.
- **Security** - Blockchain's secure and transparent data storage combined with AI's predictive analysis improve data security.

OVERWHELM & MISINFORMATION

- **Overwhelm** - AI prevents users being overwhelmed by information as it allows them to process exponentially larger amounts of data.
- **Misinformation** - Blockchain curates the provenance of data/information while AI allows for broad based sense checking.

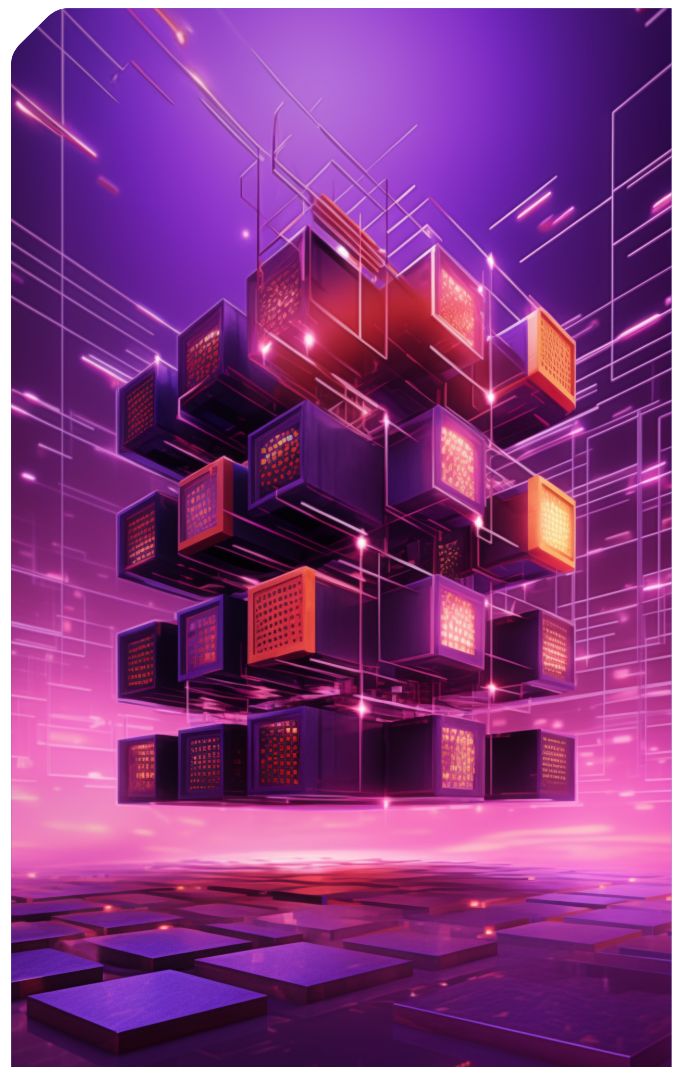
ALGORITHMIC BIAS & CENTRAL CONTROL

- **Algorithmic bias** - AI allows users to process and aggregate info from multiple sources and perspectives. Blockchain increases transparency, allowing users to assess potential bias of sources.

- **Central control** - Blockchain based internet applications naturally provide counterbalance to central control of big tech.

INDISTINGUISHABILITY & IMPACT OF BOTS

- **Indistinguishability** - AI can analyse behavioural patterns of entities on the internet. At the same time, blockchain can track the source of content and the authenticity of information used.
- **Impact of bots** - AI agents allow users to increasingly participate in the bot economy.



3. USER EXPECTATIONS

TLDR – WE GOT YOU

Web3 and blockchain based applications need to get serious about integrating AI capabilities into their front end.

Web2 applications are aggressively already doing this.

As a result, the expectations of users around UX and functionality will increase. If blockchain based applications don't follow suit with AI adoption, the gap between UX of Web2 and Web3 will be slowing down Web3 dApps adoption as users will experience too much friction using Web3 dApps.

Web3 dApps need to get serious about integrating AI capabilities into their front end if they wish to onboard Web2 users

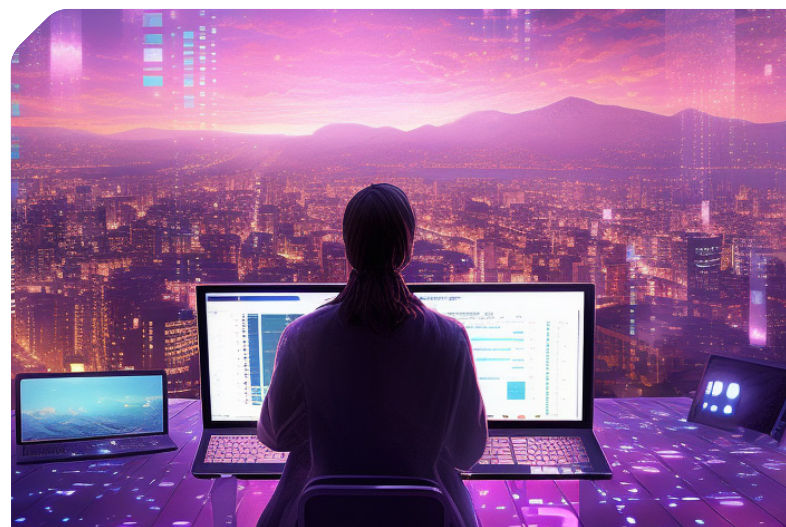
Looking at AI capabilities integrated in Web3 vs Web2 capabilities, it is clear that Web3 is actually lagging behind.

3.1 – THE UX BATTLE

The user experience and user interface (UX/UI) has always been a key driver of adoption of applications.

This is not any different in Web2 and Web3. UX/UI is a point of contention between applications that are looking for widespread adoption.

Better UX/UI means more adoption.



We believe at a high level, quality in user experience is made up of the following:

QUALITY IN UX = THE FUNCTIONALITY OF THE APPLICATION - THE FRICTION IN USABILITY

Quality in UX = The aggregate utility provided by the application. The problem it solves and frustrations it causes. It is high when the application delivers tangible, valuable solutions or services that fulfill users' needs and requirements.

Functionality = The value of the issue it solves or service it provides for users

Friction = The drawbacks to using the application. Friction is high when for example the app is complex to navigate, has slow performance or unintuitive design.

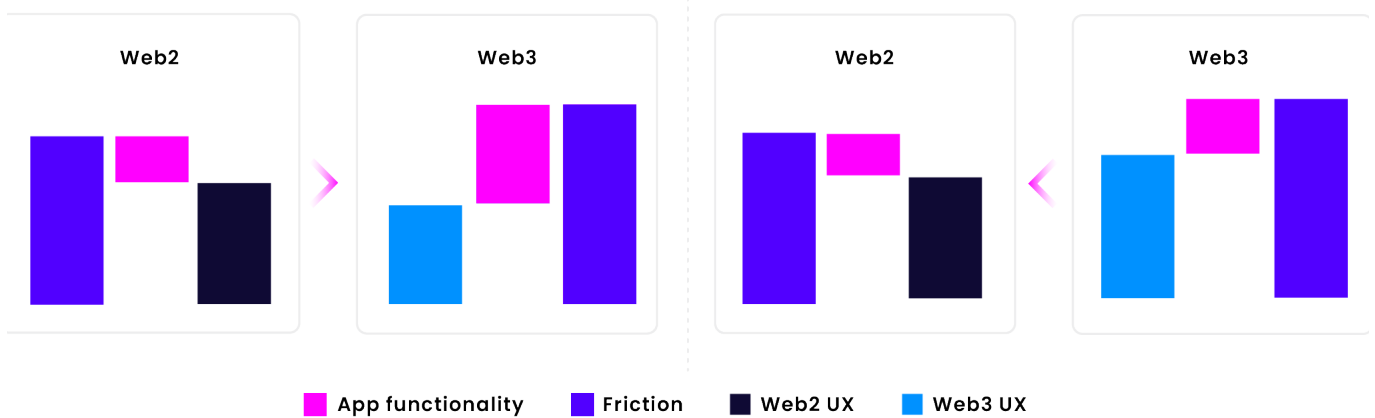
Based on these moving parts, users decide to adopt an application.

This equation also holds for users choosing between Web2 and Web3 applications. As is shown below.

The exhibit below shows users' adoption of Web3 dApps. Good UX and low friction are key drivers for adoption

NO WEB3 ADOPTION

WEB3 ADOPTION



[We are talking about the average user of the adoption curve. There are always early adopters, willing to put up with more friction]

3.2 – WEB3 CATCHING UP

Web3 dApps have been struggling with UX since inception. The poor UX in Web3 is largely driven by the increased complexity associated with using Web3 based applications.

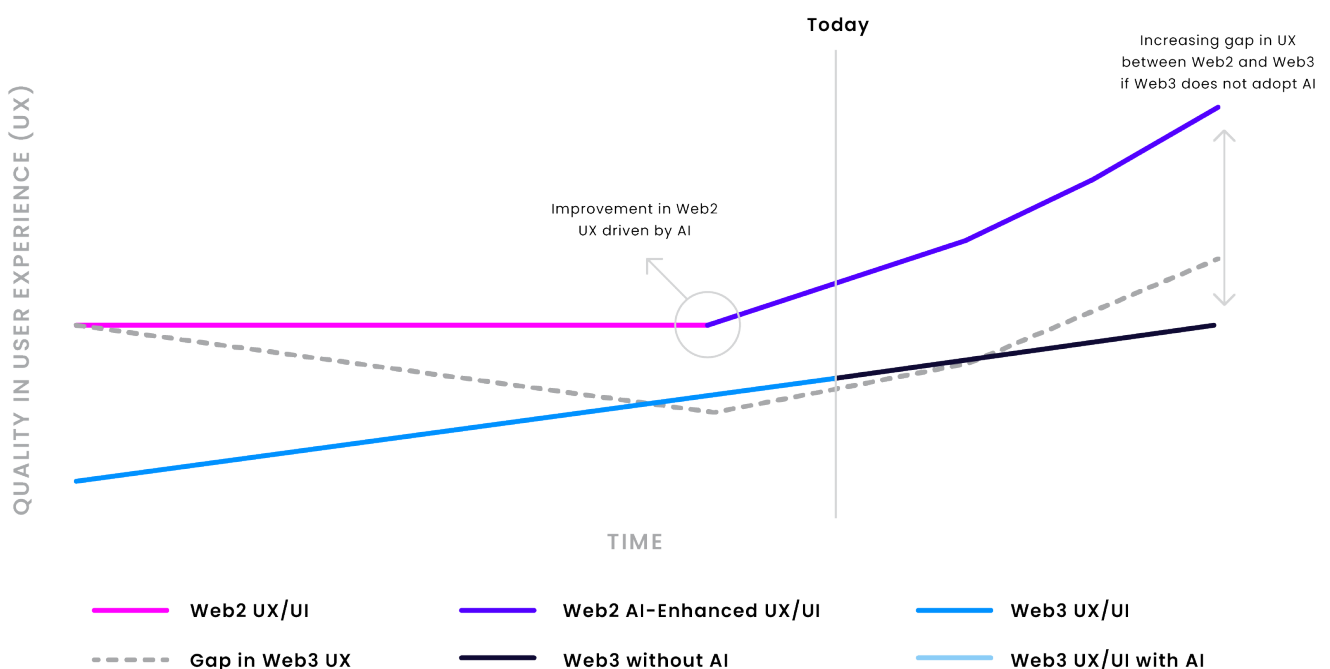
Simply copying Web2 UX concepts onto Web3 is a sub-optimal solution. Web3 is still discovering which UX is best suited to lower friction for users but the UX has been improving drastically over the past years.

This dynamic has changed over the years as Gen AI fell into the hands of the masses. Now, Web2 apps are aggressively integrating AI capabilities, leading to an improvement in UX.

As seen below, with AI-enhanced Web2 UX being a reality, Web3 runs the risk of falling behind, making adoption from Web2 to Web3 applications even harder than before.

This is shown in the infographic below. Recently, driven by AI, Web2 UX experienced an inflection point as more Web2 companies are embedding AI. An example is [Microsoft embedding its Copilot into 365](#).

The exhibit below shows the inflection in UX in Web2 applications driven by AI adoption and how this might lead to a bigger gap between Web2 and Web3 UX.



The recent inflection of Web2 UX creates a sense of urgency for Web3 dApps to take AI integration seriously.

As visible on the exhibit above, if Web3 fails to integrate AI capabilities into its front end, it risks falling behind, creating an ever increasing gap (Web3 vs Web2) in UX, making it even more difficult to convince Web2 users to adopt Web3 dApps.

EXAMPLE – AI IMPROVING UX IN DEFI

An area where Web3 is looking to improve through AI integration is in decentralized finance (DeFi).

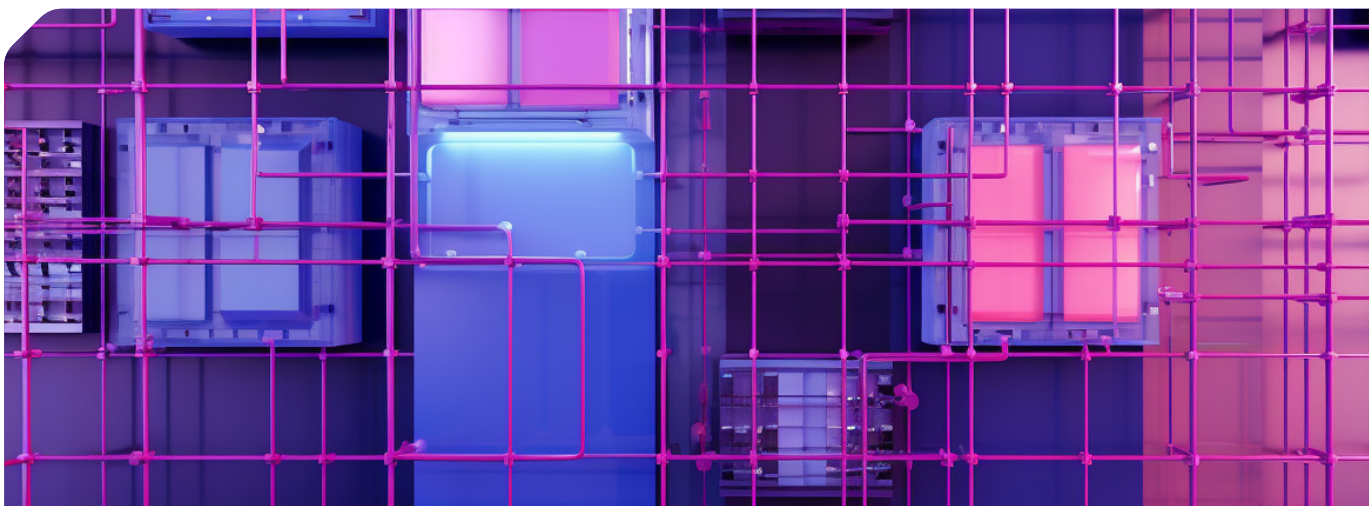
DeFi so far has not really been entry-level friendly. Besides having the ability to navigate the UX, users needed a deeper understanding of market dynamics in order to seamlessly use it.

Intent-based trading has partially improved this for new users by allowing them to trade based on the desired outcome of the trade without concerns of additional complexity.

AI now has the ability to drive adoption further. AI's integration in DeFi could mean that users have access to a personal financial steward helping them execute financial trades and engage in complex financial activity such as portfolio management, asset allocation and risk management.

Simply said, AI has the ability to drastically lower the barriers to entry into DeFi.

More [here](#)



4. TECHNOLOGICAL LIMITATIONS

TLDR – WE GOT YOU

AI and blockchain, despite being transformational technologies, have limitations in how they are used in the front and back ends of the technology stack.

While not exhaustive, we identify the following key challenges:

AI technology stack challenges:

- How can centralization of power be avoided around AI models and ownership?

- How do we prove authenticity and source of AI generated assets?
- How can we preserve data privacy without hampering the capabilities of AI models?

Blockchain technology stack challenges:

- How can the structural issues with the current state of the internet be resolved?
- How can blockchain technology improve its developer environment to attract talent?
- How can blockchain improve its scalability & efficiency as many more assets are being represented in this new database?

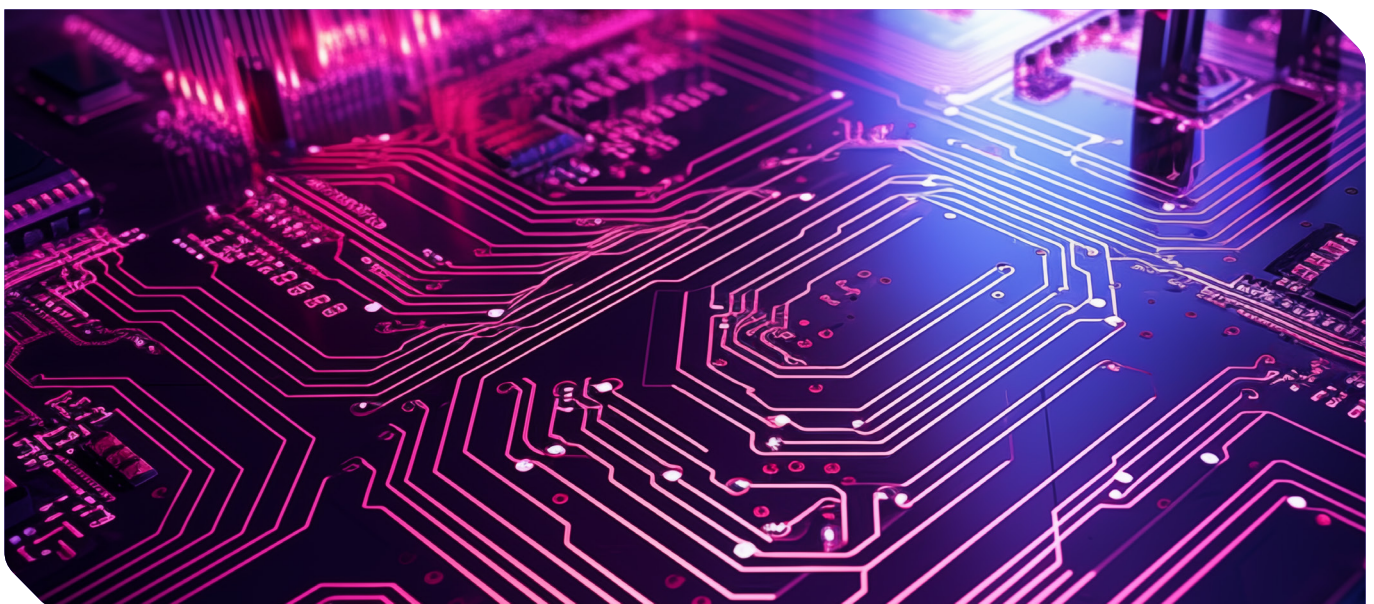
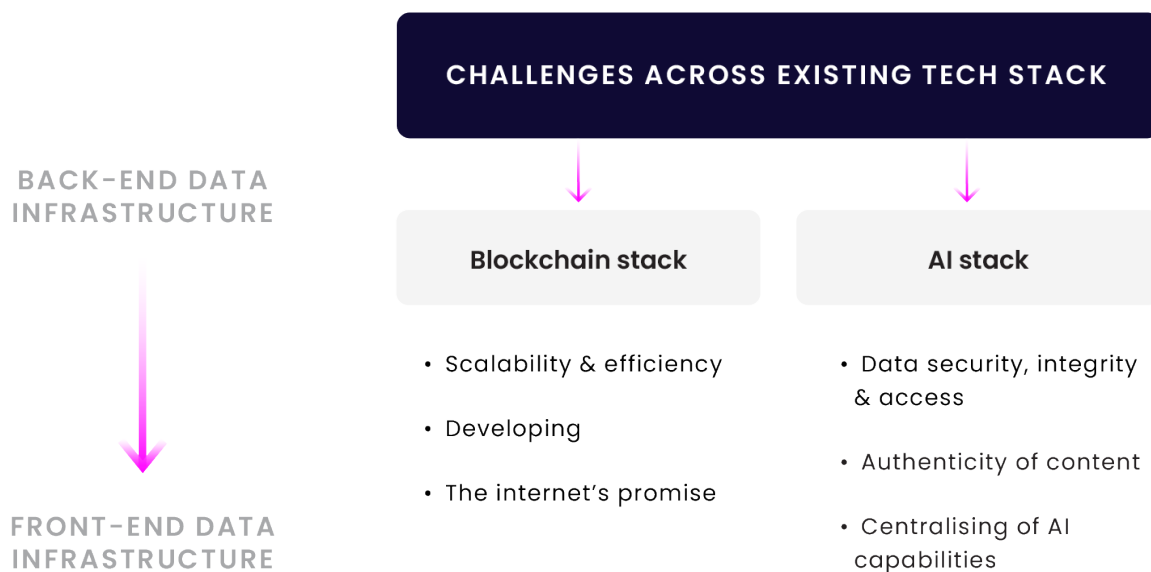
AI and blockchain technology are both monumental breakthroughs of the modern data economy, revolutionizing the way we store, secure, process and extract value from data in the digital age.

Despite their transformative potential, both technologies inherently have limitations

based on their fundamental design and operation principles. These limitations, rooted in their core architecture and algorithms, impact the potential of the applications which they underpin. After years of developments, both technologies are finally used in everyday applications. This widespread adoption is starting to highlight some of the technological imperfections and limitations.

AI and blockchain have very separate challenges which need to be addressed. Some of these are more pressing than others.

Below we discuss the key challenges that both are facing. The exhibit below shows the different challenges of the AI and blockchain stack from the front to the back-end of the technology stack.



4.1 – AI DATA LIFE CYCLE / CHALLENGES

While there are obvious application-specific challenges tied to AI, we believe there are three categorical challenges that AI needs to tackle:

1) **Data Security, Integrity and Access** – How can AI reach its true potential without compromising on data security & privacy?

2) **Authenticity** – How can we track authenticity and source (human vs computer) or digital objects (video images) or actors?

3) **Centralization of Power** – How can we prevent a rift in society as the result of access to- and oversights of AI models?

4.1.1 – DATA PRIVACY

How can we preserve data privacy without hampering the capabilities of AI models?

Personally Identifiable Information (PII) is data that can be used to distinguish a specific individual. When used in generative AI or large language models (LLM) they have

an impact on individual privacy. PII is used in LLMs during the model training and during the inference. PII makes up a significant part of potential data used in LLM. Using this data generally makes the model and the inference richer, increasing the valuable insights extracted from the dataset.

In short, there is currently an inverse relationship between giving up privacy and the strength of the model in LLMs.

So far, the solution to this is banning the use of PII through regulation and using synthetic data instead. While this protects individual privacy in the short term, this is not a long term solution.

Without PII, the LLM can quickly lose context, decreasing the value these models give. So the objective now is to find ways for the LLM model to be enriched by insights of PII without giving up an individual's privacy.

4.1.2 – AUTHENTICITY

How do we prove the authenticity & source of AI-generated assets?

Proving the authenticity of individuals and generated content on the internet is difficult. With the arrival of generative AI, this is becoming exponentially more difficult. With its ability to generate tailored digital assets such as images, sound, and videos, it is nearly impossible for the average user to tell the difference between human-generated content and AI content. The same goes for agents where AI based agents are mimicking human interactions online.

AI is also increasingly used in malicious practices. With the pace at which generative AI can create human-like content, scamming is becoming quick and easy. Also impersonation of individuals online, or deep-fakes, is becoming common practice by malicious actors contributing to the spread of misinformation. Some solutions, like synthetic data and privacy vaults exist but they aren't completely foolproof in their current form

EXAMPLE – DEEP FAKES

Authenticity of AI generated content is already a topic of debate for some time.

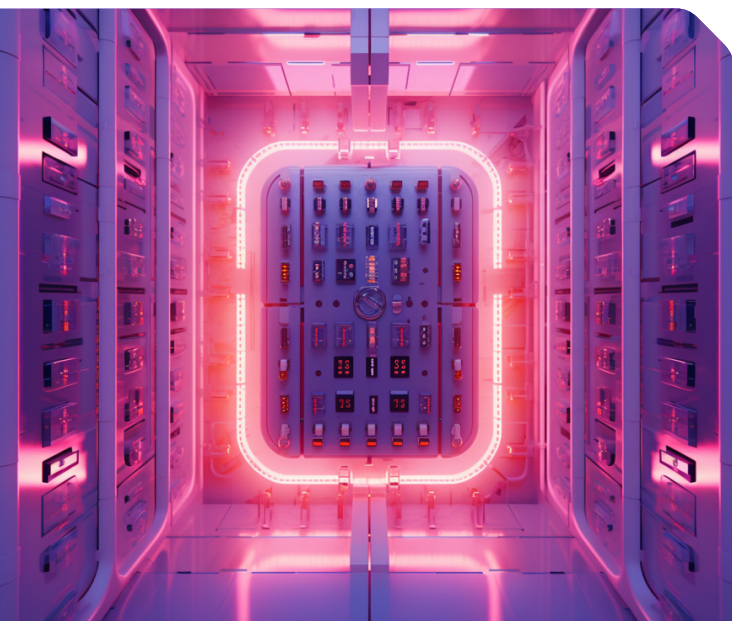
We're at an interesting intersection where gen-AI capabilities are going mainstream in the year of a US election.

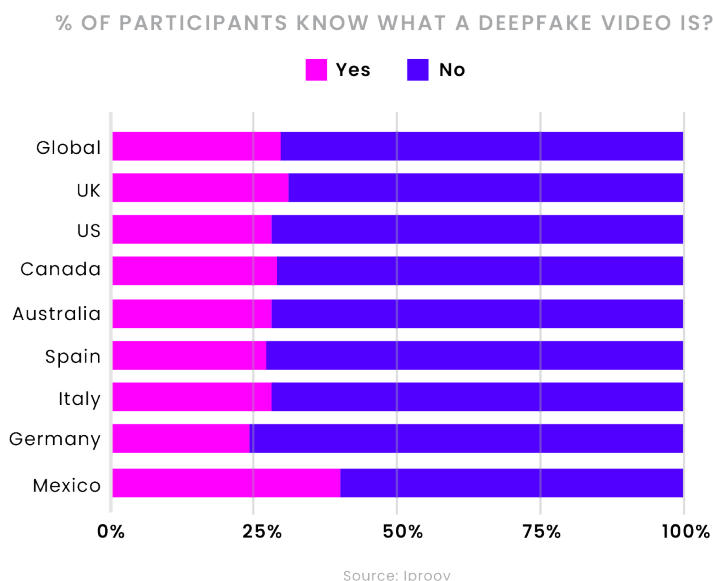
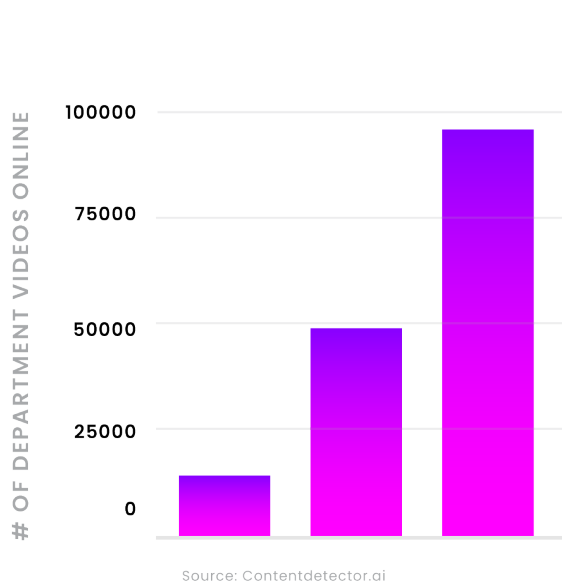
AI generated content is now being weaponized during electoral campaigns. The latest has been a deep fake audio [message of president biden](#) spreading misinformation. Experts are warning that this will only become more prominent over the next year as the campaigns heat up.

The underlying issue here is deep fakes and the lack of ability of internet users to distinguish authentic from AI generated content spreading misinformation.

As seen on the exhibits below, there is exponential growth of deep fake videos on the internet.

At the same time, the majority of the population are not aware of what deep fakes are, let alone has the ability to spot when content is AI generated or modified.





4.1.3 – CENTRALIZATION OF POWER

How can centralization of power be avoided around AI models and ownership?

AI capabilities have been rapidly diffusing across society ever since the arrival of generative AI models to consumers such as ChatGPT and Bard.ai. With it, we’ve seen founders, workers, and other economic actors successfully leverage AI to improve productivity. A recent study by MIT suggests that access to generative AI can improve productivity of highly skilled workers by as much as 40% compared to those who don’t use it. There is an increasing productivity gap between those with and without access to AI, in all facets of life.

AI models tend to centralize because of drivers like economies of scale and data availability. Society runs at risk of creating a prosperity rift between the AI “haves” and “have-nots”.

As AI becomes more powerful, the productivity and opportunity gains from having access to AI will only increase. If AI is as impactful as it’s projected to be, access to it should become almost a basic right. Also the control of the AI models should be decentralised. Having centralised models can create an “AI Elite.” A group of people with access to the model and the ability to subtly influence the behavior of large numbers of AI users without them knowing.

In short, there is a need to distribute control and access of AI models to avoid the creation of societal rifts.

4.1.4 – WHAT ABOUT REGULATION?

The regulation of both AI and blockchain technology is an important topic that is a major concern for those working in oversight and compliance.

We recognize this hurdle, but have not included this in scope as this paper focuses more on the technological challenges that AI and blockchain technology are facing. Despite being important, we will not focus on it in this piece.



4.2 – BLOCKCHAIN DATA LIFECYCLE / CHALLENGES

While there are obvious application-specific challenges tied to blockchain, we believe there are three categorical challenges that blockchain technology needs to tackle:

- **SCALABILITY AND EFFICIENCY**

How can blockchain improve its scalability and efficiency as many more assets are being represented in this new database?

- **DEVELOPER ENVIRONMENT**

How can blockchain technology lower barriers to entry for developers to speed up innovation and adoption?

- **WEB3 PROMISE**

Does blockchain technology alone have the building blocks to live up to the Web3 expectations as a place where users can read, write and own digital content?



4.2.1 – SCALABILITY AND EFFICIENCY

How can blockchain improve its scalability & efficiency as many more assets are being represented in this new database?

Blockchain, and distributed ledger technology in general, is effective at enhancing transparency, decentralisation, and trust. However, these come at a cost. There are areas in which blockchain technology still lacks compared to more traditional, centralised databases.

Some of the shortcomings of blockchain technology:

CONSENSUS MECHANISM

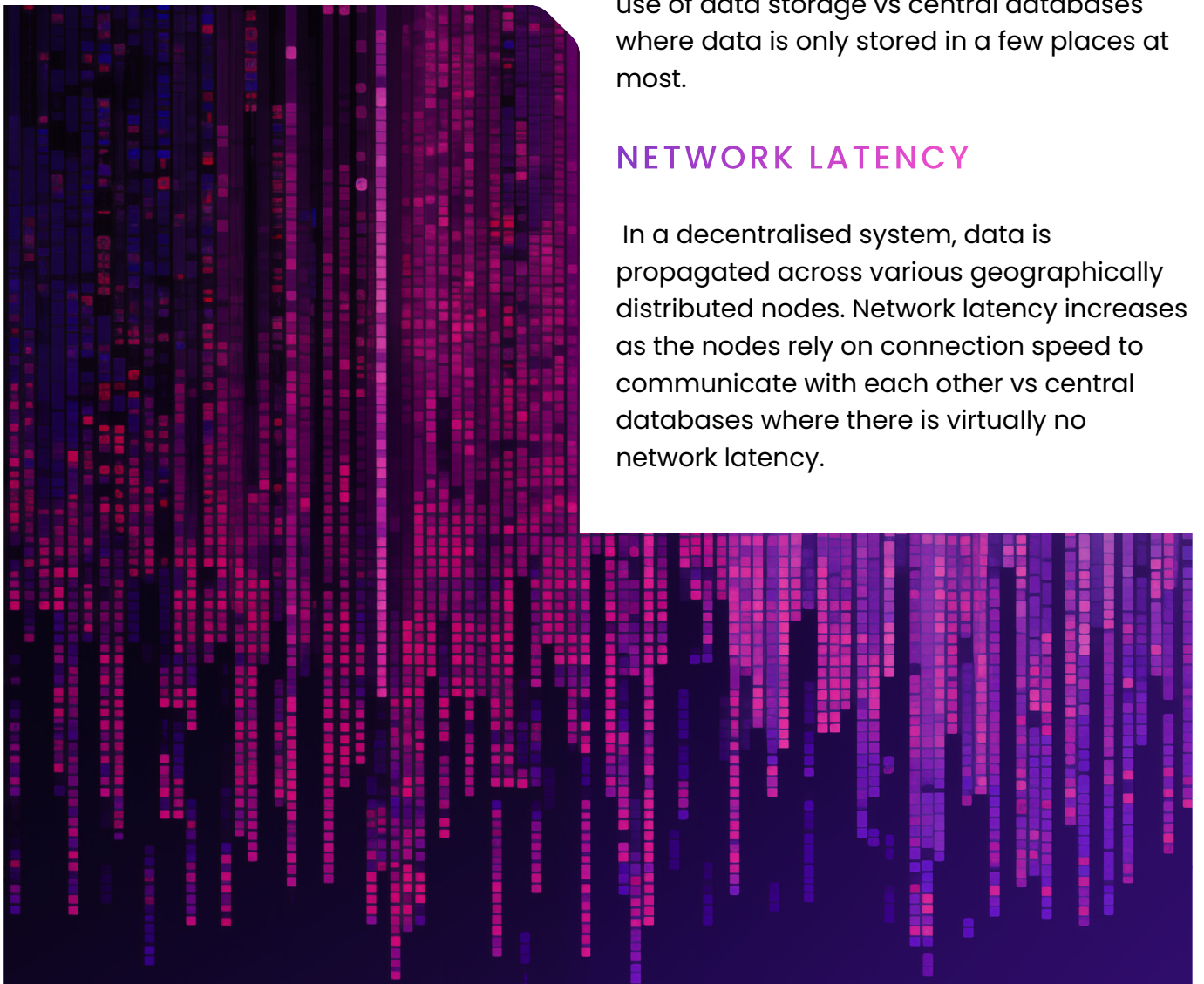
A fundamental feature of reaching consensus in a decentralised way is through the consensus mechanism. Despite improving decentralization and trust of the data, the mechanism is also more time and energy consuming vs centralised databases.

INEFFICIENT DATA STORAGE

In order to maintain the decentralised network, each node holds a full or significant part of the ledger. This leads to inefficient use of data storage vs central databases where data is only stored in a few places at most.

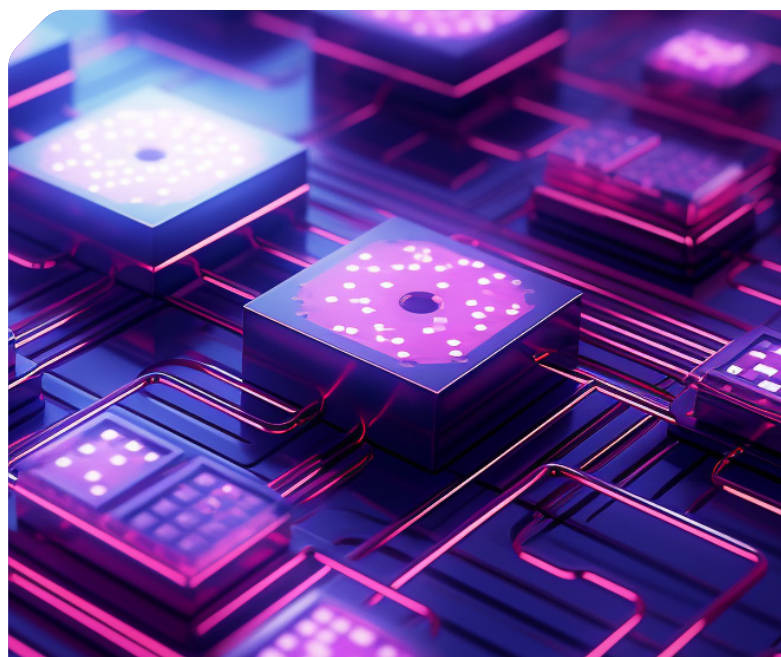
NETWORK LATENCY

In a decentralised system, data is propagated across various geographically distributed nodes. Network latency increases as the nodes rely on connection speed to communicate with each other vs central databases where there is virtually no network latency.

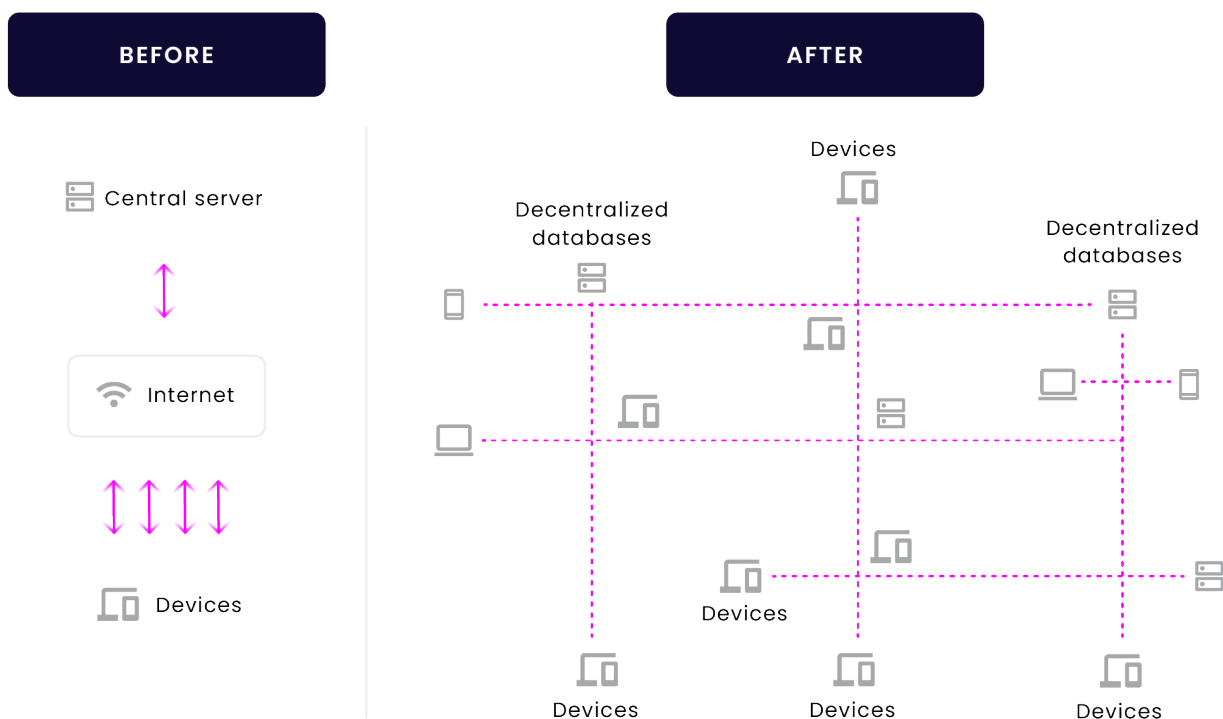


As you can see on the exhibit below, using decentralised data storage inherently leads to complexity of data storage systems causing potential inefficiencies and scalability issues, making the decision to use blockchain over central databases situational.

The infographic below shows how the fundamental way of decentralized databases can lead to inefficiencies such as latency:



CENTRALIZED Vs DECENTRALIZED INTERNET



4.2.2 – DEVELOPER ENVIRONMENT

How can blockchain technology improve its developer environment to attract talent?

Blockchain technology and Web3 have the promise of automating a lot of actions through smart contract execution based on trustless data. Unlike more mature technology, blockchain technology has underdeveloped developer tools (SDKs) in many areas. In addition, because of its ability to automate actions with smart contracts, blockchain technology is more code-intensive, adding more complexity for developers.

FOR WEB3 AND BLOCKCHAIN TECHNOLOGY TO BE ADOPTED BY ALL INDUSTRIES, LIFE NEEDS TO BE MADE EASIER FOR DEVELOPERS.

Libraries, code samples, documentation, testing tools and compilers all need to improve.

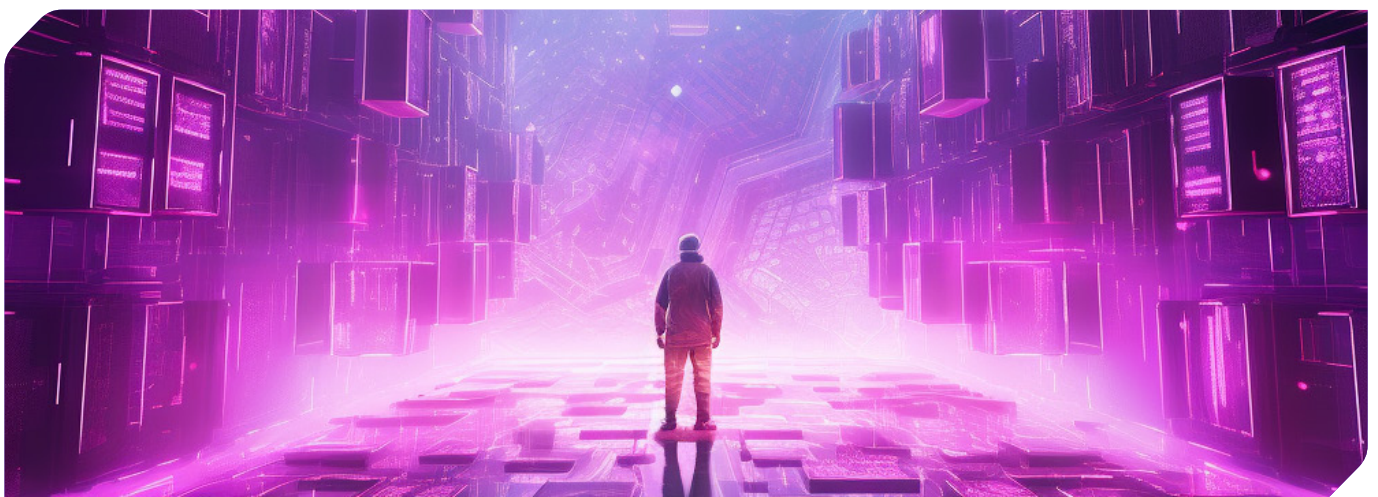
They should arguably be at an even better point than conventional Software Development Kit (SDK) as blockchain tech and Web3 is even more code reliant than previous generations of software.

4.2.3 INTERNET'S PROMISE

How can the structural issues with the current state of the internet be resolved?

This section feeds into the previous one where we talk about fixing the internet. Blockchain technology is currently the backbone technology of the Web3 movement.

However there are challenges that need to be addressed in order to fix the internet, [as discussed](#).



5. – THE CONVERGENCE TECHNOLOGY STACK

TLDR – WE GOT YOU

AI and blockchain technology are finding mainstream adoption after decades of development.

As a result the siloed technological environment both were operating in is fading. As more developers are building applications, they combine AI and blockchain to create new applications,

improve existing ones and solve the technological shortcomings.

The previously discussed challenges that both technologies are facing can be solved in part by relying on each other.

Founders, developers and companies are starting to realize that AI and blockchain technology are very synergistic. Breaking the silos will lead to the birth of the convergence technology stack

Until recently, blockchain technology and AI have been developing in silos without much consideration for one another, each advancing in their own domain.

Now that both technologies have reached a certain maturity and are falling into the hands of everyday users, this is changing. The emerging integration of blockchain's

data handling with AI's capabilities to extract value and execution upon that data is creating new and exciting opportunities.

IN ORDER TO ACHIEVE ITS FULL POTENTIAL, BOTH TECHNOLOGIES NEED TO BECOME MORE INTERCONNECTED AND BREAK THEIR SILOS TO DISCOVER SYNERGIES.

5.1 – SILOED DATA

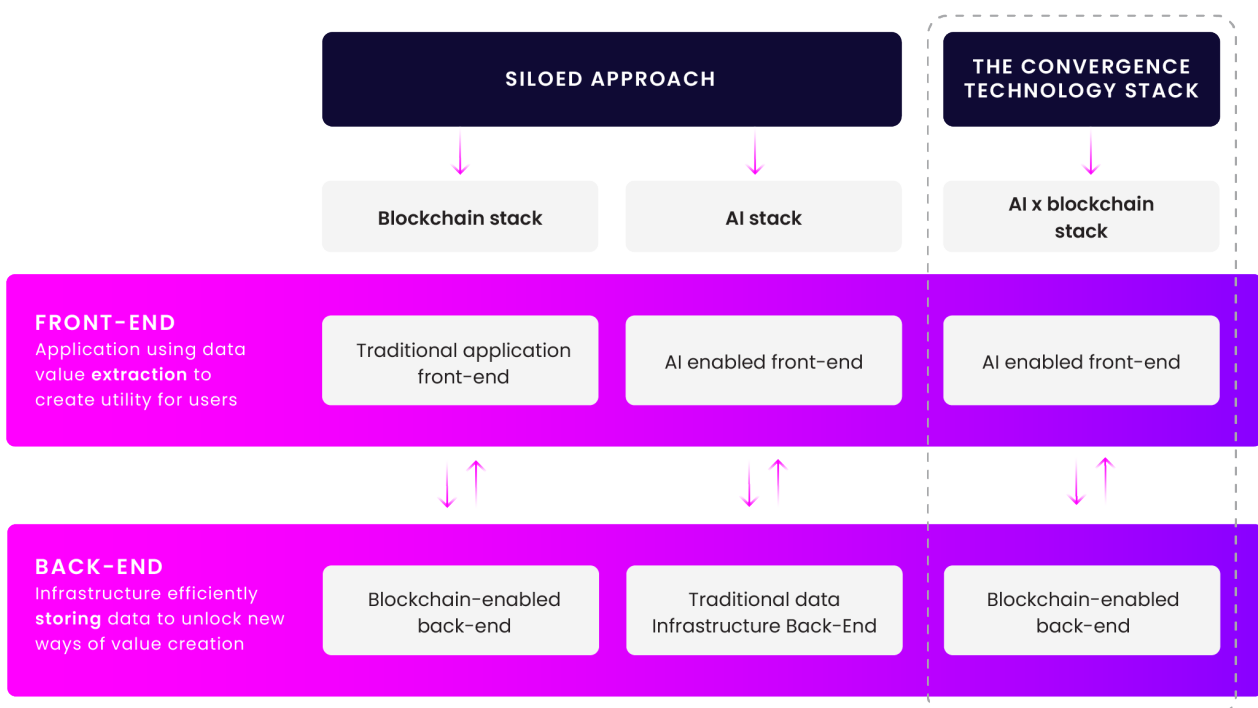
As blockchain technology and AI empower subsequent steps throughout the data lifecycle it is natural for them to have potentially strong synergies.

Both technologies have decades-old green shoots. However, up until recently these technologies have been developed in silos. The exhibit below shows the current state of the blockchain and AI technology stack and how up until recently these have been developed in silos.

WHILE BOTH TECHNOLOGY STACKS ARE MORE COMPLEX, WE SIMPLIFY THEM INTO TWO DISTINCT ELEMENTS:

Data Infrastructure Back-End – The layer where data is created and stored in a way that is convenient for later extraction of value from that data.

Application Front-End – The layer where value is extracted from the data, driving functionality in application and for users.



5.2 – THE BLOCKCHAIN STACK

Up until recently the blockchain technology stack has only been using conventional front-ends to extract value from the data. As a result, the experience for blockchain users has often been clunky, difficult and overall underwhelming.

5.2.1 – TRADITIONAL APPLICATION FRONT END

Within the blockchain tech stack, the front-end application layer is largely following conventional software design patterns, closely resembling previously successful web and mobile applications.

This front-end design interacts with the blockchain (data) via straightforward, deterministic processes, enabling users to perform actions like transactions or contract interactions. The front-end primarily focuses on executing predefined logic while leveraging the benefits of a blockchain

database, without delving into the realms of learning, adaptation, or intelligent decision-making that AI could potentially bring to the table.

5.2.2 – BLOCKCHAIN-ENABLED BACK-END

Blockchain is a new approach to data storage, characterised by its decentralised and distributed ledger system.

This new way of storing data ensures information integrity and transparency by creating immutable and secure records across a network of databases. Through storing data in this decentralised, trustless way, new ways of extracting value from data are unlocked (benefits):

High integrity data - the immutable, transparent nature of data increases the integrity and quality of the data, allowing more overall value to be extracted from it.

Automated execution - the trustless, programmable nature of blockchain based assets (tokens) allows for automated execution of complex transactions, making them highly scalable at low cost.

= Unlocks Web3

5.3 – ARTIFICIAL INTELLIGENCE STACK

Up until recently, the artificial intelligence stack has been using conventional back-end infrastructure for data storage and management.

While the initial reception has been filled with excitement by its users, some concerns around best practices around data management are being raised. Something conventional centralised databases might not be able to solve.

5.3.1 – AI-ENABLED FRONT-END

Artificial intelligence is a revolutionary approach to process and extract value from data.

By leveraging sophisticated algorithms and machine learning, AI can analyse and interpret complex data sets as it uncovers complex patterns and insights often recognisable by human analysis.

AI's ability to perform complex analysis and execution based on data sets allows it

to add exact value in new ways. The power of AI lies in its dual ability to both deeply understand and actively interact with data:

ANALYSIS

AI is able to analyse vast amounts of data through machine learning techniques. In doing so, AI is able to extract meaningful insights from datasets that are too complex for conventional analysis.

GENERATION

Generative AI has the ability to generate new, original digital content (text, images, music, video,...) by using knowledge drawn from existing data sets and content.

INTERFACES

AI-driven interfaces represent a significant advancement in how users interact with technology, offering more intuitive, efficient, and personalized experience such as adaptive interfaces, personalisation and contextual awareness.

AUTOMATED EXECUTION

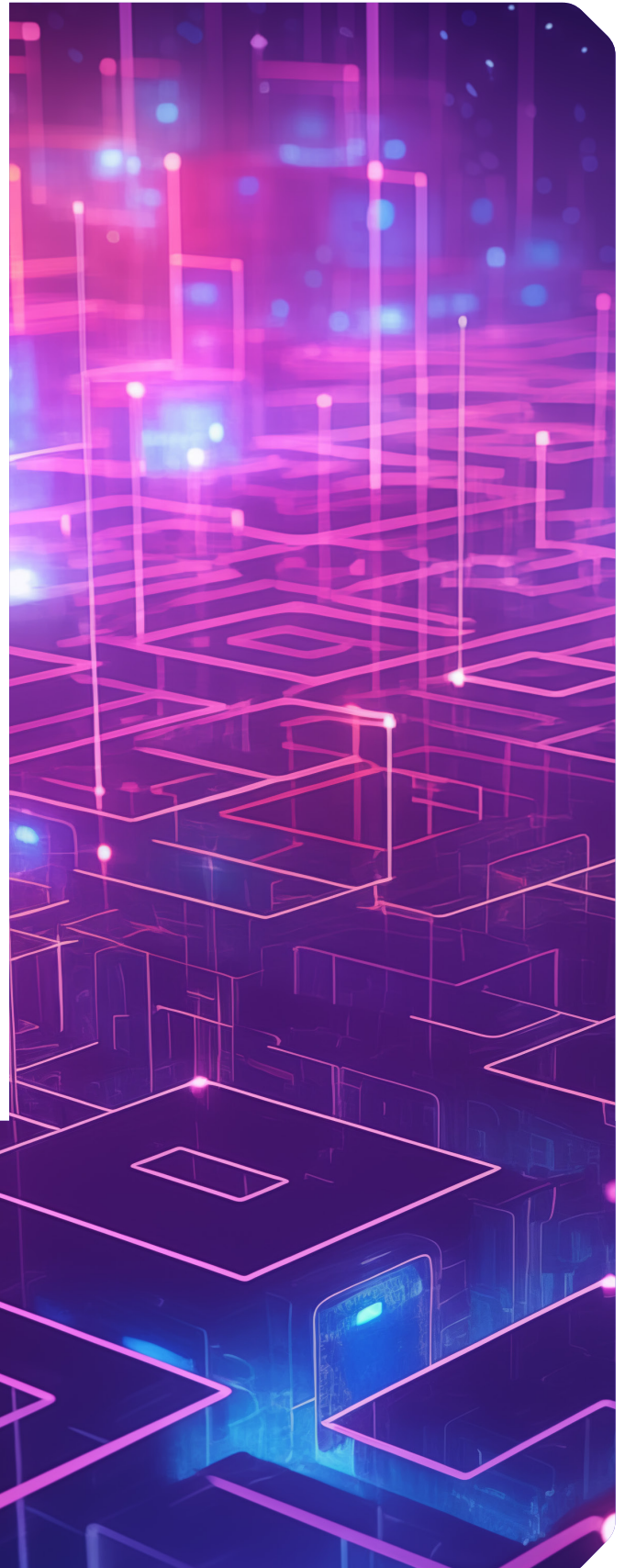
By rapidly processing large amounts of data, AI has the capacity to autonomously execute specific actions autonomously. Its data-driven, split second decision making allows it to perform a series of complex actions without the intervention of humans.

5.3.2 – TRADITIONAL DATA-INFRASTRUCTURE BACK-END

Today, Artificial Intelligence predominantly relies on traditional back-end data infrastructure.

This infra consists of a mix of bare-metal and cloud-based servers which are centralised and where large data sets are processed to extract value from.

Limitations arise from the centralised nature of AI infrastructure. Data breaches, privacy issues and the absence of robust data quality checks are just a few. These challenges significantly undermine the trustworthiness of AI systems, which often rely heavily on the quality and security of the data they process. As a result, AI is limited by its capacity to uphold security and privacy standards of conventional data management systems. These shortcomings of the data systems limit AI's potential.



5.4 – BREAKING THE SILO

In the future, the data technology stack will be running on an AI-enabled front-end, supported by a blockchain-enabled back-end.

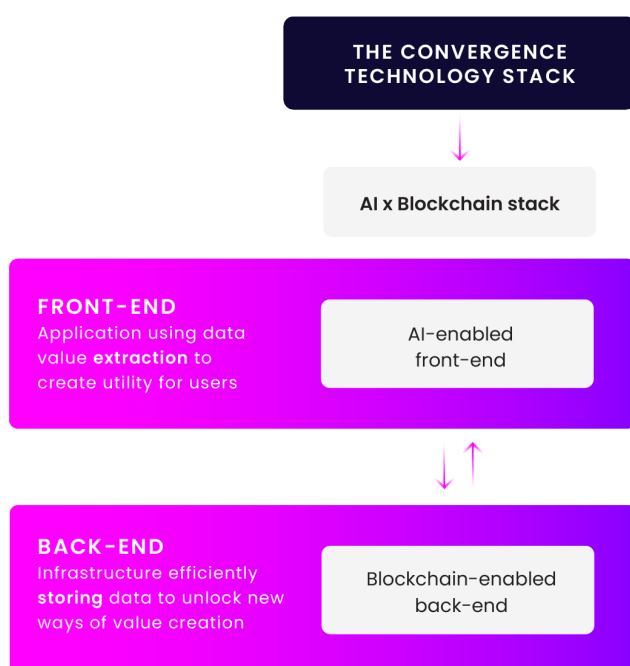
AI-enabled front ends will provide intelligent, adaptive user interactions, leveraging advanced algorithms for analysis, generation, and decision-making. This will be seamlessly integrated with a blockchain-enabled back end, ensuring data integrity and security through a decentralised ledger system. Having both integrated within the same stack will be transformative for the potential of both technologies.

LIMITATIONS

The blockchain-enabled back-end will not exclusively run on blockchain technology. There are inherent limitations (as discussed) such as latency and scalability that make it a suboptimal solution for specific applications. Instead, it will be part of a more diversified back-end architecture operating alongside cloud, bare-metal and edge storage.

Depending on the application, we'll see more prominence of blockchain technology on the back end. For example with decentralised storage or models, we expect blockchain technology to be prominent while for AI agents, we expect a more balanced approach between blockchain and more centralised solutions to unlock optimal functionality of the agents.

Both technologies have only just started to mature. For example, blockchain technology's scalability issues are being worked on while at the same time LLMs are becoming more powerful every day. Over time, as the benefits of operating on the convergence technology stack become more clear, we expect both technologies to evolve into a direction that allows them to be suited for more applications (for example specific purpose (AI) blockchains, etc.).



6. – IT'S ALL ABOUT DATA

TLDR – WE GOT YOU

Blockchain and AI are reshaping data management across its life cycle.

Fundamentally there are three steps in the data life cycle.

- Creation – IoT revolutionizes data creation with smart sensors.
- Storage – Blockchain offers a new way to store data transparent and secure.
- Value Extraction – AI excels in extracting value from data.

AI and blockchain technology are very synergistic because their proximity in the value chain and the fact fundamentally deal with the same asset...It's all about data.

To grasp the synergistic potential of blockchain and AI, we must cut through the noise and examine their fundamental value propositions.

This reveals how they mesh and add value to one another. Blockchain and AI, often perceived as distinct realms of technological innovation, share a more profound commonality than typically acknowledged: both dramatically impact our approach to managing and deriving value from data. At their core, both technologies revolutionize the way we interact with and leverage data.

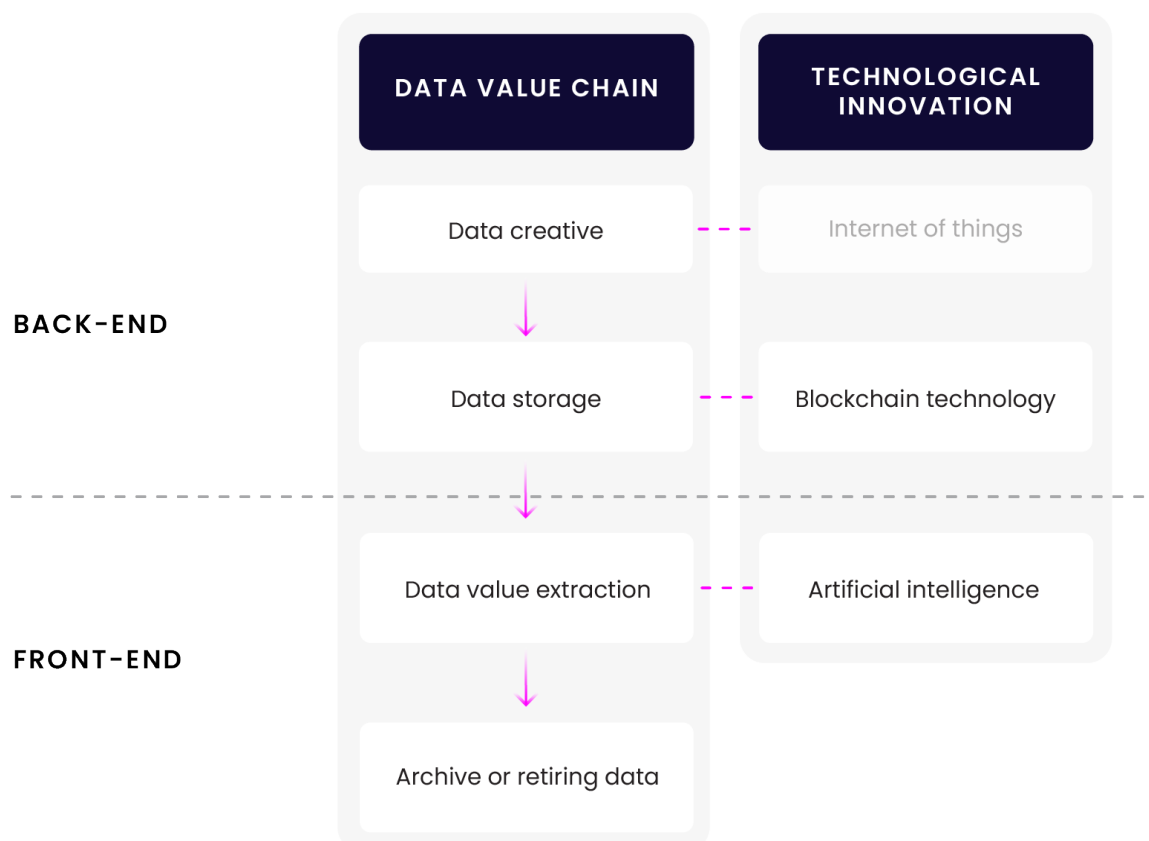


6.1 – THE DATA LIFE CYCLE

In the information era, data is the most powerful resource which, given the right tools, can be honed and converted into large economic benefits.

Since the start of this new information age, blockchain and AI are arguably the largest breakthroughs in how we handle data. As both technologies underpin the same asset, there are naturally strong synergies between both. To understand where the synergies lie, we start by looking at the data life cycle.

The exhibit below shows how AI and blockchain are part of the data value chain and are subsequent stages in that chain



Over the past decade there have been many different data life cycle frameworks suggested.

Differing in complexity, all of them talk about the same three core steps in the data life cycle:

CREATE

Initial phase where the data point is generated. The data point can be generated from various sources.

STORE

The data point is saved in a storage system (data warehouse, cloud storage, blockchain,...). This ensures that the data is kept securely and efficiently for future access and analysis.

EXTRACT

Value is "extracted" from the data point. This step involves querying the database using data analytics tools. This step is critical in the process of generating actionable insights and assets from the created and stored data points (includes modifying data points)

Extraction of value from data is the ultimate end goal. How data is gathered (quality, quantity) and storage (transparent, immutable,...) can have an impact on the value that is ultimately extracted from the data.

6.2. TECHNOLOGICAL INNOVATION

Across each of the three core steps of the data life cycle (create, store, extract), we are seeing fundamental changes in how these are done through technological innovation.

IOT & DATA CREATION

IoT increases and improves the way sensors in everyday objects, across value chains capture data points.

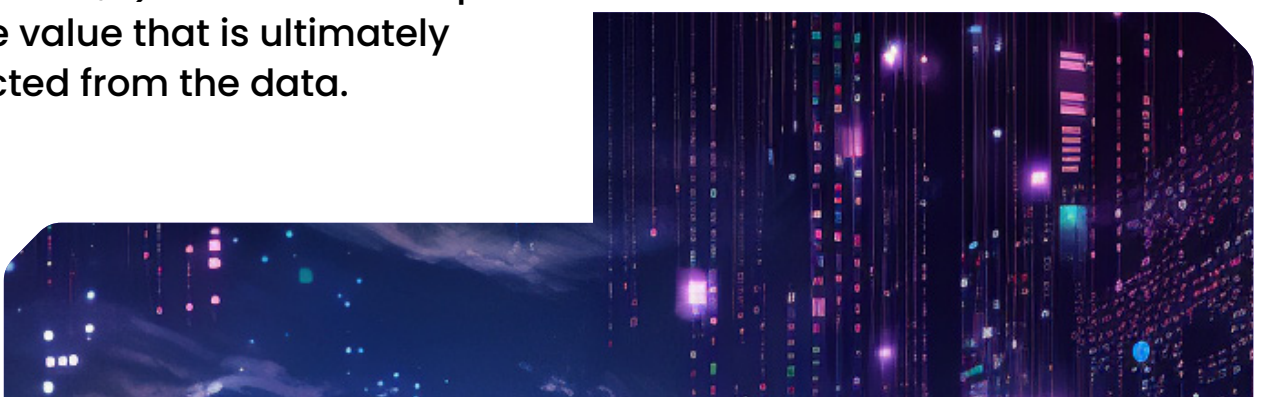
BLOCKCHAIN & DATA STORAGE

Blockchain stores data in a decentralised, tamper-proof database, improving transparency and security of data records.

ARTIFICIAL INTELLIGENCE & DATA VALUE EXTRACTION

AI transforms the way value is extracted from data by introducing complex algorithms to derive meaningful insight from datasets.

As data becomes an increasingly valuable economic asset, there is an increasing focus on technological innovation across the data value chains. Data driven economic actors in the public and private sector stand to benefit from further breakthroughs in IoT, blockchain and AI.



7. – THE ECOSYSTEM

The AI x Crypto ecosystem that is leveraging both technologies is one of the earlier stage narratives.

There are still a lot of moving parts and as discussed we are only scratching the surface in terms of opportunities and potential.

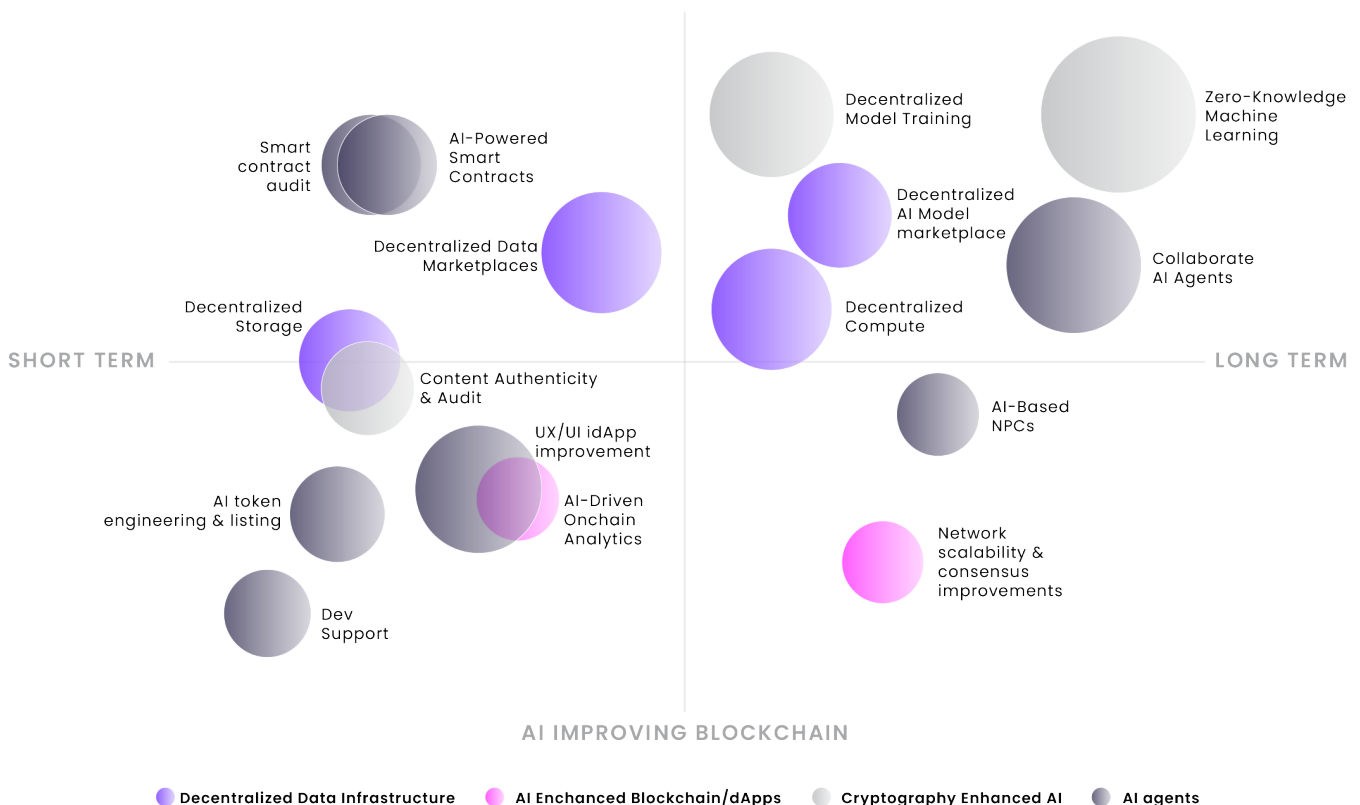
To help founders and investors navigate the space, we mapped out the ecosystem across what we believe to be three key pockets within AI x Crypto:

Cryptography Enhanced AI - Improves trust and security of machine learning models for distributed data usage with a focus on not revealing or centralizing information

Decentralized Resources - Decentralised marketplaces & infrastructure for resources for data, compute, and models.

AI Agents - AI agents as portable systems that independently pursue goals via adapting and executing complex tasks.

The exhibit below shows how AI and blockchain are part of the data value chain and are subsequent stages in that chain



CRYPTOGRAPHY ENHANCED AI

Early ecosystem focused on improving trust and security of machine learning models for distributed data usage with a focus on not revealing or centralizing information.

THE PROBLEM OF TRADITIONAL MACHINE LEARNING

- Centralized data storage creates a single point of failure.
- Difficult to track origin and ensure integrity of data.
- Potential biases as a result of singly authority points for data processing.

THE SOLUTION/VALUE PROPOSITION

- Blockchain provides a decentralized framework for data storage, improving data

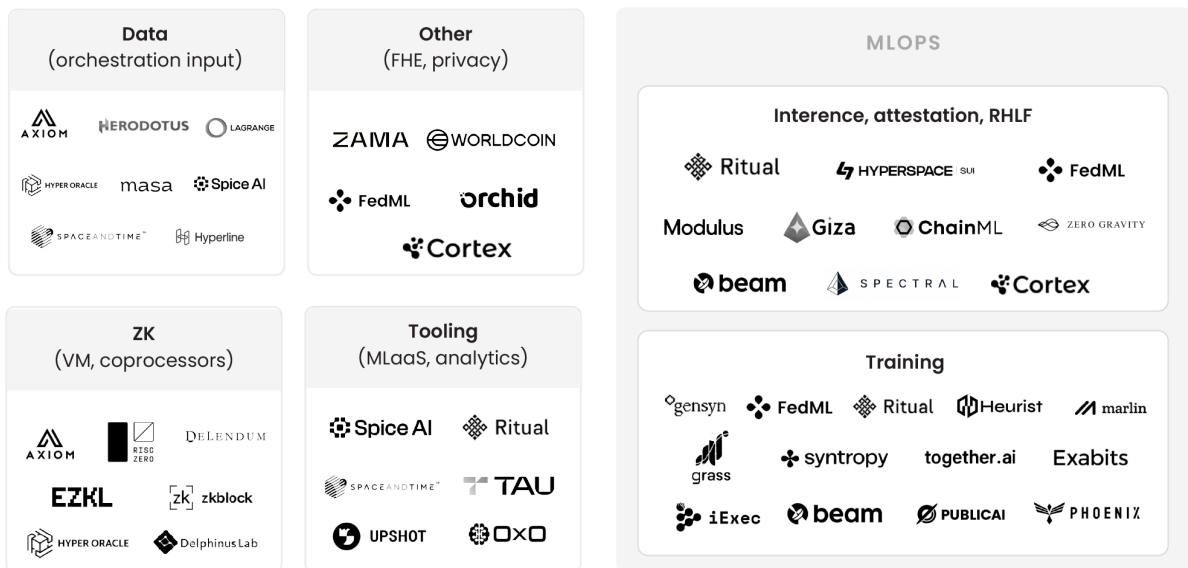
security and integrity of ML output.

- Improves data provenance, leading to verifiable and trustworthy data sources.
- Decentralized data management enables scalable processing of data.
- Promotes development of autonomous and unbiased systems.

CHALLENGES FOR CRYPTOGRAPHY ENHANCED MACHINE LEARNING

- AI x Crypto integration introduces significant complexities, requiring expertise.
 - Scalability and throughput concerns especially for real-time analysis and decision making.
 - Significant increase in computational load to process both technologies.
- Standardization to ensure interoperability between different systems.

ECOSYSTEM MAP Cryptography Enhanced Machine Learning



*We add tooling in this vertical, which can have broader utility, outside of machine learning

DECENTRALIZED INFRASTRUCTURE

Ecosystem facilitating the supply and access to crucial resources enables the convergence of crypto and AI. It offers essential infrastructure for providing computation, data exchange, and model sharing among stakeholders.

THE PROBLEM OF DECENTRALIZED INFRASTRUCTURE

- Prone to single points of failure, leading to potential downtime and data loss.
- Data monopolies, limiting access and stifling innovation.
- Vulnerability to censorship and control by central authorities.

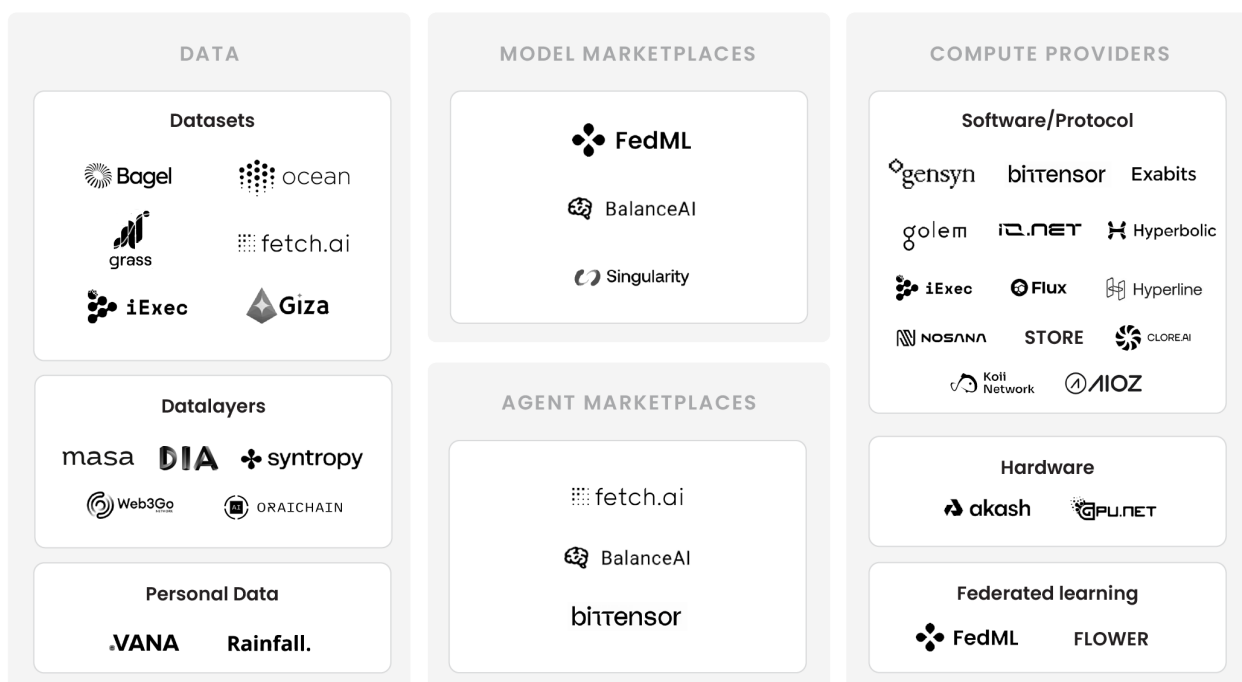
THE SOLUTION/VALUE PROPOSITION

- Improves efficiency, resilience and security of infrastructure
- Democratization of access to crucial resources.
- Improved user data privacy and control.
- Increases efficiency by putting processing resources closer to data sources.

CHALLENGES FOR DECENTRALIZED RESOURCES

- Technical complexity and scalability issues.
- Regulation and legal uncertainties.
- Interoperability between diverse systems and standards.

ECOSYSTEM MAP Decentralized Data Infrastructure



AI AGENTS

Ecosystems centered around the creation, development, and monetization of AI Agents.

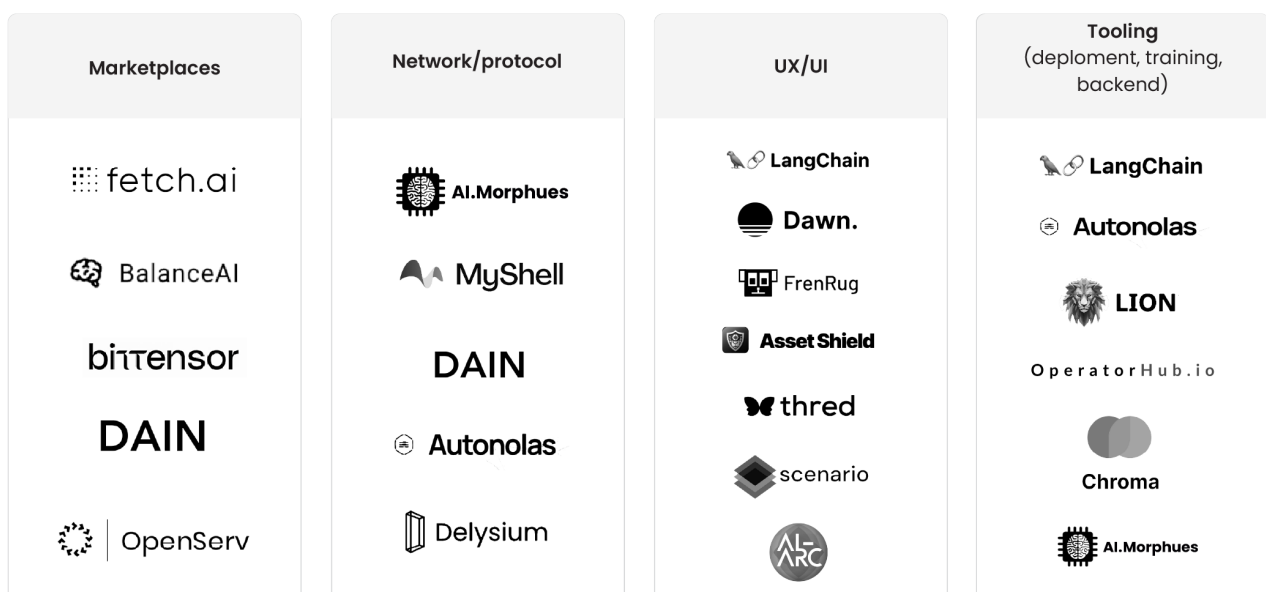
These autonomous systems independently pursue goals, adapting and performing complex tasks beyond prompt-based AI, operating without constant human input.

THE PROBLEM OF TRADITIONAL AI AGENTS

- Human intervention required due to lack of AI agent autonomy re. sensitive data.
- Insecure data handling, increasing the risk of data breaches and leaks.
- Potential unethical and biased decision-making by AI agents due to inherent biases in training data and algorithms driven by restricted data access.

ECOSYSTEM MAP

AI Agents



THE SOLUTION/VALUE PROPOSITION

- Blockchain-backed AI agents improve data security and privacy by leveraging immutability, encryption and transparency.
- Access to private and sensitive data means AI agents can operate dynamic and adaptive without constant human oversight.
- Autonomous transaction of AI agents paves the way for autonomous interactions with limited human intervention.

CHALLENGES FOR BLOCKCHAIN-BACKED AI AGENTS

- Integrating blockchain introduces latency and reduced system efficiency.
- Navigation technological limitations for ex. marrying blockchain scalability with AI Agent's high throughput requirements. Lack of clarity on the legal framework around AI agent executing transactions.

SUMMARY

1) We are extremely excited to finally see evidence of the convergence happening. Now is the time to start building.

2) **For founders** - Encourage founders to look for solutions to the problem they are solving keeping both AI and Blockchain's value propositions in mind

3) **Partners/Big companies** - To take this vertical seriously as we are dealing with inflection points in the adoption curves in both these technologies. Therefor we expect an unprecedented pace of adoption from these applications once having reached a product market fit.

We are excited to see empirical evidence of the convergence between AI and Blockchain technology shifting gears—a phenomenon that has been theorised about for some time and is now becoming a reality. More founders from both verticals are beginning to investigate the possibilities, marked by a shift towards collaboration between spaces. We expect operational and technical barriers to be overcome, driven by the increasing mindshare in this space.

We encourage founders to actively pursue solutions at the AI x Crypto intersection. For existing players in AI and blockchain, there is a strong incentive to delve into the space as they seek to address challenges tied to their existing products, looking for product-market fit and mass adoption. Equally for **investors**, this space promises unprecedented opportunities for growth and innovation.

If you are interested in co-investing in this cohort as a **Venture Partner** or working with us to grow your ecosystem in AI alongside Outlier Ventures, please get contact us

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