

Decentralised Social Media



About this report

This is the first of a series of reports that will be published addressing selected topics in accordance with European Commission priorities. The aim is to reflect on the latest trends and developments and discuss the future of blockchain in Europe and globally.

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Note

While we have done our best to incorporate the comments and suggestions of our contributors where appropriate and feasible, all mistakes and omissions are the sole responsibility of the authors of this report.

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1 Decentralised Social Media

1.1 Social media: from Web 1.0 to Web 3.0

As a component of Web 3.0, the metaverse report by EUBOF covered internet iterations from Web 1.0 to Web 3.0. It was made clear that metaverses existed in Web 2.0 but that their characteristics would undergo a radical change with the advent of new technologies and the subsequent architectures that would help to reduce inefficiencies while simultaneously increasing the platform's potential. The main factors driving metaverse adoption consisted of hardware, software, data, and integration.

There are parallels between the social media case and the metaverse case. A definition of social media is imperative to dive into characteristics, challenges, and more subjects. According to Britannica¹, 'social media' are any online platforms where people can interact and share thoughts, opinions, and content. Investopedia² adds the concepts of virtual networks and communities into the definition, along with the dimension of user-generated content and engagement with personalised profiles. The definition is dependent on the technologies and standards in place for the internet as they are the means for enabling the communication and propagation of information. Technologies and standards address the need to handle the variety, volume, and speed of data as users want to share unstructured data like sound and video with other users around the globe.

The initial version of social media for Web 1.0 included features from the definition, but their capabilities were limited due to the static nature of internet protocols. The notes by [Thayer and Notess \(2022\)](#) provide an overview of the initial platforms, including the email service, bulletin board system (BBS), internet relay chat (IRC), AOL Instant Messenger (AIM) and texting. The participation of the users with the content was limited, as they were required to load different pages to interact with other users. Moreover, the information was predominantly text-based and included limited images in the interfaces.

Because of the rise of user-generated content and improvements in accessibility and interoperability, social media platforms were at the forefront of the Web 2.0 revolution. The term 'participative social web' was coined for this era, highlighting the interaction between users ([Sharma, 2022](#)). Web 2.0 simplified user engagement in social media by centralising services on centralised platforms, whereas Web 1.0's highly scattered structure required users to acquire advanced technical knowledge in order to contribute as content authors. Examples are straightforward, as Facebook, Medium, and YouTube are platforms for creating an account and publishing content by clicking on interfaces.

Generally, the numerous social media platforms are placed into six separate categories by [Grahls \(2013\)](#) work, on the basis of actions by users. The categories are social networking, bookmarking, social news, media sharing, microblogging, and blogs and forums. The above clustering is expanded in future works with the introduction of categories for specific use ([Aichner & Jacob, 2015](#); [McCay-Peet & Quan-Haase, 2017](#)). The core of social media is the creation of a social graph for users to use for their interactions, content sharing and feedback ([Boyd & Ellison, 2007](#)). All the above features require the development of a stack of technologies facilitating data storage, discovery of content, identification system, and authentication for the harmonised use of the platform.

While technologies allowed social media to become more distributed and accessible to the public, concerns have been raised mainly due to the centralisation of decisions on privately owned platforms. MIT's report ([Barabas et al., 2017](#)) acknowledges the consolidation of platforms and two resulting implications on publishing and discovery of content. Essentially, the report points to the platforms that exert enormous influence as

¹ Encyclopaedia Britannica. (Updated on: 23 June 2023). Social Media. [Source](#). Accessed on: 27/07/2023.

² Investopedia. (Updated on: 14 April 2023). Social media: definition, effects, and list of top apps. [Source](#). Accessed on: 27/07/2023.

ensorship, findability, and revenue generation are dependent on them rather than users. Specific examples of these issues are Cambridge Analytica and the mental and economic aspects of algorithms in the attention economy ([Roubinet, 2022](#)).

1.2 What is decentralised social media?

An attempt to address the concerns regarding the current version of social media platforms is the development of protocols focusing on decentralisation. Decentralisation aims to shift publishing and discovery away from central authorities and provide ways for users to handle these activities ([Barabas et al.; 2017](#)). The decentralised platforms are clustered into ‘federated’, ‘peer-to-peer’, and ‘blockchain-based’ ([Roscam Abbing et al.; 2023](#)), with the platforms specialising in one or more social media activity. It is vital to note that blockchain is just one of the technologies available for decentralising aspects of social media, as decentralisation can be achieved with other means. A detailed table presenting decentralised social media platforms is available in an annex for readers to be introduced to the different platforms available.

Federated systems, which encourage interoperability and information sharing in a semi-autonomous fashion, were the inspiration for the first decentralised social media platforms. The social media platforms adopted open-source web standards to allow them to interact with other instances. Federated social media is envisioned as a way of ameliorating the weak points of current social media and upholding values and enhancing innovation ([Electronic Frontier Foundation; 2011](#)). Diaspora and Mastodon are two platforms that use the federated model. Intriguingly, federated systems are not driven by a desire for financial gain but rather by the generosity of users who provide their time and resources for free to support them financially and technically. The fediverse ([EDPS; 2022](#)) goes further by linking the servers running the underlying services provided by social media platforms like Mastodon, PeerTube, and others, enhancing interoperability between various services in the absence of vendor lock-in.

Unlike federated systems, where sub-networks can exist in the graph and connect via servers, peer-to-peer (P2P) architecture allows for the direct connection of the nodes in the networks ([Islam et al., 2014](#)). In other words, federated systems allow users to select a server to connect to creating sub-networks³, as users can opt to run servers or simply act as clients of existing ones. Clients and servers are sub-networks represented as clusters in the visual representation of the network.

On the other hand, peer-to-peer architecture makes no distinction between servers and clients. Baran’s definition of a decentralised system points towards federated systems adopting a communication continuum of ‘client-to-server-to-server-to-client architectures’⁴, meaning the differences between client-server network and peer-to-peer are still applicable⁵. Because of its emphasis on decentralised communication and independent nodes, the P2P model starkly contrasts with centralised social media. Each node in the system is made autonomous by running the appropriate instances of software and hardware. It has been argued that the proposed P2P networks will be more cost-effective and privacy-persistent compared to centralised approaches ([Masinde & Graffi; 2020](#)).

Blockchain-based social media are platforms benefiting from the use of blockchain to decentralise the platform’s operations. There are definitions comparing decentralised social media with blockchain (Ethereum⁶, *CoinTelegraph*⁷; 2023). *CoinTelegraph’s* (2023) article^{Error! Bookmark not defined.} sets out the specific technical aspects of blockchain to use for decentralisation: transparent data storage, smart contracts, consensus

³ Graber, Jay. (2020, 9 January). Decentralised Social Networks. Medium. [Source](#). Accessed on: 27/07/2023.

⁴ Institute of network cultures. Beyond distributed and decentralised: what is a federated network? [Source](#). Accessed on: 27/07/2023.

⁵ Zenarmor. Client-Server network: Definition, Advantages, and Disadvantages. [Source](#). Accessed on: 27/07/2023.

⁶ Ethereum. Decentralised social networks. [Source](#). Accessed on: 27/07/2023.

⁷ CoinTelegraph. (06 February 2023). What are decentralized social networks? [Source](#). Accessed on: 27/07/2023.

mechanisms, token economy, decentralised applications, secure user authentication, and censorship resistance mechanisms.

The above technical aspects explain the advantages of blockchain-based social media (Ethereum⁸; *CoinTelegraph*⁹; 2023). One of the main concerns a blockchain approach addresses in decentralised social media is arbitrariness in the form of censorship of users and ideas and the creation of echo chambers of the same ideas. Additionally, openness of participation is encouraged by the adoption of open-source ideals for the platforms. Moreover, the economy surrounding social media will undergo a significant transformation with the application of innovative approaches like non-fungible tokens (NFTs). These tokens revolutionise ownership tracking and access management, enabling the establishment of a content economy that operates in new and unique ways.

Decentralised social media are predominately alternatives to contemporary social media like Facebook, Twitter, and Reddit. For this reason, decentralised platforms establish social networking and microblogging services for users, meaning that the platforms handle the network hosting and post updates in way similar to a Twitter or Reddit update board. Users have open-source distribution at their disposal for using decentralised social media. While the early platforms catered for computers as the access points to social media, platforms like Eency, Status, and Damus have focused on a mobile experience for users since 2016. Users find it convenient to access social media via their portable devices, making it a requirement for platforms to follow. Generally, devices like smartphones have impacted both traditional and decentralised social media during the past decade.

It is not just the proliferation of mobile devices that has changed social media. Users have grown accustomed to watching videos on streaming services like YouTube and Twitch. There are alternatives to privately controlled infrastructure, such as decentralised social media sites like DTube, Pixelfed, and PeerTube. Videos can be stored either on user servers or distributed storage systems like IPFS and Hive to allow access to the resources. Most of these media-sharing platforms have incorporated blockchain into their platforms. Blockchain is used as an incentive mechanism with a token distributed for producing and curating content in the network.

The blockchain is a recent addition to the stack of decentralised social media technologies. Blockchain began to be integrated into platforms in 2016, with Steemit¹⁰ reaping the benefits of a cryptocurrency-based economy model and incentive structure. As the trend could not be ignored, existing platforms like Minds have included similar mechanisms on their platforms. The functionalities relying on blockchain have become more complex since the inclusion of cryptocurrencies. Nowadays, blockchain practitioners transition from cryptocurrencies to tokens for tokenising assets like video. Mirror is an example of tokenisation where NFT auctions support creators. When it comes to identities in decentralised social media, blockchain is just as useful as tokenisation. Users' identities on Farcaster's decentralised network are managed by smart contracts to allow persistence.

While decentralised social media platforms have been created for freedom of speech and censorship resistance, they can stumble when addressing issues stemming from lack of control. Community issues arise with decentralisation, as communities use platforms like Gab (The Verge¹¹; 2019) for their own agendas. As moderation and content curation are the responsibility of the users, misinformation and hate speech may find a platform to spread. For decentralised social media to expand, it is necessary to address both social and ethical concerns as well as technical ones. Users have to be technically adept in installing and using the

⁸ Ethereum. Decentralised social networks. [Source](#). Accessed on: 27/07/2023.

⁹ CoinTelegraph. (06 February 2023). What are decentralized social networks? [Source](#). Accessed on: 27/07/2023.

¹⁰ Wikipedia. (2023). Steemit. [Source](#). Accessed on: 27/07/2023.

¹¹ The Verge. (12 July 2019). How the biggest decentralized social network is dealing with its Nazi problem. [Source](#). Accessed on: 27/07/2023.

software distribution. Additionally, users rely on the community to curate the distribution, making it possible that support could be discontinued in the future.

Decentralised social media matures with the introduction of new platforms and updates to existing ones. Their contribution to freedom of speech cannot be ignored and gradually they will play a more significant role for users. A testament to the role of decentralised social media is the presence of the EU on platforms (PCMag¹²; 2022) like Mastodon¹³ and PeerTube¹⁴. As decentralised social media incorporate freedom of speech values and their open-source software distribution, they generally align with EU values.

1.3 Technological Underpinning & Fediverse

Often, systems and platforms are described as being decentralised (or not), yet such statements are likely preconceived or too abstract for such a strong binary statement to be made. This is due to: (i) the notion of a system typically being conflated to include both a system's code and also the infrastructure supporting the execution of logic encoded within the code; and (ii) different components of a platform being de/centralised to different degrees. Thus, it is crucial to reiterate that a system being classified as 'decentralised' is not as nuanced as required to be able to represent the spectrum along which a system may be decentralised.

To provide more clarity for how 'decentralised' such systems are, we will now delve into the decentralisation of protocols, servers, infrastructure, and the execution of code/logic. However, it is important to highlight that a platform may be decentralised to different degrees when it comes to the governance of code repositories and the development and ongoing maintenance of code.

To appreciate how the values that decentralised social media platforms possess are attained and the inherent challenges, limitations, and potential of such solutions, we will now delve into the technological infrastructure that has supported the social networks that are still popular today and those solutions proposed for the potential decentralised social networks of tomorrow.

Let's first consider a traditional social network platform's infrastructure (Figure 1), owned and controlled completely by the social network operators themselves. While infrastructure used in Web 2.0 social networks is completely centralised, they evolved into heavily distributed systems due to their sheer scale and the requirements of dealing with big data and sustaining instant interactivity. It is important to note that though a system may be a (geographically and technologically) distributed system, this does not imply decentralisation. Since a single network operator controls all the different servers (in such centralised systems), the protocols used between different servers tend to be closed protocols (i.e., how the servers synchronise data and communicate with each other) – and rightly so – since such networks are not intended to allow external entities to interact with the internal infrastructure.

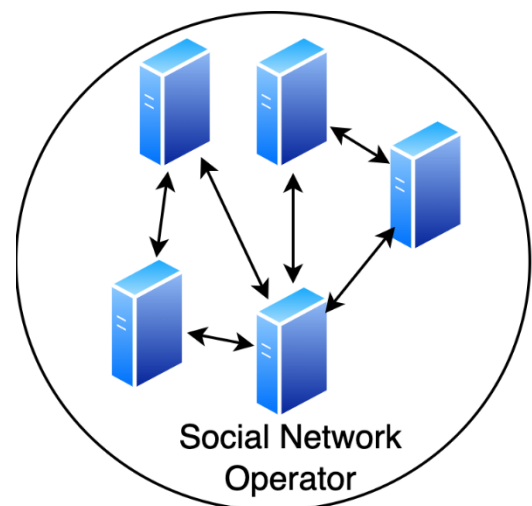


Figure 1: A (heavily distributed) social network centralised to a social network operator

In the early days of Web 2.0, as web applications were becoming more distributed and complex and widely used around the globe, it became apparent that it was impossible

¹² PC Mag. (02 May 2022). The EU is participating in the social network Mastodon, creating its own server. [Source](#). Accessed on: 27/07/2023.

¹³ Europe's Mastodon. [Source](#). Accessed on: 27/07/2023.

¹⁴ Europe's PeerTube. [Source](#). Accessed on: 27/07/2023.

to provide guarantees with respect to the availability of a system whilst ensuring a single unified source of truth at any instant, as per [Brewer's \(2000\)](#) postulated CAP theorem. As put by [Bailis and Ghodsi \(2013\)](#):

In the event of a partition between two servers ... you cannot deliver each update to all timelines. What should you do? Should you tell the user that he or she cannot post an update, or should you wait until the partition heals before providing a response? Both of these strategies choose consistency over availability, at the cost of user experience.

To ensure availability, usability, and an overall positive user experience, social network operators quickly realised they could sacrifice a single system-wide source of truth of data and employ techniques that allowed for eventual data consistency. This meant that rather than allowing for a social network action to fail when data could not be replicated (for example, when hardware failed or when parts of networks were unreachable), users could instead be presented with whatever data was available. Consider again the example described by [Bailis and Ghodsi \(2013\)](#):

Instead, what if you propagate the update to the reachable set of followers' timelines ... and delay delivering the update to the other followers until the partition heals? In choosing this option, you give up the guarantee that all users see the same set of updates at every point in time ..., but you gain high availability and (arguably) a better user experience.

It may have been this realisation (i.e., the realisation that a single source of system-wide truth was not the most crucial aspect for social networks) that paved the way for the development of decentralised social networks that we will now delve into.

Indeed, the term 'decentralised social network' is used to describe many different types of social networks. We therefore now provide clarity with respect to what exactly is being proposed to be decentralised with respect to the emerging types of decentralised social networks. Considering the fediverse, and particularly those platforms built on top of the ActivityPub protocol, the focus has been to allow 'anyone' to create or run their own social network platform or instance and allow the different platforms to easily exchange data. A depiction of the various social networks supported is presented in Figure 2 (Wikipedia¹⁵).

Fediverse: The 'fediverse', short for 'federated universe', refers to a network of interconnected social media platforms running across the globe and online communities that operate on the principles of federation and decentralisation ([Anderlini & Milani, 2022](#)). There is no one central site. Each user chooses a server to register with. It is an alternative to centralised social media platforms like Facebook and Twitter. In the fediverse, different platforms, known as 'instances', are independently owned and operated but can communicate with each other. Each instance can have its own set of rules and policies, and users can choose which instance to join based on their preferences and interests. These instances use protocols, such as ActivityPub, diaspora* and OStatus, to enable communication and interaction between users across different platforms.

The inception of the fediverse can be traced back to 18 May 2008, when the initial public post emerged on a platform called identi.ca. This platform was driven by free software, and its concept revolved around the notion that individuals could freely access and utilise the source code to create their own interconnected social networks. This marked the nascent stage of the fediverse, laying the foundation for its subsequent development and expansion¹⁶.

¹⁵ Wikipedia. A view into the Fediverse image. [Source](#). Accessed on: 27/07/2023.

¹⁶ Fediverse.Party. Explore federated networks. [Source](#). Accessed on: 27/07/2023.

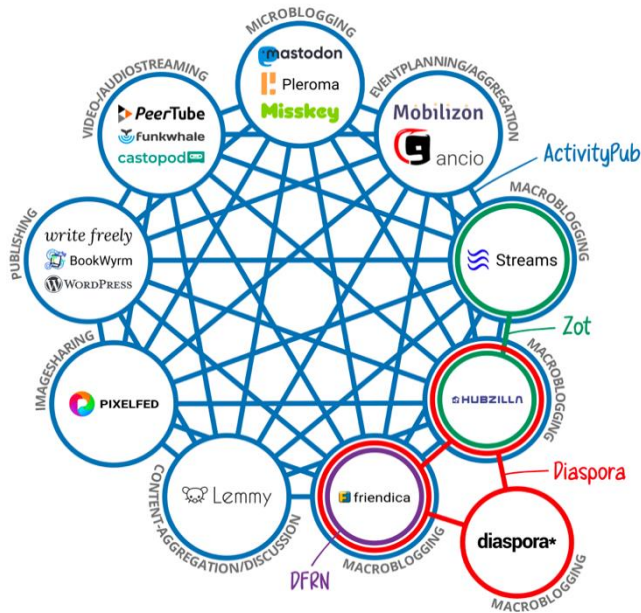
The fediverse encompasses a wide range of platforms, including Mastodon (a microblogging platform similar to Twitter), PeerTube (a decentralised video sharing platform), Pixelfed (an image sharing platform) and many others. Each platform has its own unique features and user base, but they all share the underlying principles of decentralisation and federation that define the fediverse.

The federated nature of the fediverse allows users to communicate and share content with people on different instances. For example, a user on one instance can follow and interact with a user on a completely different instance. A distributed model of social media gives users greater control over their data and allows for more diverse and specialised communities to form, as well as to promote egalitarian pluralism (Allen et al., 2023).

Within fediverse social networks, individuals and organisations have the freedom to install, own and oversee their own autonomous servers, commonly referred to as instances. These instances engage in interconnections through a process called federation, allowing them to establish P2P relationships and exchange posts in a decentralised manner.

A view into the Fediverse

Who talks to whom - and how?



 Imke Senst & Mike Kuketz
<https://creativecommons.org/licenses/by-sa/4.0/deed.en>

MORE PLATFORMS AND INFO:
<https://en.wikipedia.org/wiki/Fediverse>

Figure 2: The Fediverse (Wikipedia¹⁵)

instance called Gab (Naskali, 2020). While Gab claimed that it ‘champions free speech’, it was ‘considered by many to contain extreme hate speech’ (Naskali, 2020). Indeed, users are free to join the instances and use

But what is being decentralised in the fediverse approach? There is no longer a single centralised social network platform; users can choose the ones they would prefer to use whilst still being able to communicate with other users on other platforms. This is achieved using open protocols (e.g., ActivityPub). Social network platform servers and infrastructure are no longer centrally controlled by a social network operator, yet ‘anyone’ can run their own server/instance. However, it is important to note that an instance itself is controlled by a central operator who has control over that particular instance, including the codebase and logic/rules encoded within it and data stored on the instance.¹⁷ Such control allows for some instances to censor content and block connections to other instances. Whilst such decisions are typically made based on transparent policies, nonetheless, it must be acknowledged that instance operators do remain in control of that part of the abstract platform served from their instance. Such control and censorship may also be applied at the software client level as well. For example, Tusky, a Mastodon client, was hard-coded to block any users hailing from a Mastodon

¹⁷ In fact, Meta proposes that their new social media platform, Threads, will integrate with ActivityPub. [Source](#). Accessed on: 18/10/2023.

the software clients of their choice, yet centralised control over such instances and clients exist, and whilst the fediverse allows anyone to run their own instance, their instance's interaction with other users on other instances is dependent upon the operators of the other instances (as they may choose to block specific instances).

ActivityPub: ActivityPub is an open standard protocol for decentralised social networking. It provides a framework for communication and interoperability between different social media platforms and online communities within the fediverse. ActivityPub was developed by the W3C Social Web Working Group¹⁸ and is designed to facilitate the exchange of social activities and data between servers in a federated network.

- The protocol allows users to create, share and interact with various types of content, such as posts, comments, likes and followers, across different platforms that implement ActivityPub. It enables users on one platform to follow and interact with users on another platform, regardless of the specific software or instance they are using.
- ActivityPub defines a set of standard JSON-based messages and objects that are used to represent activities and data within the network. These messages are exchanged between servers to propagate user actions and updates, ensuring that the shared information is distributed and synchronised across the fediverse.
- By adopting ActivityPub, platforms in the fediverse can achieve a high level of compatibility and interconnectedness, allowing users to communicate seamlessly and fostering a decentralised social media ecosystem. Many popular fediverse platforms, such as Mastodon, Pleroma and Pixelfed, have implemented ActivityPub as their underlying protocol for federated communication.

The infrastructure allows for high levels of decentralisation, yet findings (based on Mastodon) show ([Raman et al., 2019](#)) that: (i) topics spread across more instances tend to have fewer users than topics spread across fewer instances; (ii) few instances are popular and have many users, where '10% of instances host almost half of the users' and outages of a small number of instances could result in a majority of content being unreachable; and (iii) a small subset of hosting service providers are used to host instances (given their dominance and cost-effectiveness in hosting provision).

To summarise, the protocol is open, allowing for anyone to run an instance, but individual instance operators have control over the code that their own instance executes. Emergent points of centralisation can be seen (i.e., popular instances and centralisation of hosting service providers), allowing for situations where centralised control could be exercised which may involve censorship. Here we do not provide this as a critique of such networks but just highlight the realities of some centralised points – which may be perfectly fine for the purpose of social media platforms when considering the higher levels of decentralisation achieved in other aspects. In the aim of further decentralising control that such instance operators have, Nostr¹⁹, makes use of: (i) public key cryptography that puts users in control of their accounts (and provides a means of decentralised provenance); and (ii) allows for data to be replicated across different 'relays', which ensures that a single operator cannot censor or have control over what data is censored in isolation.

Blockchains and other distributed ledger technologies (DLT) ensure that rules in digital processes can be decentralised among participating entities and provide guarantees with respect to the immutability and tamper proofing of recorded data. Blockchain-based decentralised social media platform solutions can not only democratise the infrastructure used for such networks but also aim to remove an operator's control over the infrastructure they operate. With respect to social media platforms, traditional centralised social media

¹⁸ ActivityPub, W3C Recommendation 23 January 2018. [Source](#). Accessed on: 27/07/2023.

¹⁹ Nostr. [Source](#). Accessed on: 18/10/2023.

platforms have complete control over the algorithms used to promote content over others and the ability to censor/remove data as required. Fediverse/decentralised social media platforms delegate such authority to instance operators. On the other hand, blockchain-based decentralised social media platforms can remove such control from individual entities (be it a centralised platform or instance operator) and force operators to follow agreed-upon rules. As an example, a blockchain-based platform could encode within its rules that define processes that must be followed for content to be censored (e.g., a majority vote using governance tokens), and there would be no way to break such encoded rules. This highlights a significant difference between fediverse social media platforms and blockchain-focused ones, which are more rigid because of the encoded rules and, in turn, can be seen to be more decentralised. While fediverse platforms provide more flexibility to instance operators, they can also be seen to give them more centralised control.

In essence, the transition of social media networks from Web 2.0 to 3.0 is primarily defined by the aspect of decentralisation and its inherent characteristics, as depicted in Figure 3.

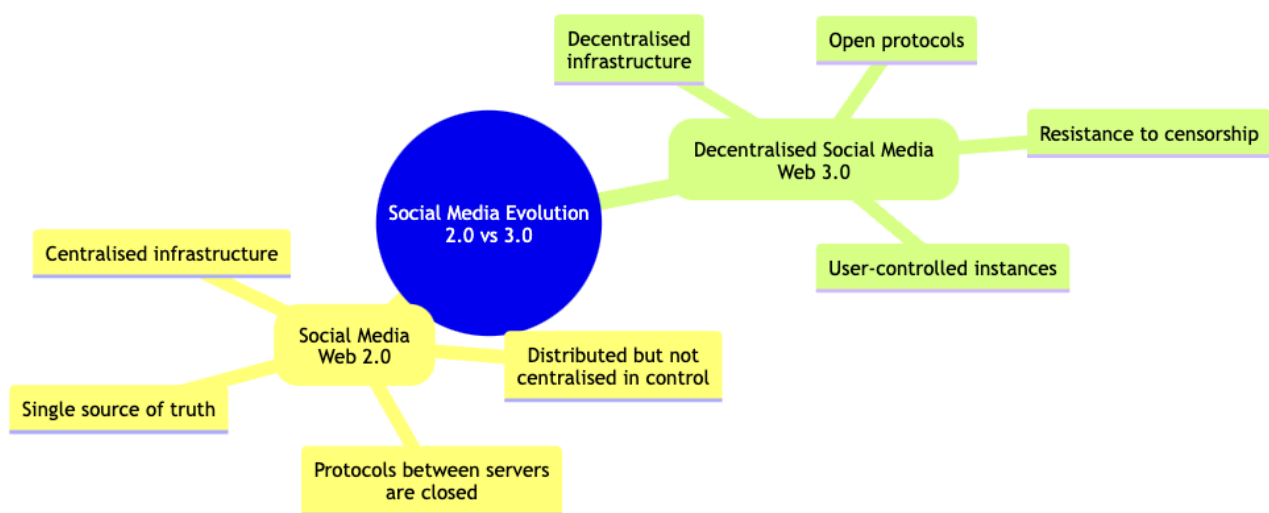


Figure 3: Social media evolution: Web 2.0 vs Web 3.0*

1.4 Decentralisation approaches

The quest to decentralise the social media landscape has taken different forms. While decentralisation seems to be the ultimate goal of many ideas, projects, iterations, applications and solutions, the means to achieve this outcome vary. The current state of decentralised social media is in flux, and any attempt to create rigid categories faces insurmountable obstacles. One could still, nonetheless, cognitively map two discernible tendencies within the movements for decentralising social media applications. In that sense, one could indeed speak of a) decentralised social media projects that borrow heavily from the free software movement and b) decentralised social media projects that are actively incorporating blockchain solutions.

This categorisation is not so much based on the technological underpinnings of each cluster of projects but on the different philosophy and ethos that permeates their communities and defines their user characteristics and loyalties. One could, for example, identify the use of free software licences on projects that apply blockchain-based solutions (Steemit, for example, has released its code with the MIT licence²⁰). In other words, the technological boundaries between the two different families of decentralised social media projects are in more of a state of flux than one would imagine. Nonetheless, their defining characteristics and underlying philosophy allow a clearer delimitation of their differences (Tiffany, 2022). In this context, one could observe that while

²⁰ GitHub. (2019). Steemit's licence. [Source](#). Accessed on: 27/07/2023.

free software projects envisage empowerment of the end user via the development of federated digital communities, blockchain-based social media projects strive to achieve the same goal by elevating the importance of user ownership over profiles and data, as well as the importance of monetisation incentives for user-generated content.

1.4.1 Decentralisation via free software

Decentralised social media platforms inspired by the free software movement appeared almost around the same time as incumbent Web 2.0 platforms. Therefore, they have reached a relatively mature stage in their development. The most popular project on this family tree, both in terms of visibility and actual users, is Mastodon²¹, created in 2016 by Eugen Rochko, a German software developer, with the ambition of becoming a viable alternative to Twitter. Mastodon is, nonetheless, neither the first nor the only available project. Diaspora^{*22}, for example, a social media project created by Dan Grippi, Maxwell Salzberg, Raphael Sofaer and Ilya Zhitomirskiy, students at New York University's Courant Institute of Mathematical Sciences, emerged in the early 2010s (Dwyer, 2010). Within the family tree of free software social media projects, one can identify all the use cases available on the incumbent Web 2.0 centralised social media landscape: Mastodon, diaspora*, Pleroma²³ and GNU social²⁴, for instance, are mostly microblogging applications with functionalities very similar to those offered on Twitter; Pixelfed²⁵ is the decentralised free software equivalent of Instagram; PeerTube²⁶ is a decentralised alternative to YouTube; and Friendica²⁷ is a decentralised alternative to Facebook.

It is important to stress that social media projects that draw heavily from the free software tradition are trying to achieve decentralisation at two distinct levels. Not only do they strive to decentralise user experience within their own ecosystems, but they are also trying to achieve universal decentralisation by allowing their users to freely interact with their peers from other free software decentralised projects.

Decentralisation within the confines of each project is achieved by the diffusion of control, participation, and user experience from dominant centralised entities to independent servers that are usually called instances. Unlike traditional Web 2.0 social media, where a powerful commercial organisation intermediates the entire architecture, development, user experience and user participation, decentralised free Software social media applications are more like clusters of independent servers that run the same software. These projects usually start as software communities around a core developer team that programs the basic social media application. As soon as development is completed, the software is distributed freely via a copyleft free software licence (usually AGPL v3²⁸). Indeed, Mastodon²⁹, diaspora^{*30}, Pleroma³¹, GNU social³², Pixelfed³³, PeerTube³⁴ and Friendica³⁵ all released their social media software with the AGPL v3 licence). A non-profit organisation (for

²¹ Mastodon. Decentralised social media. [Source](#). Accessed on: 27/07/2023.

* *This figure is generated with the support of AI tool.*

²² The diaspora* project. Welcome to diaspora*. [Source](#). Accessed on: 27/07/2023.

²³ Pleroma. A lightweight fediverse server. [Source](#). Accessed on: 27/07/2023.

²⁴ GNU Social. A free software social networking platform. [Source](#). Accessed on: 27/07/2023.

²⁵ Pixelfed. Decentralised social media. [Source](#). Accessed on: 27/07/2023.

²⁶ PeerTube. What is PeerTube? [Source](#). Accessed on: 27/07/2023.

²⁷ Friendica. A decentralised social network. [Source](#). Accessed on: 27/07/2023.

²⁸ GNU Affero General Public License - GNU Project - Free Software Foundation. [Source](#). Accessed on: 27/07/2023.

²⁹ GitHub. (2016). Mastodon's licence. [Source](#). Accessed on: 27/07/2023.

³⁰ GitHub. (2016). diaspora's licence. [Source](#). Accessed on: 27/07/2023.

³¹ GitLab. (2017). Pleroma's licence. [Source](#). Accessed on: 27/07/2023.

³² GitHub. (2008). GNU's copying. [Source](#). Accessed on: 27/07/2023.

³³ GitHub. (2018). Pixelfed's licence. [Source](#). Accessed on: 27/07/2023.

³⁴ GitHub. (2017). PeerTube's licence. [Source](#). Accessed on: 27/07/2023.

³⁵ GitHub. (2021). Friendica's licence. [Source](#). Accessed on: 27/07/2023.

example, in the case of Mastodon, it is Mastodon gGmbH³⁶, or in the case of PeerTube, Framasoft³⁷) or a digital community (as is the case with diaspora*³⁸) usually remain in control of the further development and maintenance of the software. The same non-profit organisation or digital community will usually create the first instance where users can register and start experiencing the ecosystem. Since the social media software is released on a free licence, many new instances, completely independent from the original, will eventually adopt the software. This guarantees that the ecosystem will become decentralised, since anyone can create an instance running the social media code and set up their own rules on accepting new members and moderating content. The scope of each server can vary, as some are dedicated to specialised topics while others are more general (see, for example, the content and theme plurality of the available servers of PeerTube³⁹, Mastodon⁴⁰ and Pleroma⁴¹).

Apart from achieving decentralisation within their own projects, free software social media communities also aim at universal decentralisation. This is achieved by actively promoting the idea of interoperability between the different free software social media projects. Such interoperability is achieved by deploying and implementing the ActivityPub protocol. ActivityPub⁴² is an open, decentralised social networking protocol developed by the World Wide Web Consortium (W3C⁴³). It provides a client/server API for creating, updating, and deleting content and a federated server-to-server API for delivering notifications and content. ActivityPub allows users from different decentralised social media projects to communicate with one another without having to change their native ecosystem. For example, a user registered with a diaspora* server can directly communicate with another user registered with a Pleroma server, which is impossible in the siloed world of Web 2.0 social media. Decentralised free software social media projects implement the ActivityPub protocol and actively encourage their servers and users to build interoperability bridges. They have developed a strong common digital identity⁴⁴, and they consider themselves as an element of a bigger project ([Pierce, 2023](#)) that is called the fediverse (a portmanteau of the words ‘federated’ and ‘universe’ ([EDPS, 2022](#))).

Despite the fact that free software social media projects have established themselves as viable alternatives to the incumbent social media platforms (evidenced by the fact that user dissatisfaction with Web 2.0 platforms is usually translated into migrations to the fediverse ([Huang, 2022](#))), they have not yet achieved mass adoption. User numbers are modest⁴⁵ in comparison to those recorded in incumbent Web 2.0 platforms. Still, they are not discouraging if one takes into account that decentralised social media platforms constitute an important paradigm shift for the average user ([Gow, 2022](#)).

1.4.2 Blockchain-based social media projects

The development of blockchain ecosystems is gradually escaping the confines of financial innovation and is entering more mainstream applications. In that sense, it should not be a surprise that blockchain-based solutions have also been implemented in the area of social media.

Unlike free software social media projects, blockchain-based projects are much more diverse in their development and deployment and, therefore, it is more difficult to extract general conclusions about their

³⁶ Mastodon. Mastodon hosted on mastodon.social. [Source](#). Accessed on: 27/07/2023.

³⁷ Framasoft. Framasoft Association. [Source](#). Accessed on: 27/07/2023.

³⁸ The diaspora* blog. (2013, 27 August). diaspora* celebrates one year as a community project. [Source](#). Accessed on: 27/07/2023.

³⁹ PeerTube. PeerTube instances. [Source](#). Accessed on: 27/07/2023.

⁴⁰ Mastodon. Servers. [Source](#). Accessed on: 27/07/2023.

⁴¹ Pixelfed. Pixelfed Servers. [Source](#). Accessed on: 27/07/2023.

⁴² ActivityPub Rocks! [Source](#). Accessed on: 27/07/2023.

⁴³ W3C. [Source](#). Accessed on: 27/07/2023.

⁴⁴ Fediverse.Party - explore federated networks. [Source](#). Accessed on: 27/07/2023.

⁴⁵ The federation – a statistics hub. [Source](#). Accessed on: 27/07/2023.

current state, characteristics, and mode of operation. There are, nonetheless, relatively mature and well-documented projects that allow a basic sketch of the current state of affairs.

Perhaps one of the most well-documented blockchain-based social media ecosystems is Steemit. It is based on the Steem blockchain⁴⁶ that was created with the deployment of social media applications in mind. Steemit is a microblogging social media application that runs entirely on the Steem blockchain. This means that user accounts and user content are created and recorded on-chain. The Steem blockchain produces its own native crypto asset, the so-called STEEM coin, which is used by the system in order to reward users for the popularity of the content they post on Steemit (for that purpose 65% of the tokens produced within the Steem blockchain are allocated to the so-called reward pool⁴⁷). The Steem blockchain operates on the basis of a delegated proof of stake consensus mechanism⁴⁸, which means that the power to control the fate of the ecosystem rests effectively with the small community of ‘witnesses’ (this is the term used in the Steem blockchain to describe what other proof of stake blockchains called ‘validators’). Witnesses are elected by the users holding the available units of the STEEM coin. They are responsible for block creation and all the major governance decisions of the ecosystem.

A very similar project is the Hive. The Hive ecosystem also runs its own blockchain (the Hive blockchain) and also uses a delegated proof of stake consensus mechanism⁴⁹. It also produces its own native token, the HIVE, which is used as a monetisation tool for content providers on the various social media applications built and supported by the Hive blockchain⁵⁰, including the microblogging service Hive.blog. The similarities between Steemit and Hive.blog are not coincidental, since Hive was developed by a group of people involved in Steem. The saga of the split between Steem and Hive will be explored in section 2.1.1. as it constitutes a very valuable example of the dynamics of governance and the development of power structures, content moderation and ecosystem standards in blockchain-based social media projects.

Apart from Steemit and Hive, there are other blockchain-based social media projects under development. A very characteristic example is the Lens Protocol, which is currently still in beta. Lens is a Web 3.0 social graph on the polygon proof-of-stake blockchain⁵¹. It aims to address the current limitations of Web 2.0 social media services by empowering user participation on the basis of the record keeping capabilities that are characteristic of blockchains. Lens will support the development of classic social media applications such as user profiles⁵² and user generated content⁵³. The latter will come in three different shapes⁵³: posts, comments, and mirrors (the latter being the equivalent of reposting content in legacy social media platforms). User profiles will be designed as NFTs stored in blockchain wallets. User posts, comments, and mirrors, on the other hand, will not be NFTs per se, but they will be immutably associated with the user profile NFT. The actual content of user posts, comments and mirrors will be stored off-chain either in a decentralised manner (e.g., on an IPFS⁵⁴ or Arweave server⁵⁵) or within centralised server farms (such the Amazon AWS S3⁵⁶). This architecture implies that unlike Steemit and Hive, Lens does not intend to move the entire social media exchange on-chain. On the contrary, though, similar to Steemit and Hive, the Lens Protocol will reward users for their content. Instead of creating a ‘reward pool’, as is the case in Steemit and Hive, Lens will provide monetisation opportunities via

⁴⁶ Steem. Powering Communities and Opportunities. [Source](#). Accessed on: 27/07/2023.

⁴⁷ Steemit. FAQ: What is the reward pool? [Source](#). Accessed on: 27/07/2023.

⁴⁸ Steemit. Delegated Proof of Stake. [Source](#). Accessed on: 27/07/2023.

⁴⁹ Hive Blog. FAQ: What is the difference between Proof of Work, Proof of Stake, and Delegated Proof of Stake? [Source](#). Accessed on: 27/07/2023.

⁵⁰ Hive. Hive Ecosystem. [Source](#). Accessed on: 27/07/2023.

⁵¹ Polygon Technology. The value layer of the Internet. [Source](#). Accessed on: 27/07/2023.

⁵² Lens Protocol. Profile. [Source](#). Accessed on: 27/07/2023.

⁵³ Lens Protocol. Publication. [Source](#). Accessed on: 27/07/2023.

⁵⁴ IPFS. IPFS powers the Distributed Web. [Source](#). Accessed on: 27/07/2023.

⁵⁵ Arweave. Permanent information storage. [Source](#). Accessed on: 27/07/2023.

⁵⁶ Amazon. Amazon S3. [Source](#). Accessed on: 27/07/2023.

the NFT user profile of each member of the community⁵⁷. Monetisation and community building capabilities will also emerge by the 'Follow' function of the network, which will come in the form of a 'Follow NFT'⁵⁸.

In conclusion, no matter whether via native protocol crypto assets or ad hoc NFTs, blockchain-based social media projects aim to empower users of social media applications. When it comes to decentralisation, blockchain-based social media projects are heavily dependent on their governance model, which is, in turn, usually expressed through their consensus mechanism. The level of user adoption, while small in comparison to the level of adoption achieved by incumbent Web 2.0 platforms, seems to be similar to that of free software social media projects, ranging between tens and hundreds of thousands active users (as, for example, is the case with the Hive ecosystem⁵⁹).

1.5 Differences between the social media of our times & their technical realisation

Sharing was a main motivational goal for the design of the internet ([Leiner et al., 2009](#)) – the ability for individuals and entities to share information easily and efficiently ([Berners-Lee et al., 1999](#)). Sharing of information over the internet (and networks leading up to the internet) was subject to varying degrees of decentralisation, and for those who desired freedom, the internet provided a natural home ([Sterling, 1993](#)). Yet, over the decades, clear points of centralisation emerged, possibly due to self-hosting maintenance costs and the expertise required to do so. Social media apps, from one perspective, can be seen to have created a platform for all to share and access content by lowering direct costs for users (though users 'pay with their data'), along with removing the need for any form of expertise to set up one's own digital space or find and navigate those of others. Yet, the degree of control that social media operators retain has put into question the degree to which users can share and navigate information available on such platforms (when the platform can censor, promote/shadow-ban and decide on which subjective truths should be deemed as facts). It is control over key functions such as 'data storage, content distribution, discovery, identity mechanisms, governance and moderation, revenue models and network topology' ([Abbing et al., 2023](#)) that decentralised social media platforms aim to disintermediate from traditional centralised social media platform operators.

There are several differences between the traditional digital social media and decentralised social media, either technically or in terms of governance. Key differences determining decentralised social media platforms from those we are more typically accustomed to include the following aspects ([Abbing et al., 2023](#)).

Governance and moderation: Each centralised social media is owned and operated by a single company, which oversees its social media infrastructure and governance. As centralised service providers, traditional social media platforms have not only the control to moderate content but also the responsibility and, depending upon jurisdictions, the legal obligation to do so. While mandates to moderate content or other aspects of the platform may be driven by legal obligations or a particular social media entity's policy defined by its internal governance structure, traditional social media platforms tend to have full control of how the platform is governed and how content can be moderated. On the one hand, this allows for such platforms to act quickly when required (for example, to remove illegal content once it is reported), whilst, on the other, users must trust the platform with such control.

Decentralised social media distinguishes itself from mainstream platforms in several key ways. Unlike mainstream platforms that centralise millions of users on a single controlled governance model, exert control over decision-making, enforce censorship and monetise users' data for profit and surveillance, decentralised

⁵⁷ Lens Protocol. Collect. [Source](#). Accessed on: 27/07/2023.

⁵⁸ Lens Protocol. Follow. [Source](#). Accessed on: 27/07/2023.

⁵⁹ Hive Blog. Hive Statistics – 2023.06.22. [Source](#). Accessed on: 27/07/2023.

social media platforms take a different approach. Decentralised social media platforms intend to be developed by a global community of individuals, independent of any company or official institution. This community-driven model empowers users with the freedom to register on any server of the decentralised social media of their choice. Additionally, users have the ability to choose their data custodian – the administrator of their server – who will oversee the handling and storage of their personal information ([De Filippi & Lavayssière, 2020](#)). In contrast to centralised approaches, decentralised social networks have been operating on freely available software developed by the community, capable of supporting multiple access points. This flexibility enables users to join the network through their preferred sign-on providers or even establish their own server, eliminating the need for dependence on a centralised authority ([Vergne, 2020](#)). The decentralised social media does not have a single centralised governance model, which in its essence is more in favour of freedom of speech, as the content published is harder to censor and erase, particularly when we consider it is technically supported by a blockchain or a DLT that is difficult to tamper with without the community realising it. There is no one big corporation dictating the rules and declaring what should not be published or visible ([Alsarsour et al., 2020](#)).

By decentralising power and data, these platforms aim to foster a more democratic and inclusive social media environment, where users can have a greater say in the platform's governance, content moderation and data privacy. Decentralised social media provides an alternative to the centralised control and data monopolies associated with mainstream platforms, emphasising user empowerment, and fostering a more open and diverse online ecosystem ([Guidi et al., 2020](#)).

Content discovery and distribution: When data is stored and processed/accessed in a centralised manner, content discovery and distribution techniques can make use of a global view – for example, for determining trending content/topics. While the more decentralised data access mechanisms are, the harder and less efficient it becomes to undertake actions that require a more global view of data. Indeed, the flipside to centralised content discovery and distribution mechanisms is the level of control a centralised platform will maintain with respect to the ability to decide on what content should be given more/less importance and/or be censored, 'fact-checked' or shadow-banned.

Decentralised social media platforms prioritise principles such as transparency, user control, privacy, and censorship resistance. Users have more autonomy over their data, and they can choose to connect with specific communities or instances that align with their interests and values. Interactions and content sharing can occur across different instances or nodes, enabling a federated network where users from different platforms can communicate and collaborate ([Freni et al., 2020](#)). On the other hand, decentralised social media platforms distribute control and ownership among multiple participants, often through the use of blockchain technology or other ledger technologies. In this model, the platform's infrastructure is typically distributed across numerous servers or nodes, which can be operated by different individuals or organisations ([Li & Palanisamy, 2019](#)).

For those with technical expertise, the option exists to administer their own server, allowing them to create a private space for friends and family while connecting with thousands of other independent servers across the internet. The power and data are decentralised, spreading across numerous servers, creating an autonomous universe where self-direction and information are distributed across diverse territories ([Zutshi et al., 2021](#)).

Network topology: Decentralised social media refers to a type of social media platform that operates on a decentralised architecture, in contrast to the traditional centralised model employed by mainstream platforms. In centralised social media, a single entity or company owns and controls the platform, making decisions, enforcing policies, and managing user data ([Guidi, 2020](#)). Traditionally, social media platforms relied on heavily centralised technology implementations that required centralised coordinating nodes and, in turn, points of failure. In the aim of providing higher levels of platform availability, social media operators early on realised

that social media content did not involve a high degree of connectedness with other social media content (beyond ‘replies’ or other direct interactions with the specific content itself). This realisation allowed platforms to move away from centralised network topologies, providing strong consistency for higher availability through distributed systems offering eventual data consistency. Yet, it must be mentioned that whilst such platforms are largely distributed, they are still typically centralised to the single social media network operator – whilst decentralised social media networks, as discussed within this report, tend to have higher degrees of decentralisation of the underlying technology supporting the network.

Data storage: Traditional social media platforms store all data related to the platform, its users and user interactions in a centralised manner – whilst it can be done in a manner that is geographically distributed, it is still centralised from the perspective of the platform being the sole controller and maintainer of the data. Indeed, the platform must be trusted to keep user data confidential and secure – yet such platform-controlled data storage removes the burden and complexities of data storage responsibilities from users and can provide higher levels of assurances with respect to data availability (as long as the centralised platform has sufficient levels of assurances and redundancies).

Revenue models: Social media platforms, for the most part, operate revenue models that direct income towards the centralised platform operators – whilst at the same time, incentivisation schemes are typically offered for content creators who reach a certain level of interaction. Users most typically are allowed to use such social media platforms ‘for free’, which, as discussed above, removes the burden of having users maintain their own digital spaces – however, users often question if it is really ‘free’ or whether ‘free is too high a price’⁶⁰ for the amount of data users are ‘selling’ in exchange for the use of traditional social media platforms. Different decentralised social media platforms aim to distribute revenue in a manner that incentivises various stakeholders according to their levels of involvement and responsibilities.

Identity: The popular adage ‘On the internet, nobody knows you’re a dog’⁶¹ is true for the most part. Yet this is not exactly the case when it comes to centralised social media platforms and the level of information they have access to about their users – centralised social media platforms are likely to know ‘that you are a dog’. This is due to: (i) centralised digital identities used to log in and associated with social media accounts, e.g. we often use email accounts that are identifiable and linked to other centralised services, and we also directly or indirectly reveal personal information to social media platforms as part of account information; and (ii) the quantity of personal data we reveal as part of our social media interactions: isolated social media interactions may not reveal much, but when greater numbers of social media interactions are looked at, a character profile may be built. For example, if you liked a picture of a dog, not much can be determined from this single interaction. However, if you also checked in to a dog park, rated your favourite dog food, and posted a message that you are going to try out a new leash, the platform may be able to realise that ‘you’re a dog’ (or rather that you own a dog). Decentralised social media platforms attempt to decentralise such a centralised view of identities to different degrees – with some who aim to achieve self-sovereign identities.

1.6 Key benefits of decentralised social media

Decentralised social media offers a wide range of solutions that could transform the entire approach to social networking. Below, we highlight the main advantages of decentralised social media networks, as discussed throughout this section (Figure 4).

1. **No single centralised platform or authority:** Decentralised social media does not rely on a single platform or authority, allowing for diverse interactions across various networks and diverse governance.

⁶⁰ The Wall Street Journal. (2019, June 8). Christopher Mims. Why Free Is Too High a Price for Facebook and Google. [Source](#). Accessed on: 27/07/2023.

⁶¹ Wikipedia. On the Internet, nobody knows you’re a dog. [Source](#). Accessed on: 27/07/2023.

2. **User autonomy & data ownership:** Anyone can run their own server/instance, giving them control over their platform's infrastructure or data, enhancing privacy and security.
3. **Customisable terms of service:** Users can create their own terms of service, allowing for tailored user experiences.
4. **Cross-platform data exchange:** Open protocols (i.e., ActivityPub) facilitate seamless data exchange between different platforms.
5. **No single point of failure:** The distributed nature ensures that the entire system does not collapse if one part fails.
6. **Resistance to censorship:** Decentralised platforms are less exposed to content control by any single entity, making it more difficult for governments or corporations to shut down or control.
7. **Less surveillance:** The decentralised networks are less prone to mass surveillance, which enhances user privacy.
8. **Independence from larger tech companies:** Decentralised social media platforms operate autonomously from larger networks, reducing the danger of a monopoly and enhancing privacy and data handling transparency.
9. **Resistance to monopolistic practices:** The decentralised structure of social media is more resistant to monopolistic control and practices.
10. **Social innovation:** The open nature encourages healthy platform competition, leading to social innovation.

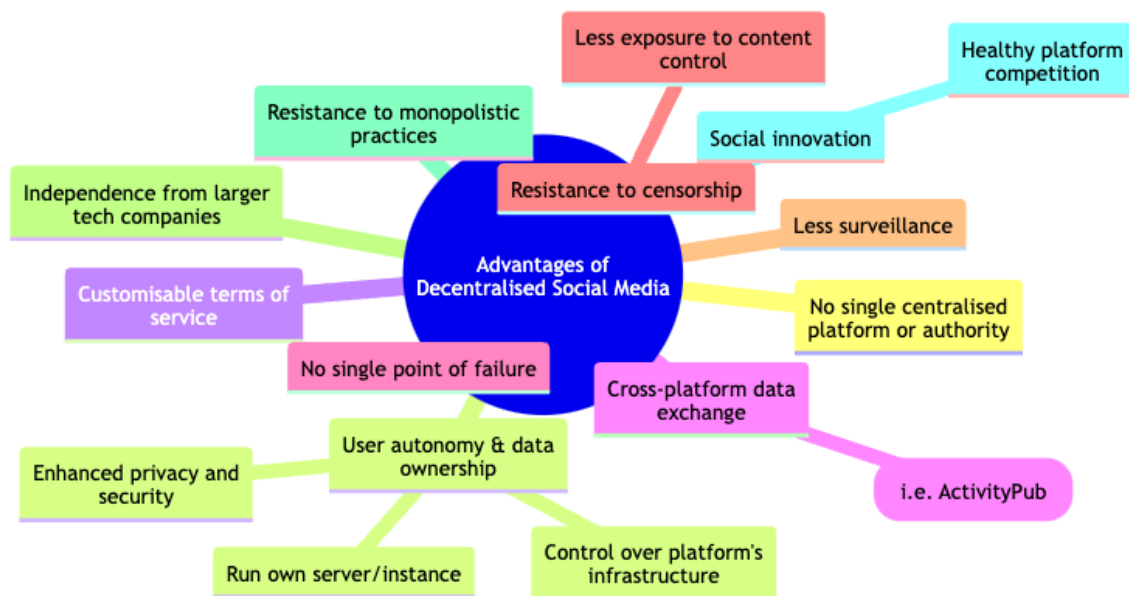


Figure 4: Advantages of decentralised social media**

2 Federated Social Networks: Regulations, Challenges, and Future

2.1 Standards and regulations

The creation of digital spaces that enable human interaction is inextricably linked with questions of regulation and compliance. Discussions about the regulation of social media spaces usually revolve around two main axes: a) who will regulate these digital spaces and b) what are the critical areas where some form of regulation is necessary. This section will briefly discuss these two axes within the context of decentralised social media projects. Due to size and scope limitations, this section will focus on the problems of regulatory authority and freedom of expression. It must be stressed, nonetheless, that the spectrum of concrete regulatory issues is much broader and encompasses a wide range of issues such as platform liability, data protection, and financial regulation.

2.1.1 On the regulatory modalities of decentralised social media ecosystems

Decentralised social media projects are not immune to regulatory discussions, no matter their technological underpinnings. Nonetheless, in many industry⁶² and academic circles ([Becker, 2022](#)), the term ‘decentralised’ is being viewed as a starting point for renegotiating the terms of regulatory intervention. A very popular narrative in the context of this discussion is that decentralised software communities cannot be regulated at all by traditional regulatory modalities and that, if any form of regulation is necessary, this cannot and should not come from government intervention, but should rather evolve organically via the self-regulatory mechanisms of decentralised digital communities ([De Filippi et al., 2022](#)).

Such discussions can be traced back to the early days of the commercial era of the internet when the entire ecosystem was arguably more decentralised than it is today. It is undoubtedly true that the regulation of decentralised digital environments should not be viewed exclusively through the lens of existing Web 2.0 regulatory patterns. The key difference is the distribution of power within the various iterations of digital communities and spaces. Web 2.0 platforms have traditionally been key regulatory stakeholders because of the critical level of control that they exert over their digital dominions. In decentralised digital communities, on the other hand, the distribution of power is less straightforward.

Nonetheless, while decentralisation changes the power distribution within digital ecosystems, it does not make creating new power architectures impossible. On the contrary, one can observe power structures and points of power concentration within free software and blockchain-based decentralised social media architectures. In that sense, decentralisation should not be viewed as a characteristic that renders any governmental intervention impossible but rather as a challenge that requires regulatory flexibility so that governmental regulation remains meaningful and productive ([Werbach, 2018](#)).

When it comes to free software and social media ecosystems, power concentration can, first and foremost, be identified with the individual servers that run the software and facilitate user participation and interaction. While not as powerful, decisive, exclusive, and dominant as Web 2.0 platforms, free software social media servers constitute critical regulatory stakeholders within the ecosystem. This is because servers are not only

⁶² YouTube. Gavin Wood – Allegality. [Source](#). Accessed on: 27/07/2023.

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** This figure is generated with the support of AI tool.

responsible for the implementation of the software but also for the development and implementation of the framework that governs user experiences: it is their set of technical and participatory standards, for example, that dictate the behaviour of the users within their ecosystem and their rules that dictate what is and what is not tolerable.

Apart from individual servers, free software social media projects display some form of overarching governing authority. Mastodon is a good example. The founder and creator of the ecosystem, Eugen Rochko, has not been shy in expressing the principles that underlie the philosophy behind the creation and operation of the ecosystem⁶³. It is true that the independent servers that run the Mastodon software have no obligation to follow the course set by Eugen Rochko and Mastodon gGmbH. In reality, though, the strong influential presence of Eugen Rochko and Mastodon gGmbH has attracted considerable attention and shaped the ecosystem's behaviour. One can also observe similar governance architectures in other free software social media projects. For example, Framasoft seems to be designing overarching community guidelines within the PeerTube ecosystem (<https://docs.joinpeertube.org/admin/moderation>), while similar discussions have also arisen in other free software social media projects (e.g., Friendica⁶⁴).

When it comes to blockchain-based social media projects, the key governance component is usually identified with their consensus mechanism. While blockchain projects usually self-identify as 'decentralised', the level of this decentralisation and its limits must be considered carefully. Blockchains are not free from mechanisms of power concentration and governance hierarchies. Two blockchain projects explored in section 2.1 (i.e., Steemit and Hive) are very characteristic examples, since their creation and development are closely interwoven. Steemit runs on a blockchain that employs a delegated proof of stake consensus mechanism. While this governance system may be perceived as being decentralised, it did little to prevent a rather aggressive takeover of the ecosystem by a single entity (Tron DAO ([Copeland, 2020](#))), which was eventually able to control the 'witnesses' and impose its will on the entire community ([Benson, 2020](#)). Dissatisfied members of Steem have been able to migrate and create Hive. The fact remains that the system was created with a single point of power, despite its decentralised appearance. This means that blockchain-based social media projects are also capable of power concentration and regulation.

The existence of alternative power structures within decentralised social media projects does not necessarily imply that governmental regulation is the only source of regulatory standards, nor should it be used as an excuse to undermine the regulatory potential of self-regulatory mechanisms native to decentralised digital communities. On the contrary, the existence of local and federated governance architectures elevates the regulatory position of authoritative stakeholders within such networks. At the same time, existing IT law still has a role to play. In reality, the core body of applicable EU IT law will remain relevant for most decentralised social media projects, and it will shape, together with self-regulatory mechanisms native to these networks, the development and growth of these ecosystems. Regulatory standards for decentralised social media ecosystems have endogenous and exogenous layers, which must always be examined in combination.

2.1.2 On freedom of expression and content moderation standards

A rather prominent issue within digital spaces is that of freedom of expression and content moderation. Fediverse-like decentralised social media applications allow the production of user-generated content whilst also enabling cross-platform user interaction. Like Web 2.0 social media platforms, they create extended digital spaces for human communication. They are, therefore, part of the wider discussion about freedom of expression and content moderation in digital spaces.

⁶³ Mastodon Blog. (2019, 16 May). Introducing the Mastodon Server Covenant. [Source](#). Accessed on: 27/07/2023.

⁶⁴ Friedica's GitHub. Feature Request: implement Moderation system #8724. [Source](#). Accessed on: 27/07/2023.

Regarding decentralised social media projects that draw from the free software tradition, the search for regulatory standards on freedom of expression and content moderation must begin with the individual servers that power the ecosystem. These servers are the elementary particles of each social media universe, and their technical standards and participation terms set the regulatory tone of such ecosystems. Users must accept the terms set by the server of their choice when trying to register with the ecosystem. They must also uphold the terms when their membership is accepted, and, ultimately, their continuous participation on the server and the ecosystem depends on their level of respect for the terms of the server. If one were to browse through the servers of different free software social media projects, it would quickly become apparent that individual servers are very active in determining the rules of accepted speech within their communities: the mastodonapp.uk server, for example, has a clear content moderation policy that sets limits on the freedom of expression of its users⁶⁵, and the same applies to many of the active servers within the PeerTube ecosystem (see, for example, the moveIT Tube server⁶⁶), or the servers that run the Pixelfed software (see, for example, the FotoFed.nl server⁶⁷).

Apart from the local rules devised by the different independent servers, free software social media also display overarching power structures that strive to introduce universal rules for the entire ecosystem. It is, of course, true that individual servers are not obliged to abide by the rules set by any proposed overarching instance. But recorded governance incidents might tell a different story. Mastodon is a good example of a decentralised social media project with well-pronounced overarching centralised power architectures and universal standards (expressed through the Mastodon Server Covenant⁶³). Eugen Rochko and Mastodon gGmbH have generally been very active and influential within the Mastodon universe. Their influence became apparent during the two major governance incidents that have occurred within the Mastodon ecosystem so far. The first incident was that of the migration of Gab, a far-right social media platform, to the Mastodon universe. In 2019, probably because it was banned from such official distribution channels as Google Play and the Apple App Store, Gab decided to abandon its own code and switch to Mastodon software. Among other things, this move would allow Gab to circumvent the bans and restrictions it was facing at the time (Gab ended up being one of the biggest Mastodon servers at the time). Eugen Rochko reacted swiftly, and while he acknowledged that the principles of the Free Software movement made it possible for Gab to switch to Mastodon software, he also made it clear that its presence within the Mastodon ecosystem was neither desired nor welcome⁶⁸. He even called Mastodon servers to be 'vigilant and domain-block them (i.e., Gab) on sight'⁶⁹. This resulted in a huge backlash against Gab within the Mastodon universe. This backlash was expressed by independent bans against Gab by the majority of Mastodon servers and the eventual demise of the Gab server from the Mastodon community. Mastodon has also quickly reacted to the infringing use of their software by TruthSocial, a microblogging application created by former United States President Donald Trump, when he was banned from mainstream microblogging platforms such as Twitter. While this time Eugen Rochko did not call for domain-blocking and other acts of network isolation, he still demanded that TruthSocial adhere to the copyleft clause of the AGPL v3 licence and denounce any proprietary claims on the Mastodon software⁷⁰. TruthSocial had no other option than to comply with the request.

The way that Mastodon handled these major governance incidents has gathered much attention and has even provoked calls for a re-imagining of the political and social architecture of free software decentralised digital communities. In fact, some commentators argue that the creation of decentralised digital spaces (legitimately) challenges the libertarian ethos of traditional free software communities and their loyalty to the supposed universality and neutrality of software ([Mansoux & Abbing, 2020](#)). It needs to be stressed that the existence of

⁶⁵ Mastodon. Mastodon's policy & sign-up. [Source](#). Accessed on: 27/07/2023.

⁶⁶ Move IT tube. About move IT Tube instance. [Source](#). Accessed on: 27/07/2023.

⁶⁷ Pixelfed. Fotofed.nl's server information. [Source](#). Accessed on: 27/07/2023.

⁶⁸ Mastodon. (2019, 4 July). Gab switches to Mastodon's code – Our statement. [Source](#). Accessed on: 27/07/2023.

⁶⁹ Eugen Rochko@Mastodon. [Source](#). Accessed on: 27/07/2023.

⁷⁰ Mastodon blog. Trump's new social media platform found using Mastodon code – Our statement. [Source](#). Accessed on: 27/07/2023.

such universal community standards is not unique to Mastodon. Many social media projects within the fediverse ecosystem have displayed similar attitudes. PeerTube is a characteristic example, as Framasoft actively supports the creation of universal community⁷¹ and content moderation⁷² standards.

One can also observe similar power architectures that produce regulatory standards in blockchain-based social media projects. Steemit⁷³ and Hive.blog⁷⁴, for example, have adopted clear terms and conditions that dictate user participation and content moderation. Decentralisation, after all, does not necessarily mean a lack of native regulatory standards for the ecosystem but maybe a more participatory determination of such standards.

Finally, next to these native self-regulatory content moderation frameworks (no matter whether local or universal), one must also take into account the revised EU law regime on platform regulation. Indeed, the Digital Services Act ([DSA](#)) has modernised the EU framework that regulates the relationship between users and digital content-enabling platforms. While at first glance the provisions of the DSA are aimed at incumbent Web 2.0 ecosystems, one could still legitimately argue ([Komaitis, 2022](#)) that they are general enough to encompass decentralised social media projects. Similar thoughts have been expressed in other jurisdictions as well, most characteristically in the United States, where the relationship between [Section 230](#) and decentralised social media projects has also been discussed ([Ahojja, 2023](#)).

2.2 The risks and challenges

Using centralised social media has its own trade-offs: privacy, security, control of data and incentives as well as censorship. Some of these issues can ideally be avoided to regain control by using federated or decentralised social media platforms. Decentralised social networks running on independent servers with open-source codes give users more control and autonomy while lowering censorship barriers, which become user-dependent, to enhance transparency. Some examples of such platforms are Mastodon, Steemit, etc., where the founder of a federated social network sets the accepted user behaviour and terms. A collection of interconnected servers used for decentralised social networking makes up a fediverse⁷⁵ that can be used for multiple activities to put information in front of the accepted community. An independently hosted federated network can interact with other networks in the fediverse, thereby being interoperable across platforms without any special channel requirement.

Decentralised social networks sound quite idealistic when we look at the advantages of connectivity, community building, knowledge sharing, user control and lower censorship barrier, but some trade-offs and risks should be considered. For example, the lack of moderation can lead to challenges and risks that include cyberbullying, political misinformation and extreme responses culminating in criminal activity in some cases. Below, we list a few risks and challenges associated with decentralised social media use.

User data recovery: On federated social networks, users can create accounts without linking to real-world identities, like email addresses or phone numbers⁷⁶. Some decentralised networks rely on public-key cryptography for enhanced account security rather than relying on a single organisation to protect user data. While this is advantageous from a data security perspective, it presents challenges when we consider operations in the long run. For example, Steemit runs on Steem blockchain, where all users must keep their private key to log in and post, and if they lose their keys, they cannot recover their account or money. Also,

⁷¹ De-Google-ify Internet. Main Page. [Source](#). Accessed on: 27/07/2023.

⁷² PeerTube documentation. Moderate your instance. [Source](#). Accessed on: 27/07/2023.

⁷³ Steemit. (2018, 15 June). Terms of Service. [Source](#). Accessed on: 27/07/2023.

⁷⁴ Hive blog. (2020, 20 March). Terms of Service. [Source](#). Accessed on: 27/07/2023.

⁷⁵ Arimetrics. What is Fediverse. [Source](#). Accessed on: 27/07/2023.

⁷⁶ Blockchain magazine Blog. (2023, April 15). The Pros And Cons Of Decentralized Social Networks. [Source](#). Accessed on: 27/07/2023.

bootstrapped federated social networks may cease to exist for multiple reasons, such as a lack of funds, causing users to lose their data and connections. In such a scenario, users have no easy way of reconnecting and recovering their data since federated networks do not keep personal data records on servers. With respect to privacy, decentralised social media platforms do not necessarily encrypt data, resulting in the privacy⁷⁷ of users being compromised and private messages being visible to server administrators, who can use this information at their discretion.

Misinformation: In a federated network, no single group can dictate other groups' rules, giving users more control and lowering censorship barriers. Anyone can run their social media site without a central authority, meaning users can post anything they want without worrying about having their posts taken down. A downside of this structure is that people who want to spread misinformation or hate or to further their own agenda have the freedom to launch their own social media sites to spread fear and misinformation on many topics ranging from political statements to financial speculation to personal information sharing. While users can block such groups (sometimes even under the guidance of certain overarching authorities within the ecosystem, as is the case, for example, in Mastodon with Mastodon gGmbH), they cannot prevent them from engaging on the network.

Cyberbullying: Cyberbullying is a vulnerability that has not spared the decentralised social media platform and its users. It has been observed in multiple instances that administrators are vulnerable to harassment from users who do not like their decisions and to legal issues, subject to the jurisdiction of the location of the server instance. Moderation of content is dependent on instance operators to moderate content pertaining to their own instance, and also ban connections to other instances that they deem necessary to be banned – which may be due to such instances allowing/not stopping acts of cyberbullying. That said, when it comes to a user's ability to run their own instance, there is no other central authority that can moderate content and enforce rules, resulting in an environment where users are free to post whatever they want, regardless of the correctness or veracity of the content⁷⁸.

Legal compliance: Social media platforms have to adhere to the regulations of different jurisdictions where they want to operate and be accessible to their users. Legal compliance in incumbent Web 2.0 social media platforms is usually straightforward since the controlling commercial company behind the ecosystem can devise and implement a cross-border compliance strategy. But in the case of decentralised social media platforms, the responsibility of making the platform compliant, for it remain operational in different jurisdictions, must be taken up by the administrator or the owner of the server running the platform instance, who may be the same person in most cases. Looking at the case of Mastodon⁷⁹, we see that it relies on server administrators who bear more resemblance to internet service providers than normal users and, thereby, are responsible for keeping their servers compliant with copyright and privacy laws. Failure to do so makes them vulnerable to legal action.

A federated social media platform catering to users from a specific region can offer users of that region a higher level of compliance. Still, as the number of regions being covered by the platform increases, the quality of coverage decreases. And, once the platform is found not to be compliant with the region's laws, its operations can be restricted. This is an important reason why it has been observed that special-interest communities⁸⁰ or individual users may decide to use the same federated platform with a server location in their

⁷⁷ Forbes. (2022, November 22). Twitter Alternative Mastodon Has Security Issues. [Source](#). Accessed on: 27/07/2023.

⁷⁸ Cointelegraph. (2023, February 23). What are decentralized social networks? [Source](#). Accessed on: 27/07/2023.

⁷⁹ Wired. (2022, December 21). Mastodon Is Hurling Toward a Tipping Point. [Source](#). Accessed on: 27/07/2023.

⁸⁰ TechDispatch. (2022). Federated social media platforms. [Source](#). Accessed on: 27/07/2023.

region rather than covering multiple areas. In this way, they can engage in confidential communication with other users of the same platform without involving international data transfer laws and the associated risks.

Need for technical knowledge: Due to the technical complexity⁸¹ of setting up a decentralised social media server and continuing its operations, it becomes difficult for non-technical users to continue using decentralised social networks in the long term. This raises the concern of to what extent such platforms will be decentralised, or whether users will flock to a few centralised instances. Furthermore, user authentication often requires users to keep track of private keys – which may be a barrier to entry for some users. It is one of the major roadblocks to decentralised social media being adopted more.

2.3 Assessing the future potential

2.3.1 Tokenisation as a business model

Some decentralised social media platforms are based on a kind of platform economy. As opposed to simple company business models, a platform economy has many different roles and incentive mechanisms for each of these roles, motivating actors to participate on the platform actively⁸². The incentive mechanism can be monetary. However, it is important to note that in most cases there are no, or hardly any, monetisable elements either, which are based on different psychological factors (Zhang et al., 2009). This is true for decentralised social media, especially if blockchain and tokenisation support it. As a consequence, the business model of a platform economy can be best described by listing roles or actors (Ballon et al., 2008) and different monetised or non-monetised incentive mechanisms for these actors.

2.3.1.1 Roles and actors of decentralised social media

Platform investors: Platform investors usually finance the kick-off of decentralised social media. The investing period can be a centralised process as well. In decentralised systems, however, it is more common to base the platform economically on one or several tokens that are sold in a token sale pre-sales phase. There are examples as well where platform investors are actually the platform developers kicking off the system with non-monetisable motivations, like the Status communication app.

Infrastructure maintainers: Actors for maintaining the core infrastructure. The infrastructure might contain several components that work differently from an incentive point of view, like decentralised storage for storing small pieces of information, blockchain for tokenisation or cryptocurrencies, or even decentralised media servers. Maintaining an infrastructure component usually has a cost factor (in fiat currency), so most decentralised social media business models try to incentivise infrastructure maintainers in money or money like liquid assets, like a fully liquid platform token.

Content providers, contributors: Content providers provide multimedia content like text (tweets), pictures, audio, or video content. Content providers might or might not be financially incentivised. If the creation of the content can be realised with relatively low effort, like a tweet or a post, content providers might be motivated more by psychological factors. As an example, getting positive feedback for a post works on a deep psychological basis by activating neurotransmitters like dopamine. If the content creation requires more effort, like creating complex multimedia content, then usually there is the possibility for a monetisable incentive as

⁸¹ Flatline Agency. (2022). What is decentralized social media? Pros and Cons. [Source](#). Accessed on: 27/07/2023.

⁸² The Intactone. (2022). Difference between Platforms and Traditional Business Models. [Source](#). Accessed on: 27/07/2023.

well in the format of payment, which can be either fiat or a kind of a liquid fungible token, like the Only1⁸³ platform.

Content consumers: Content consumers are usually not directly incentivised financially. There are different models where consumers are motivated psychologically or by different badges or even by crypto badges or NFTs. Most social media platforms work based on a freemium model. There is, however, the possibility that content consumers explicitly pay for some ‘premium’ content.

Platform maintainers: Platform maintainers might have different roles, like administrators or power users. Platform maintainers might work with special governance tokens if the platform is truly decentralised. Maintainers are usually incentivised in a non-financial way, like with different non-liquid tokens.

Advertisers, app roles: Some decentralised social media platforms have additional roles and functionalities on top of the core layer. Examples are advertisers or even mini-apps with app-specific roles. They usually have different incentives.

2.3.1.2 Mechanisms

Considering incentive mechanisms, we can distinguish between classical and tokenised mechanisms. Classical incentive mechanisms cover direct financial or non-financial motivations for directly contributing to the platform. As most of the decentralised social media platforms have some connections with a blockchain protocol, incentive models based on advanced tokenisation are and will be more common. Tokens might play the following roles in the business model of a platform ([Euler, 2018](#)).

Crypto badges: These are non-transferable NFTs, working as a motivation to reach a goal, like top community contributors. An example of a badge comes from Kleoverse for contributing to the Ethereum Foundation⁸⁴. They are based strongly on psychological factors, like gamification, and are considered non-financial incentives.

NFTs (non-fungible tokens): These are classical, transferable NFTs ([Clark, 2022](#)). They work like crypto badges; however, in some situations, they are tradable and have direct financial value in another token or in crypto.

Non-tradable fungible tokens: These are local tokens that can be collected and used only for special purposes. Examples are collecting attention or experience on a platform. These tokens are not directly tradable but might be used to boost social attention for media content.

Local currencies: Some tokens can be traded and used for buying or exchanging other assets or services; however, only in a limited context, typically only inside the platform.

Platform tokens: These tokens play a role in maintaining the core infrastructure of the platform. This core infrastructure can be an underlying blockchain but a more complex decentralised infrastructure. For example, in decentralised Twitter-like Peepeth⁸⁵, a transaction fee must be paid in ether, a token of the underlying Ethereum platform.

⁸³ Only1. (2023, 12 June). Tokenomics at Only1: LIKE – the utility token of web3 social. Medium. [Source](#). Accessed on: 27/07/2023.

⁸⁴ Kleoverse. Organisation Contributor: Ethereum Foundation. [Source](#). Accessed on: 27/07/2023.

⁸⁵ Peepeth. A blockchain-powered social network for our best selves. [Source](#). Accessed on: 27/07/2023.

Tradable tokens: These tokens are freely tradable on cryptocurrency exchanges. They have the advantage of being fully liquid, implying a liquid financial incentive. On the other hand, however, this liquidity means that the token and the ecosystem are open to different market manipulations.

Investment tokens: These tokens are pre-sold at the kick-off of the platform for financing the coming development steps. Such tokens usually have other functionalities, like platform and tradable tokens.

2.3.1.3 Steemit as an example of a decentralised social media platform

Steemit has one of the most classical and well-documented decentralised social media business models. Steemit is a decentralised social media platform using strong tokenisation with its native decentralised infrastructure. It offers rewards for contributions in a transparent manner. On Steemit, the following tokens can be found, forming the basis of the business model⁸⁶:

Steem: The fundamental platform token of the decentralised system. It can be freely traded on different exchanges, and it can be used to purchase Steem Power or Steem Dollar.

Steem Dollar: Steem Dollar, or SBD, is a stable cryptocurrency pegged to the USD. Content creators and curators are paid in SBD when they create popular content. Popularity is measured by upvotes weighted by Steem Power.

Steem Power: A long-term investment token representing a user's influence in the Steemit ecosystem. Users with many tokens can have more upvotes in the system.

With tokenised decentralised social media business models, it is pretty much a question of which is sustainable in the long run, and which will be abandoned and collapse in a shorter period. Such analysis is more complex than on classical social media platforms due to the following reasons.

- Tokens are new innovative and programmed financial constructs. There is still insufficient experience in deciding which token inflation rate, token distribution, and token burn mechanisms are ideal for a decentralised social media platform.
- The psychological factors of tokens sometimes are not clear. It is not yet apparent how much a collectable NFT or fungible attention token can motivate a contribution to a social media platform.
- Web 3.0 is still difficult from a user experience point of view. Everyday users usually do not find it convenient to use non-custodial cryptocurrency or identity wallets for authentication and they are responsible for storing keys.
- Tokenisation is still difficult from a regulatory point of view.

2.3.2 Fediverse user experience research

Decentralised social media usage is not yet well widespread, which hampers detailed general user experience analysis. However, some preliminary food for thought follows. The primary hurdles faced by decentralised social media involve its comparatively smaller user community when compared with mainstream centralised social media and the idiosyncrasies associated with the decentralised nature of its network, where various hosts contribute to its infrastructure.

⁸⁶ Steemit. (2018, 18 September). *Token Economy – Steemit*. Medium. [Source](#). Accessed on: 27/07/2023.

Decentralised social media is not a completely distributed topology network without rules. Each decentralised social media has several servers, and each server is operated by an individual or a set of individuals who set their codes of conduct and rules. They can remove undesired content and accounts according to their terms of use that govern their server.

When comparing Twitter and Mastodon, Mastodon, while offering a distinct user experience from Twitter, remains approachable for users, including novices with limited technical expertise. Its interface shares similarities with Twitter, making it intuitive to navigate. Mastodon provides dedicated applications for both iOS and Android, ensuring accessibility across mobile devices. Additionally, there are several third-party apps available, each offering unique features. Some apps even provide the convenience of merging Twitter and Mastodon feeds, enabling users to view and manage both platforms simultaneously ([Swogger, 2023](#)).

[Jeong et al. \(2023\)](#) explored user behaviour migrating from Twitter to Mastodon. They concluded that Mastodon sets itself apart by strongly emphasising community-centred experiences, which stands in contrast to traditional platforms that often prioritise individual self-promotion or the creation of viral content aimed at capturing a wide audience. Mastodon fosters an environment that builds and nurtures communities, facilitates meaningful connections, and encourages genuine interactions rather than solely seeking widespread attention or personal promotion. The same authors also found that engaging in many Mastodon activities, diverse interactions and forming connections with individuals who previously followed the user on Twitter significantly influence users' motivation to remain active on Mastodon. These factors contribute to a compelling user experience and foster a sense of satisfaction and attachment to the platform.

When it comes to PeerTube, its instances may resemble conventional video platforms like YouTube in appearance. However, the operators of each instance have the freedom to customise the interface, features, and terms of use according to their preferences. For instance, many instances include tabs like Discovery, Trending and Recently Added, along with a search function for videos, channels, and playlists. Users can search for videos within their instances or across the federated network. Additionally, certain instances employ advanced (unofficial) plugins, such as earning cryptocurrencies by engaging with videos. These customisable elements contribute to the diversity and unique experiences found within different PeerTube instances.

Within the PeerTube ecosystem, instances often provide explicit information about the functions they offer and the terms of use that govern their platforms. These functions can vary, including the availability of registering new accounts. Some instances foster interactive environments, allowing users to upload and comment on videos. In contrast, others use PeerTube as a personal video library, focusing on hosting their content while aiming to establish a network of smaller, independently managed instances. This diversity in functionality and objectives allows for various experiences and approaches within the PeerTube community.

Instances in the PeerTube federated network can follow one another, enabling the display of videos from a followed instance directly on the follower's instance. This allows users to view videos from other instances without navigating to different websites. However, it is important to note that requests to follow an instance are not automatically accepted and require approval from the instance being followed. Once the following request is accepted, videos from the following instance become accessible on the follower's instance. The video files remain hosted on the server of the following instance, while users from various instances can comment on them. This means that viewers on one instance can engage with and comment on videos hosted on another federated instance without the need to switch platforms. Similarly, users can subscribe to channels through their local account or via an account on a federated instance, further enhancing the interconnected nature of the PeerTube network.

While [Gerster et al. \(2023\)](#) highlight the capabilities of the usage of decentralised social media, such as PeerTube by extremist groups, [Chen et al. \(2023\)](#) analyse the relationship between censorship, self-

copyright and anti-copyright, and potential ways of democratising social media. [Gehl and Zulli \(2022\)](#) analyse non-centralised platform governance functions in the Mastodon social network and highlight new methods of platform governance that go beyond the corporate and alt-right dichotomy.

[Caelin \(2022\)](#) discusses how moderators, activists, and developers within several fediverse tools have leveraged moderation tools, implemented representative codes of conduct and exhibited substantial organisational efforts to foster healthy online environments. These dedicated individuals work together to ensure the fediverse remains a space where positive interactions thrive. By employing effective moderation tools, they can address and mitigate issues that may arise within their respective communities. Additionally, implementing well-defined codes of conduct helps set clear expectations for user behaviour and fosters an inclusive and respectful atmosphere. Through collaborative efforts and a strong sense of organisation, these individuals actively promote and maintain healthy online spaces within the fediverse.

3 Decentralised Social Media: Study on Public Awareness

3.1 Purpose, scope, and methodology

Our survey aimed to assess public awareness, familiarity, experience, and potential use regarding federated/fediverse social networks, allowing the EUBOF3.0 team to gather and disseminate insights on concerns and facilitators for adopting decentralised social media platforms.

The survey was designed on the basis of three blocks of questions, considering participants' (1) awareness and familiarity with fediverse social media, (2) experience (if any), and (3) aspects of potential use, including potential improvements and barriers to adoption. More specifically, the blocks assessed the following.

- **Awareness and familiarity** assessed participants' awareness of federated/decentralised social media platforms and their preliminary understanding of these concepts. This block also explored the importance of data privacy and ownership when using social media platforms.
- **Experience** mainly addressed participants who have tried using a decentralised social network via assessing the platforms they have used and asking them to rate their overall experience compared to mainstream platforms.
- **Potential use** sought insights regarding participants' beliefs about the potential of federated social networks, including the aspect of it being a democratic alternative to centralised platforms, facilitators for regular use of such networks, and the concerns that might prevent or slow down the adoption.

The survey included several types of questions to gather various aspects of decentralised social media awareness and experience. Specifically, we used:

- *closed-ended questions* (e.g., yes/no, etc.) and often included additional options (e.g., 'not sure', 'yes, some of them', and 'yes, all of them', etc.) to better understand the experiences of the participants;
- *Likert scale questions* aiming to rate participants' familiarity and experiences on a scale from 1 to 5, allowing them to move the slider and defining the extremes (e.g., 1 - not familiar at all, 5 - very familiar);
- *multiple choice questions* offering key expected replies based on the in-depth research and preparation of the EUBOF3.0 team for the survey; and
- *open-ended questions* allowing respondents to express additional aspects if not listed or when seeking an unbiased opinion (by the multiple choice options) when necessary.

The survey was disseminated using EUSurvey⁸⁷, an online survey management system built for the creation and publishing of globally accessible forms and supported by the European Commission's DEP-Interoperability programme and was made accessible for over a month through June and July 2023.

The survey was anonymous; hence, no personal information was assessed or collected. However, the participants were asked to accept the terms when submitting the survey, confirming their agreement for their responses to be processed for the purpose of the analysis made available in this report.

⁸⁷ EU Survey. Decentralised social media questionnaire. [Source](#).

3.1.1 Survey

Awareness and familiarity

1. Have you heard of federated (or fediverse) social networks or decentralised social media platforms? (Yes/No)
2. How would you rate your familiarity with the concept of federated (or fediverse) social networks on a scale of 1 to 5? (1 - being not familiar at all, 5 - being very familiar)
3. Have you heard of platforms such as diaspora*, Mastodon, Pleroma, Pixelfed, PeerTube, GNU social, Friendica, etc.? (Yes, all of them/Yes, some of them/No)
4. How important are data privacy and ownership to you when using social media platforms on a scale of 1 to 5? (1 - being not important at all, 5 - being very important)

Experience

5. Have you tried using a federated social network instead of or along with mainstream centralised platforms (e.g., Facebook, Instagram, Twitter, etc.)? (Yes/No)

If no, no further questions are required. If yes, the following questions are available:

6. Which platforms did you try? (*Multiple choices*)

- a) diaspora*
- b) Mastodon
- c) Pleroma
- d) Pixelfed
- e) PeerTube
- f) GNU social
- g) Friendica
- h) Other (please specify)

7. If you have used a federated social network, please rate your overall experience compared to centralised platforms on a scale of 1 to 5 (1 - being poor, 5 - being excellent).

8. What features or functionalities do you appreciate most about federated social networks? (*Open question*)

9. Are there any specific improvements or enhancements you would like to see in federated social networks to make them more appealing and accessible to a wider audience? (*Open question*)

10. Would you recommend a federated social network to your friends or acquaintances? (Yes/No/Not Sure)

Potential use

11. Do you believe that federated social networks have the potential to offer a more democratic and decentralised alternative to centralised platforms? (Yes/No)

12. What factors would motivate you to switch to or regularly use a federated social network? *(Multiple choices)*

- a) Increased data privacy and ownership
- b) Control over content moderation policies
- c) Interoperability with other platforms and instances
- d) Resilience against censorship and outages
- e) Other (please specify)

13. What concerns would prevent you from using a federated social network? *(Multiple choices)*

- a) Lack of familiarity with the platforms and how they work
- b) Limited user base and fewer connections compared to mainstream platforms
- c) Uncertainty about content moderation and potential exposure to harmful or illegal content
- d) Perceived technical complexities in using federated social networks
- e) Other (please specify)

3.2 Results and insights

3.2.1 Awareness and familiarity

In total, we received 72 responses to the survey, with nearly 60% of the participants having heard about decentralised/fediverse social media (Figure 5). However, only about 82% of all participants responded to the question about familiarity with fediverse social media platforms. Of these responders, 66% were not familiar at all. Of the participants who did not answer the question about familiarity, nine had heard about decentralised social media, and two had not. One might try to attribute the limited responsiveness due to limited awareness in general and, as a result, skipped question. Another aspect could be terminology, as such platforms are sometimes called decentralised or federative or fediverse. This might add some complexity when assessing familiarity.

In one of the questions, we listed a few better known platforms (e.g., diaspora*, Mastodon, Pleroma, Pixelfed, PeerTube, GNU social and Friendica) and asked if the participants had heard about them. The intention behind the question was to assess if participants might have heard about such tools without knowing they are decentralised. The results split exactly 50/50 between those who had heard and those who had not (Figure 6). Combining and comparing the results with the first question (if the participants had heard about decentralised social media in general), we noticed the following interesting finding:

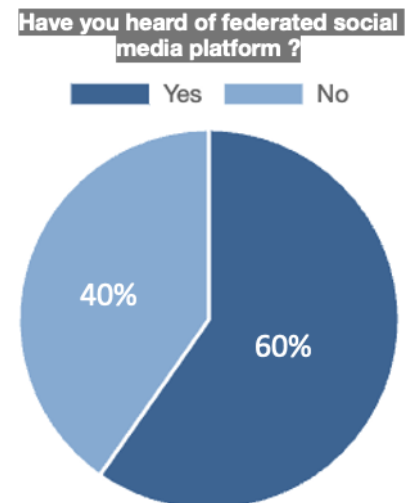


Figure 5: Participants' familiarity with decentralised social media

- Participants who had not heard about decentralised social media knew some well-known fediverse platforms (7% of all responders).
- Participants who had heard about decentralised social media did not know any of the listed best known fediverse platforms (19% of all responders).

As elaborated above, the terminology, as well as the positioning and advertising of federated social media platforms, might contribute to such findings. Another explanation could be the propensity to acknowledge that they had heard of technology solutions while not being sure enough to be able to contribute to the survey.

About 92% of all participants shared their perception of the importance of data privacy and ownership when using social media platforms. For the vast majority (91%), privacy and ownership are (very) important. Interestingly, about 14% of respondents value such aspects and have heard about decentralised social media and its better known platforms but have never used them. This can potentially be explained by a lack of public awareness of the benefits such platforms might provide.

Have you heard of platforms such as Diaspora, Mastodon, Pleroma, Pixelfed, Peertube, GNU social, Friendica, etc.?

■ Yes, all of them
 ■ Yes, some of them ■ No

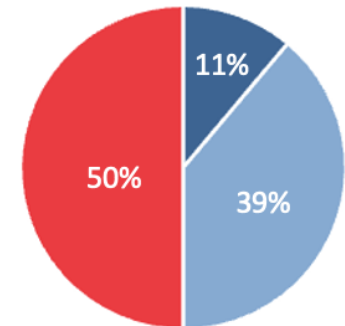


Figure 6: Participants' familiarity with most famous decentralised social media platforms

3.2.2 Experience

Seventy-four per cent of respondents had never tried decentralised social media. Of those participants who had tried (26%), the most popular reported platforms are Mastodon (79%), diaspora* (26%) and PeerTube (26%). Nearly half of the respondents (47%) had tried more than one decentralised social media platform (Figure 7).

■ Diaspora ■ Mastodon ■ Pixelfed ■ Peertube
 ■ GNU social ■ Friendica

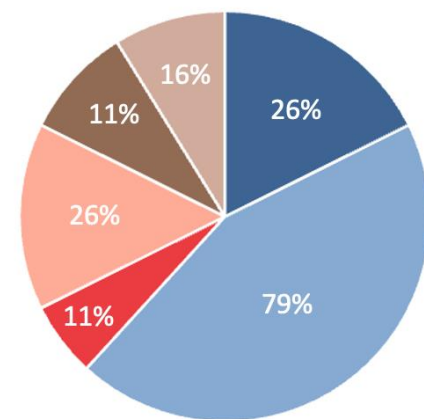


Figure 7: Most popular decentralised social media platforms tried among survey respondents

Sixty-three per cent of users would recommend such platforms to their friends, while the rest were either not sure or certainly would not.

Among the features and functionalities the users appreciate most about federated social networks, the following aspects were mostly emphasised:

- decentralisation (and alternatives to centralised approaches);
- enhanced privacy;
- control of content moderation and no spam;
- higher level of openness and democracy compared to the centralised platforms;
- no bots, no spam, integration with Web 3/NFTs/non-custodial wallets; and
- interoperability with other apps.

All users (100%) shared their belief that fediverse social networks have the potential to offer a more democratic and decentralised alternative to centralised platforms.

However, users also identified the main pain points where most improvement is required, including:

- improved user experience (UX) and more variability of services based on different user profiles;
- promotion to increase its adoption and user base; and
- integrating decentralised social media into the economy based on cryptocurrencies and crypto assets.

3.2.3 Potential use

Seventy-nine per cent of respondents with experience favoured increased data privacy and ownership to motivate use, then interoperability (58%), and resilience against censorship and outages (53%). Those respondents without previous experience of fediverse social media also mainly favoured privacy and data ownership (74%), followed by control over moderation (49%) (Figure 8).

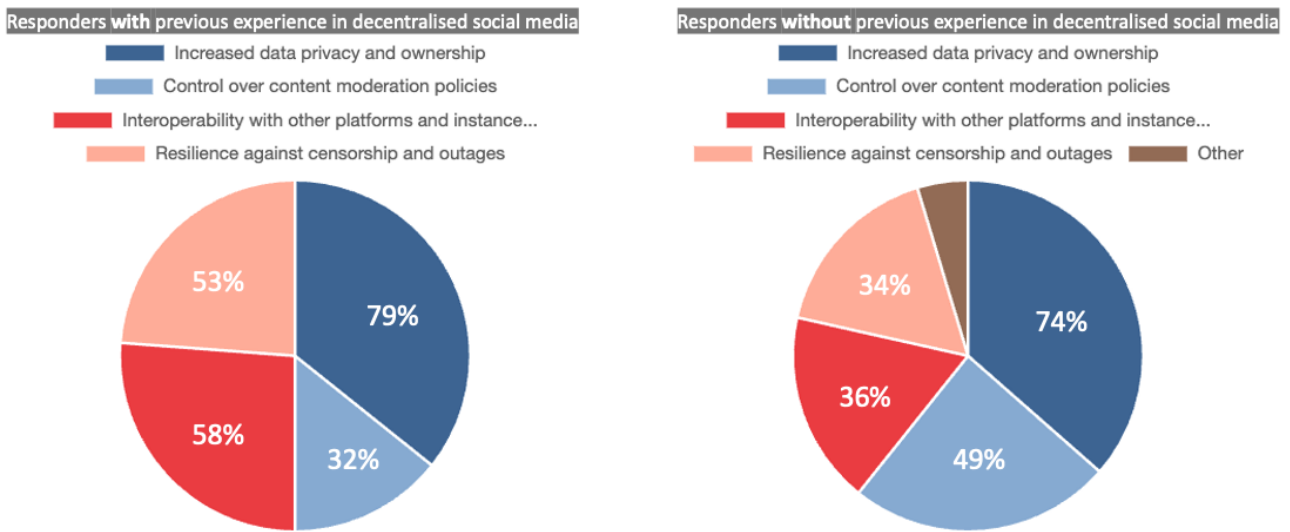
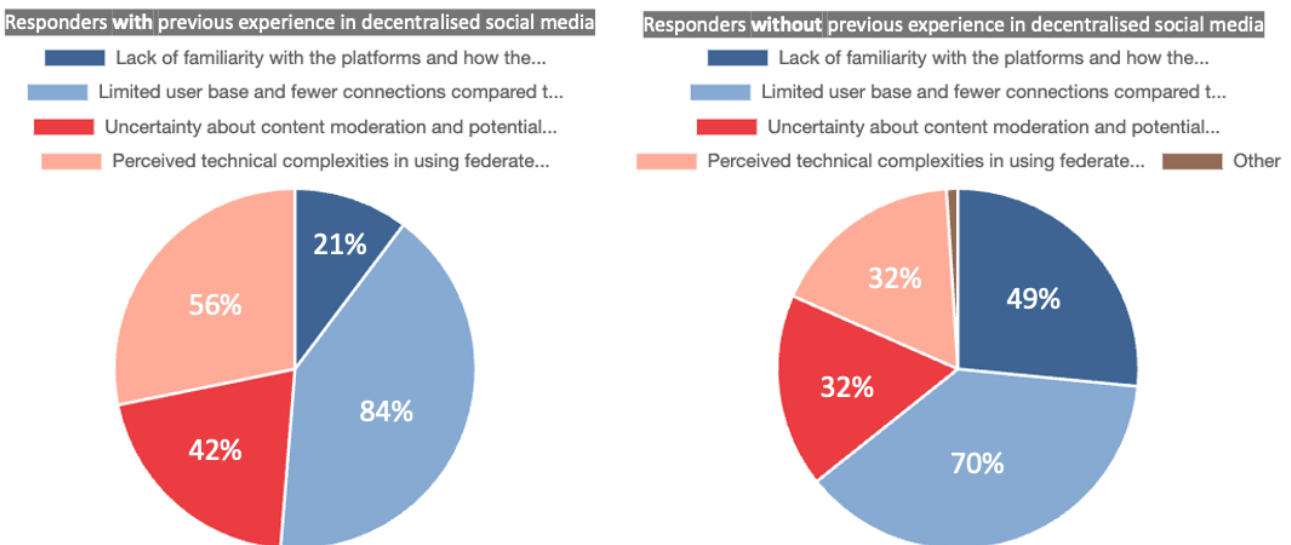


Figure 8: Reasons to use decentralised social media: users with previous experience (left) and without (right)

As regards barriers to adoption, those respondents who had tried decentralised social media solutions considered the limited user base (84%) a major drawback as well as perceived technical complexities in using



federated social networks (58%). Non-user respondents reported the limited user base (70%) and lack of familiarity in general (49%) (Figure 9).

Figure 9: Barriers to decentralised social media adoption: users with previous experience (left) and without (right)

This leads us to the conclusion that if decentralised solutions were advertised emphasising the strong aspects that many users might value (e.g., increased privacy, etc.) and were more understandable from the new user perspective, and offered a similar (or at least larger than at present) size of community, decentralised solutions have every chance of being adopted more widely.

4 Concluding Remarks

In recent years, social media platforms have undergone continuous evolution, mirroring the development of web technologies. As the development of Web 3.0 approaches, new paradigms for social media are set to shape the future of the internet. The core concept of social media platforms lies in facilitating communication between users. These platforms serve as the means for social networking, bookmarking, social news, media sharing, microblogging, and blogs and forums. Notably, the emergence of decentralised social media in 2007 marked a shift towards democratic alternatives, with options like federated and P2P platforms gaining traction. As Europe embraces the movement, several platforms like Mastodon and PeerTube have established official channels, garnering public attention.

This report delves into the technological underpinnings of both traditional and decentralised social media platforms. The definition of decentralisation is not binary: platforms may exhibit varying degrees of centralisation in different aspects. Traditional social media platforms have predominantly been centralised, while decentralised platforms seek to decentralise various aspects while acknowledging the existence of certain points of centralisation. Approaches to decentralisation differ between projects that draw from the free software movement and those incorporating blockchain solutions. The former focuses on democratisation and open digital spaces, while the latter emphasises user empowerment and robust digital rights. As such, these categorisations are not solely based on technological underpinnings but rather reflect the diverse philosophies within their respective communities. Projects influenced by the free software tradition, such as diaspora*, Pleroma, Mastodon, GNU social, PeerTube, Friendica and Pixelfed, prioritise decentralisation through the libertarian ethos of open and interoperable digital spaces, emphasising democratisation of user participation. In contrast, blockchain-based social media projects like Steemit, Hive and the Lens Protocol focus on user empowerment by creating strong monetisation incentives for user-generated content and robust digital rights over user identities and input.

Specifically, one area of interest is the implementation of tokenised business models, where various combinations of monetised and non-monetised elements are being explored. Identifying the most successful and sustainable combinations for future exploitation is an ongoing challenge that awaits resolution. Moreover, the robustly decentralised nature of these platforms presents another difficulty. While attempts are being made to create regulatory frameworks for decentralised platforms, like the MiCA (Market in Crypto Asset) regulation, these attempts are at a relatively early stage, and will take time to grow in terms of definition and maturity.

The decentralisation of social media applications undoubtedly alters power distribution within digital ecosystems. However, it is crucial to acknowledge that new power architectures can still emerge despite decentralisation. Both free software and blockchain-based decentralised social media architectures exhibit power concentration at various levels, such as individual servers and overarching foundations. Examples like diaspora*, Pleroma, Mastodon, GNU social, PeerTube, Friendica, and Pixelfed demonstrate power

concentration within the free software approach. Similarly, blockchain-based platforms have overarching authorities within native blockchains supporting social media projects. While decentralised social media can be subject to regulation, it should not solely rely on hard governmental regulations. Instead, a mix of self-regulatory modalities (individual server terms and conditions) and traditional secondary EU law rules like the DSA can facilitate a balanced regulatory landscape. Freedom of expression and content moderation remain critical regulatory concerns in decentralised digital ecosystems. These platforms allow user-generated content and cross-platform interactions, contributing to the broader discussion on freedom of expression and content moderation in digital spaces. Although decentralised social media relies less on centralised controlling authorities, there still exists some overarching authority. Generalised and universally applicable content moderation and user participation covenants are already in practice.

Although the adoption of decentralised social media applications has not reached massive levels, it is evident that user awareness and migration from centralised to decentralised platforms are noteworthy. Decentralised social media has firmly established itself as a legitimate and valid alternative to the heavily centralised incumbent social media landscape. As these platforms mature, their appeal and user base are likely to grow, further reinforcing their credibility as a viable option in the digital space.

Following our exploration of various decentralisation approaches within this report, we also provided an overview of key differences between traditional centralised social media platforms and proposed decentralised social media platforms. These differences were highlighted across critical aspects, including data storage, content discovery and distribution, identity control and verification, governance and moderation, revenue models and network topologies. All in all, decentralised social media platforms present users with many benefits, offering greater control over their data, enhanced privacy, heightened security, reduced censorship, and increased freedom to express their views openly. This decentralised model empowers users and fosters a more democratic digital space.

However, with these advantages come inherent vulnerabilities that users must be mindful of. Concerns such as the spread of misinformation, cyberbullying and potential compliance issues are areas that users need to be aware of before sharing sensitive or private information on these platforms. Despite substantial advancements in decentralised social media over the last few years, there is still a considerable journey ahead to potential transition towards new environments from existing centralised platforms. Innovations in security measures, content moderation tools and user-friendly interfaces will be pivotal in making decentralised social media a viable and attractive alternative, ultimately achieving a more balanced risk-to-reward equation for users.

In conclusion, decentralised social media is currently in the early stages of its technology life cycle, characterised by a plethora of experimental initiatives. While promising, the long-term success of these applications remains uncertain.

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Annex – Overview of decentralised social media platforms

<i>Platform Name</i>	<i>Founded</i>	<i>Active (Y/N)</i>	<i>Type of DeSo</i>	<i>Social Media Categories</i>	<i>Description</i>
GNU social	2007	Yes	Federated	Social networking	The platform is the continuation of the StatusNet project and allows public and private communications. The version 0.9 published in 2010 was compatible with OStatus allowing blogging capabilities.
identi.ca	2008	No	Federated	Social networking	identi.ca was an open-source social network based on pump.io selected by its creator Evan Prodromou. The site is closed for new registration.
FreedomBox	2010	Yes	Federated	Social networking	FreedomBox allows for personalised servers based on Debian packages launched in 2010 by Prof. Eben Moglen. It is regarded as a home server operating system for the web.
diaspora*	2010	Yes	Federated	Social networking	diaspora* is a distributed network with independent nodes named as pods. The network is not owned by a single entity.
Friendica	2010	Yes	Federated	Microblogging	Friendica is a communication platform integrating social communication. The message exchange is supported by ActivityPub and extends to other platforms using the same protocol.
Minds	2011	Yes	Blockchain	Social networking	Minds is an open-source and distributed social network. Users earn MINDS tokens for contributing on the network. The app was launched in 2015 and the blockchain was introduced with an ERC-20 token in 2018.
Eris	2014	No	Blockchain	Blog & forum	Eris was a platform like Reddit that failed in 2014, built on Ethereum. It failed due to both technological and legal reasons.
Secure Scuttlebutt (SSB)	2014	Yes	Peer-to-peer	Social networking	Secure Scuttlebutt provides communication and social network capabilities via self-hosting.
Matrix	2014	Yes	Federated	Social networking	Matrix is an open-source protocol for communication. It is parallelised with mailing services.
Mastodon	2016	Yes	Federated	Microblogging	Mastodon is free and open-source software for self-hosting social networking services.
Steemit	2016	Yes	Blockchain	Microblogging	Steemit is a platform based on Steem blockchain allowing users to gain STEEM tokens for their activity in the platform. Essentially, Steemit is a DApp encouraging users to curate the application. The platform is similar to Reddit.
Briar	2016	Yes	Peer-to-peer	Blog & forum	Briar is a decentralised messaging app for discussing any topic. There is an absence of reliance on a central server as it encrypts and synchronises messages between the users.
Solid	2016	Yes	Federated	Media sharing	Solid is an abbreviation of 'Social Linked Data' and is a project led by the inventor of the World Wide Web (Sir Tim Berners-Lee) originating from MIT. The project's benefits range from pods to decentralise data storage.

<i>Platform Name</i>	<i>Founded</i>	<i>Active (Y/N)</i>	<i>Type of DeSo</i>	<i>Social Media Categories</i>	<i>Description</i>
Gab	2016	Yes	Federated	Microblogging	Gab is a social media platform and is parallelised with Twitter. In 2019, the infrastructure forked Mastodon for its application. This is one of the most controversial platforms due to its content.
Ecency	2016	Yes	Blockchain	Microblogging	Ecency was previously known as Esteem operating as a mobile application in 2016. The platform uses the Hive Blockchain for storing data and developing a reward mechanism with tokens.
Pleroma	2016	Yes	Federated	Social networking	Pleroma is an open-source distribution for self-hosted social networks similar to Mastodon. The platform uses ActivityPub, making it a part of the Fediverse. The platform functionalities include microblogging apart from the social networking aspect.
Dtube	2017	Yes	Blockchain	Media sharing	DTube is an amalgamation of decentralised tube for the DApp built on Avalon blockchain. Videos are stored on IPFS to resist censorship. User participation is encouraged via rewards in DTube Coin (DTC).
Status	2017	Yes	Blockchain	Social networking	Status is a messaging web and mobile application relying on Ethereum. It is a DApp for encrypted messages. The project has its native token in Status Network Token (SNT).
DLive	2017	Yes	Blockchain	Media sharing	DLive is a live streaming platform using blockchain for donations. The platform has used initially Steemit, briefly operated in Lino network and finally moved to TRON after the BitTorrent's purchase.
Peepeth	2018	Yes	Blockchain	Microblogging	A platform is censorship resistant by using Ethereum blockchain and IPFS. Users' posts cannot be changed or deleted after their publication. There are no ads involved in the network.
Pixelfed	2018	Yes	Blockchain	Media sharing	Pixelfed is an image sharing social network based on open-source distribution. It is part of the fediverse as the ActivityPub protocol is used for communication.
PeerTube	2018	Yes	Peer-to-peer	Media sharing	PeerTube is a P2P platform for viewing videos. It is part of the fediverse since ActivityPub is used for the platform.
PeakD	2018	Yes	Blockchain	Microblogging	PeakD started in 2018 as a project and launched in 2020. The platform uses the Hive Blockchain for permitting users to control their data and earn rewards.
Hive	2019	Yes	Federated	Microblogging	Hive is a mobile platform and was the platform gathering the most attention during Twitter's acquisition in 2022.

Platform Name	Founded	Active (Y/N)	Type of DeSo	Social Media Categories	Description
Aether	2019	Yes	Peer-to-peer	Social networking	Aether is an application allowing for handling communities with self-moderation and mostly compared to Reddit. The application offers various services (chat, threads, newsletters, moderation, emails) via a P2P architecture.
Lemmy	2019	Yes	Federated	Blog & forum	Lemmy is an open-source distribution for creating forums and discussions moderated by policies by the user hosting the instance. ActivityPub is part of the technical stack of the distribution allowing the connection to other platforms.
Mirror	2020	Yes	Blockchain	News	Mirror is a publishing platform for writers to benefit from blockchain. The protocol uses Ethereum for tokenising articles, Optimism for transacting and Arweave for decentralised storage. It allows for community support to authors with tips, NFT auctions and crowdfunding.
Odysee	2020	Yes	Blockchain	Media sharing	Odysee is a platform for video sharing similar to YouTube based on the LBRY protocol. The application created by the LBRY team has one of the bigger user bases. Creators can earn tokens while not fearing censorship.
Dialect	2021	Yes	Blockchain	Social networking	Dialect is an application launched on the Solana network to allow messaging between digital wallets. Essentially, the application is a blockchain-based mobile messaging and notification tool.
Bluesky	2021	Yes	Peer-to-peer	Microblogging	BlueSky is a platform similar to Twitter aiming to use P2P architecture for decentralisation. In 2022, the project unveiled its open-source code.
MAIN community	2021	Yes	Blockchain	Microblogging	MAIN is a decentralised social media partially operated and owned by its users. The platform uses Ethereum and Binance chains. The tokenomics use two tokens for creating an economy on the platform, MAIN and Board coins.
Farcaster	2021	Yes	Blockchain	Social networking	Farcaster is an open-source distribution for developing social networks. Essentially, it abstracts the need for developers to handle data storage and user identities. It uses blockchain for mapping identifiers to key pairs via smart contracts.
Damus	2022	Yes (Testbed)	Blockchain	Microblogging	Damus is the entity behind an application similar to Twitter and based on Nostr. The application is available for mobile in Android as Amethyst and Apple as Damus.
Lens Protocol	2022	Yes	Blockchain	Social networking	It is a Web 3 social graph on Polygon that is introduced as a permissionless, non-custodial social media profile. Different applications are available on the network. The uniqueness of the network is based on NFTs and modularity.
Lenster	2022	Yes	Blockchain	Microblogging	Lenster is built with the Lens Protocol for building a permissionless platform.

Platform Name	Founded	Active (Y/N)	Type of DeSo	Social Media Categories	Description
Momoka	2023	Yes	Blockchain	media sharing	Momoka introduced by the Lens Protocol for hyperscaling data availability in 2023. Momoka is an Optimistic Layer 3 scaling solution taking transactions away from Polygon (L2).
P92		Yes (Developing)	Blockchain	Microblogging	Meta's project researching the development of a text-based platform that uses ActivityPub, a decentralised social networking protocol of Mastodon.