HIVEMIND

The Case for Decentralization in Blockchain and Technology

A Historical and Comparative Look at Decentralization Across Major Blockchain Networks

BY RICHARD SKEET | MANAGING PARTNER

Decentralization means there is no single controlling party; control is distributed across independent actors. The term and its implications have a profound impact on both technology and society.

A practical test: if there is no single 'kill switch' that can disable the system, it is meaningfully decentralized. History shows a pendulum swinging between periods of centralization and decentralization. Scholars note that over millennia, empires and states have continually cycled between concentrating power and diffusing it. In computing, too, we've gone from centralized mainframes to decentralized personal computers, back to centralized cloud servers, and now toward distributed networks again. Today, this age-old cycle has come to the forefront: the world is grappling with eroding trust in institutions, rising authoritarianism, and giant tech platforms controlling information. After decades of increasing centralization in finance, data, and governance, the case for decentralization matters more now than ever.

In this context, decentralization is not a buzzword; it is a design response to declining institutional trust. For many it serves as a method of pushback against centralized authority and a way to reclaim self-sovereignty, resilience, and freedom in our lives. As we'll explore, blockchain technology emerged as a direct response to these needs, aiming to decentralize trust and authority. The journey of Bitcoin and other projects shows how decentralization can be both challenging and essential. We can understand why valuing decentralization is critical by looking at the trade-offs between centralization and decentralization and examining how various blockchain networks balance these trade-offs.

Ultimately, decentralization is about aligning technology with the social values of trust, freedom of speech, and the provenance of truth. Without it, those values weaken. This article offers a contemplative but assertive defense of decentralization – why it's worth the effort even when it's less efficient – and why that principle is key to our future.

Why Blockchain Exists

Blockchain technology wasn't invented to be a faster database or a more efficient computer network – it's usually the opposite. Blockchains trade efficiency for robustness: redundancy, verifiability, and fault tolerance. Their value proposition is trust minimization, not raw throughput.

A blockchain makes sense only when you need a system with no single point of control or failure. If a traditional centralized service can do the job, it will do it cheaper and faster. As one blockchain expert bluntly put it, "If you are a centralized service, a blockchain doesn't get you anything that you can't do a thousand times cheaper with a centralized database." In other words, using blockchain for something that doesn't require decentralization is like using a cargo ship to row across a pond.

The reason blockchain exists is to enable trust without trusting any single party. It's a solution for situations where we can't (or don't want to) rely on a central authority to keep records accurate or to enforce rules fairly. By spreading data across a peer-to-peer network of computers (nodes), blockchain removes the single point of failure that plagues centralized systems. No one person or company can unilaterally alter records, censor transactions, or suddenly go offline and take the whole network with them (No Single Point of Failure Exists With Blockchain Technology). This makes blockchains harder to corrupt and more resilient.

The reason blockchain exists is to enable trust without trusting any single party. It's a solution for situations where we can't (or don't want to) rely on a central authority to keep records accurate or to enforce rules fairly.

The flip side is that blockchains are inherently less efficient. Every node has to process every transaction and store every piece of data, which is redundant by design. We accept that inefficiency as the price for trust minimization. A helpful way to think about it: blockchains trade performance for decentralization.

They shine in scenarios where having a neutral, tamper-proof record matters more than raw speed.

Money is a classic example of one such scenario. Bitcoin was born in 2009 during a crisis of faith in centralized finance, emblazoned with a message in its first block about bank bailouts. Its creator designed it specifically to be "a peer-to-peer electronic cash system" with no bank or government in charge. That only made sense because people wanted a form of money that no single authority could debase or freeze. Likewise, many blockchain projects today explicitly choose worse performance because the problems they are attempting to address (e.g. financial trust, censorship, data integrity) require decentralization.

In summary, blockchain exists as a remedy for centralized points of failure. It is often the worse technical solution except in those crucial cases where removing central control is worth every inefficiency. When the goal is to ensure that no one can cheat the system, shut it down, or control it arbitrarily, that's when a blockchain (and decentralization) becomes not just useful but transformative.

If you take anything away from this article, take the three core tenets of blockchain:

> **Decentralization** - Instead of relying on a central authority or intermediary, blockchain distributes control across a network of participants. No single entity controls the system, making it resistant to censorship and single points of failure.

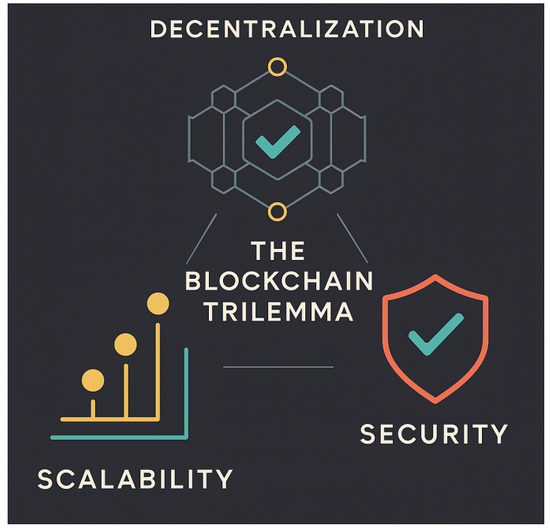
> **Transparency** - All transactions and data on the blockchain are visible to network participants. The ledger is open and auditable, allowing anyone to verify the system's history and current state.

> **Immutability** - Once data is recorded in a block and confirmed by the network, it becomes extremely difficult to alter or delete. This creates a permanent, tamper-resistant record of all transactions and changes.

These three principles work together to create a trustless system where participants can transact and share data without needing to trust each other or a central authority, relying instead on cryptographic proof and network consensus.

Centralization vs. Decentralization: Speed, Efficiency, and Control

Centralization and decentralization represent a fundamental trade-off in system design. Centralization concentrates decision-making and operation in one entity or a small group. This often makes things faster and more efficient. Decisions can be made quickly; services can be optimized under one roof. Think of a traditional bank or credit provider: it processes transactions on its servers, so it can be very fast and handle massive volumes – but you must trust the bank entirely. Decentralization, on the other hand, distributes those functions across many independent participants. This typically makes processes slower or more complex, but it yields greater resilience and fairness. No single participant can dictate outcomes, and the system can survive the loss of any one node.



A useful concept here is the "blockchain trilemma." It suggests that a decentralized network can't maximize decentralization, security, and scalability

(speed/capacity) all at once – improve one, and you likely impair one of the others. For example, a highly decentralized network – many nodes all over the world – might be very secure against attacks and collusion, but it could be relatively slow and resource-heavy as every node must reach consensus, which takes time. Conversely, a highly scalable network – processing thousands of transactions per second – often achieves that by being more centralized – perhaps using only a few powerful servers – which can weaken security if those servers are compromised. Real-world blockchain platforms make different trade offs along this spectrum.

Centralized systems excel in speed and efficiency. They have lower latency (information doesn't need to propagate through many nodes) and higher throughput (no need to wait for global consensus). This is why, say, Visa's centralized payment network can handle tens of thousands of transactions per second, whereas Bitcoin at the base layer handles roughly 7 TPS. But with that speed comes a single point of control – Visa can censor or reverse transactions, and an outage at Visa can halt payments for millions.

Decentralized systems prioritize trust and robustness. They ensure no single failure or authority can compromise the whole, vital for things like censorship resistance (no one can block you from using Bitcoin if you follow the rules) and for transparency (anyone can verify the blockchain's history themselves). However, participants in a decentralized network must do more work: each transaction might be verified by hundreds or thousands of nodes, not just one server. This redundancy is costly. As one analysis put it, a blockchain must perform many more operations than a centralized database for the same task – writing data and checking it repeatedly – so the overhead is substantial. Thus, decentralization sacrifices some efficiency to gain fault tolerance and trustworthiness.

A balanced perspective recognizes that neither extreme is "one-size-fits-all." Centralization isn't evil by definition – in fact, for many applications, centralization is excellent and more practical. But decentralization offers a compelling advantage when the stakes involve broad social trust, potential abuse of power, or critical resilience. A decentralized social network, for instance, might be slower in removing harmful content, but it is also harder for any one government or CEO to silence speech across the entire network. In a time when concerns about surveillance, censorship, and systemic fragility are growing, these trade-offs are not abstract: they directly impact our lives. The speed and convenience of centralization are attractive, but they can be used to limit or prevent access, and they become liabilities if a single point of failure crashes.

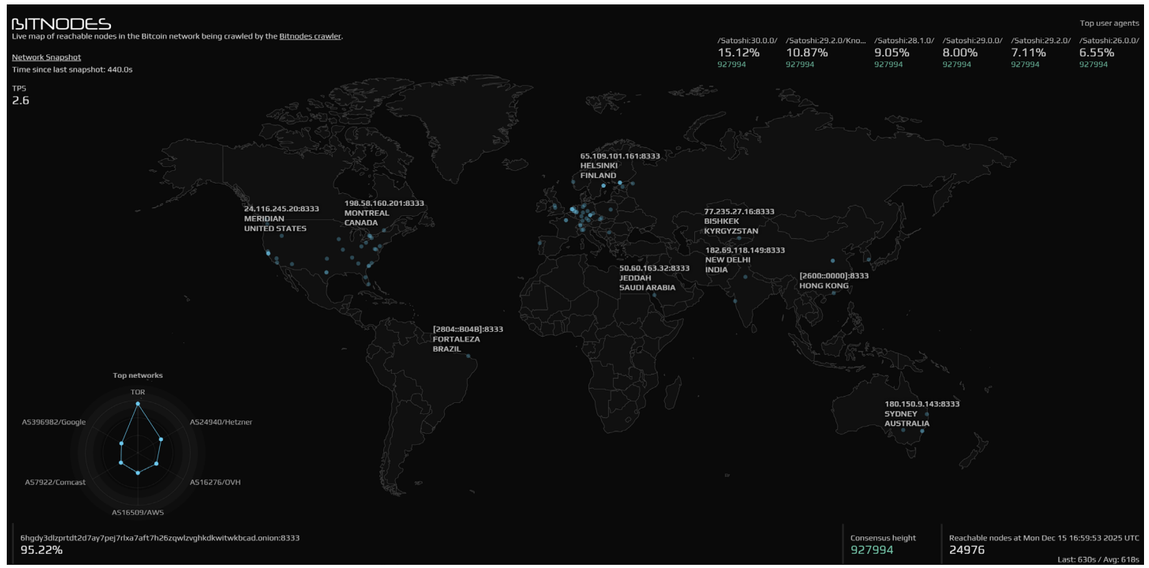
Decentralization asks us to accept a bit more complexity and perhaps slower speed in return for systems that are fairer and don't fall apart when one piece fails. In the end, it's a question of priorities: does one value maximum efficiency, or does one value a system that aligns with our ideals of trust and autonomy? Blockchain technology stakes a claim on the latter, arguing that we should tolerate less efficiency for specific domains where trust minimization has profound benefits.

Decentralization in Action: Comparing Blockchain Platforms

Not all blockchains are created equal in terms of decentralization. Each network makes design choices that place it at a different point on the decentralization spectrum. By comparing a few prominent examples, we can see how they navigate the trade-offs of speed, hardware requirements, governance, and security. Below, we look at how several well-known blockchain platforms approach decentralization – from the maximally decentralized Bitcoin to newer networks like Sui and Plume – and what that means for their performance and trust models.

Bitcoin and Ethereum: Pillars of Decentralization

Bitcoin is often held up as the gold standard of decentralization. It was the first blockchain and remains the most decentralized in terms of governance and network distribution. Tens of thousands of nodes worldwide run the Bitcoin software, and anyone with an internet connection



Global Bitcoin Full-Node Distribution Map

and the right hardware – an ASIC miner for competitive mining or just a computer for a full node – can participate. No central party controls Bitcoin's issuance or transaction validation. Changes to the network rules require broad consensus from the miners with strong economic incentives to select only beneficial protocol upgrades, making unilateral changes nearly impossible.

The social contract of Bitcoin is very conservative, prioritizing security and decentralization over quick innovation. This means the block size intentionally limits Bitcoin's throughput to keep it easy for many nodes to stay in sync even when the available infrastructure is low-powered or the internet connection is sporadic. The result is a system that has run continuously for over 14 years with no central coordinator. It's slow, but extremely resilient. Bitcoin's decentralization is not perfect – for example, mining power has sometimes concentrated in a few large pools – but it has proven robust against censorship. Even nation-states have found they cannot shut down or control Bitcoin without essentially turning off the internet.

Top 10 Countries by Full-Node Count

As of 12 Dec 2025, Bitnodes reports ~72,018 estimated global nodes and ~24,661 reachable nodes. The country breakdown below is based on reachable nodes and should be treated as a snapshot.

Rank	Country	Nodes	% of Total
1	United States	14,955	29.64 %
2	Germany	6,633	13.14 %
3	Canada	2,839	5.63 %
4	France	2,076	4.11 %
5	United Kingdom	2,012	3.99 %
6	Netherlands	1,727	3.42 %
7	China	1,680	3.33 %
8	Russian Federation	1,218	2.41 %
9	Australia	1,215	2.41 %
10	Switzerland	1,131	2.24 %

Ethereum, the second-largest blockchain, also embodies decentralization, though in a different way. Ethereum started with proof-of-work mining like Bitcoin, but in 2022, it transitioned to proof-of-stake. Now, Ethereum's security comes from approximately one million validators staking ETH, making it arguably the most decentralized validator set in existence by sheer numbers.

Anyone can be a validator by staking 32 ETH[1] – or even with less, by joining pools. Ethereum's node count is also high, and like Bitcoin, its design encourages broad participation – you don't need supercomputers to run an Ethereum node, just a consumer-grade computer and sufficient storage. The Ethereum community values decentralization

[1] Since the Pectra Update in 2025 an Ethereum Validator can stake 32-2,048 ETH as a single node.

HIVEMIND HIVEMIND.CAPITAL

In order to have a decentralised database, you need to have security. In order to have security, you need to have incentives.

- Vitalik Buterin

but also upgrades the protocol regularly to improve capacity without sacrificing the core principle that the network should remain open and verifiable by the public.

The trade-off Ethereum often navigates is complexity: it's doing more, given the rich flexibility of Smart Contracts, so keeping it decentralized is an ongoing effort (ensuring the blockchain can be pruned, clients optimized, etc., so it's not only big players who can run nodes).

Both Bitcoin and Ethereum demonstrate "true decentralization" in the sense that they have no official owners or operators[2]. These platforms prioritize decentralization, even at the cost of speed or efficiency. For instance, Ethereum's base layer can handle far fewer transactions per second than a centralized database. However, that's improved via scaling solutions such as layer-2 implementations rather than sacrificing the core network's decentralized nature.

In summary, Bitcoin and Ethereum illustrate the strength of decentralization: they are permissionless (anyone can use them or help secure them), censorship-resistant, and highly reliable (there is no downtime in a properly functioning decentralized network). They also show that decentralization is a journey – over time, both networks have become more decentralized in some respects, guided by the principle that the network should belong to its users, not to any governing company or small group.

Solana: Speed at a Cost

Solana is a prominent example of a blockchain that emphasizes speed and high throughput, even if it means taking on some centralization trade-offs. Solana is known for its ability to process thousands of transactions per second and very low costs, making it attractive for high-frequency applications like decentralized exchanges or NFT marketplaces.

How does Solana achieve this performance? Through a combination of a unique consensus mechanism (Proof of History + Proof of Stake) and by requiring very powerful hardware for its validators. Solana takes the ideological stance that Moore's Law exists, and we should take advantage of it to build a gigantic state machine that is still impressively fast, utilizing the best hardware. Solana validators handle an enormous workload: they process transactions in parallel, use a special mechanism to order transactions quickly, and maintain multiple data streams.

The recommended hardware for a Solana node is daunting – as of late 2024, a validator might need a 24-core server-class CPU, 512 GB of RAM, high-speed SSD storage, and a gigabit fiber connection. While ensuring high performance, these stringent requirements concentrate validator operations within professional data centers, as one analysis noted. In plainer terms, not just anyone can run a Solana validator node from home; you need a pretty expensive rig and infrastructure. This naturally limits the number and diversity of participants. Indeed, Solana currently has on the order of a few hundred full nodes (validating nodes). Recent estimates suggest ~1,000+ independent validators support the network, which is far fewer than Ethereum's many thousands.

The Solana team and community are aware of these trade-offs and have been working on optimizations – like the Firedancer client – to lower hardware barriers, but it remains a concern. A full Firedancer client is still in development, but an interim 'Frankendancer' approach is already being used on mainnet (Firedancer components alongside Agave), improving client diversity and resilience. The consequence of this semi-centralization surfaced notably in Solana's early years when the network experienced several outages. In some cases, network halts required coordination among validators to restart – something critics argue wouldn't happen in a more decentralized network where no one can (or needs to) reboot the whole system. Each outage invited criticism that Solana's design is "too centralized" or that it achieves speed by sacrificing the very point of blockchains.

[2] There are prominent groups and individuals in the respective communities whose opinion holdssubstantial weight, especially on technical matters.

Supporters counter that Solana is charting a path to make high throughput compatible with decentralization eventually and that even with higher hardware needs, it's still non-custodial and globally accessible. The reality likely lies in between: Solana has made a deliberate trade-off, opting for performance with the understanding that it narrows who can effectively participate in block production. For now, this means centralization risks: the network relies on a smaller set of sophisticated validators – often funded by the Solana Foundation – than a network like Bitcoin or Ethereum.

Solana demonstrates how far performance can be pushed – it shows that blockchains can rival traditional systems in speed if they relax decentralization. The question it raises is: how much centralization is too much?

On the positive side, Solana demonstrates how far performance can be pushed – it shows that blockchains can rival traditional systems in speed if they relax decentralization. The question it raises is: how much centralization is too much? Solana is a fascinating experiment in finding that boundary. It's very fast and throughput-rich, which proves useful for certain applications, but it asks its community to trust that the network's validator set won't become too concentrated. The ongoing challenge for Solana is improving the accessibility of running a node to gain more of decentralization's benefits without losing its speed edge.

In summary, Solana's speed-first, hardware-intense model is a bold bet. It achieves what it set out to (high TPS, low fees), but the trade-off is clear: fewer, more powerful nodes, meaning a higher potential for central points of failure or control. Solana's story underscores the theme that decentralization is a spectrum – and Solana has consciously moved toward centralization to address scalability.

Hedera Hashgraph: Governing Council and Growing Decentralization

Hedera Hashgraph (HBAR) is an interesting case of a network that started more on the centralized side and is progressively decentralizing over time. Hedera isn't a blockchain per se but a DAG-based distributed ledger using a Hashgraph consensus algorithm. It launched with a governing council model: a fixed number of global enterprises and organizations act as the primary nodes that validate transactions. This design choice ensured reliability and governance by known, trusted entities in the network's early stages. The upside is high efficiency and fast consensus finality – Hedera can handle thousands of transactions per second with very low energy cost – but the obvious downside is centralization: only approved council members could run nodes initially, so it wasn't permissionless in the way Bitcoin or Ethereum are.

Over time, Hedera's roadmap has aimed to open the network to more node operators and community influence, gradually increasing decentralization. A notable development in this direction is Hedera's "Block Streams." In late 2024, Hedera introduced Block Streams, which unify all its transaction history data into a single verifiable sequence. Previously, Hedera had separate logs (event streams, record streams, etc.), but with Block Streams, they produce one continuous, cryptographically signed history of the ledger that anyone can access. Each "block" in this stream has a signature from a majority of Hedera nodes, attesting to its validity.

Why is this important for decentralization? Because it enhances transparency and trust – now any user can independently verify the entire history of transactions with minimal effort, even on offline devices, thanks to these proofs and unified data. In essence, Hedera, despite its limited validator design, is trying to provide the same ability to audit transactions that more decentralized chains have.

Hedera has begun the work to introduce community nodes outside the council, starting with permissioned community nodes and, in the future, potentially permissionless nodes. The network's consensus still relies on weighted voting (the council members have fixed node slots currently), but decentralization is increasing as no single council member has too much influence, and more parties get involved. By design, the council membership is diverse geographically and by industry to avoid collusion.

One can argue Hedera's model is decentralized governance (39 independent organizations must agree on changes) but centralized operation (limited node count). Now, with things like Block Streams, they are mitigating risks by making the data open for verification by anyone. So, even if you're not running a node, you don't have to blindly trust the council's nodes, you can fetch the signed history and check that no invalid transaction has been included. Hedera's approach thus far might be described as "progressive decentralization roadmap." It started closer to the Ripple model (which we'll discuss next) but is moving toward the more open models. The introduction of third-party node hosting, community nodes, and robust public audit tools shows a commitment to not remain a closed club. It acknowledges that decentralization is essential for long-term trust, especially if Hedera is to be used for things like public record-keeping or as a base layer for applications.

The trade-off Hedera chose was to sacrifice permissionless access at launch in exchange for performance and predictable governance.

The trade-off Hedera chose was to sacrifice permissionless access at launch in exchange for performance and predictable governance. Now, it is carefully trying to add decentralization without sacrificing its stability. It's a different path than the open chaos of Bitcoin's early days or Ethereum's public sale – call it a "corporate decentralization" approach. Critics might say it's still not decentralized enough – since a known set of companies could, in theory, collude or be coerced. Proponents will point out that no single company has majority control and that, over time, Hedera will diversify further. With features like Block Streams providing everyone with unified, verifiable historical data, Hedera is equipping users with tools to "trust, but verify." It's a sign that even networks that begin life as closed or centrally governed recognize the imperative of decentralization for credibility and resilience.

Ripple (XRP Ledger): A More Centralized Design

Ripple's XRP Ledger represents one end of the spectrum where decentralization is intentionally limited to serve a specific purpose. Ripple - the company behind XRP - created XRP Ledger to facilitate fast, low-cost international payments, often in partnership with banks. From the start, the design was more centralized than Bitcoin's. XRP uses a consensus protocol that relies on a list of trusted validators - called the Unique Node List, or UNL. Initially, many of these validators were operated or chosen by Ripple Labs.

Over time, Ripple has tried to decentralize by encouraging other parties to run validators and diversifying the UNL. The current list of validators remains small and the default UNL - the set of validators most users trust for consensus - is curated. Multiple entities publish recommended UNLs, and stewardship of the default UNL has moved under the XRPL Foundation. This means the network has clear known validators and is not permissionless in the same way: you or I could run an XRP node, but our node won't matter unless recognized by others' UNLs. In practice, the XRP Ledger is very fast - it can close ledgers in seconds - and handles a decent volume of transactions. It achieves this speed because consensus is limited to a small group of nodes reaching agreement, rather than having to get global proof-of-work or stake confirmations.

However, the cost is a trust requirement in Ripple's network to operate correctly. In the extreme case, if a majority of those validators misbehaved or if the list was corrupted, the ledger could be manipulated or halted. Ripple critics have long labeled it "centralized" – for example, unlike Bitcoin's fully public mining, a significant portion of XRP was created and is held by the Ripple company and its founders, and changes to the ledger often involve Ripple's coordination. The Ripple model has a clear niche: by being semi-centralized, it aims to interface smoothly with the existing banking world - which values knowing participants and having someone to hold accountable. It's arguably more of a distributed payment network than a pure decentralized blockchain.

The social philosophy behind XRP is different – it's less about empowering individuals with self-sovereignty and more about improving efficiency of interbank transactions using a crypto token. Thus, in debates, Ripple often comes up as an example of the limits of decentralization: how far can you go toward centralization before you're no longer meaningfully "blockchain"? The reality is that XRP Ledger runs on independent servers and cannot be changed by a single party instantaneously – so it is decentralized to a degree – but that degree is tightly bounded. If Bitcoin is a fully open commons, XRP is more like a members' club. For the purpose it was built (fast settlement), it works well, but users must trust that the club of validators will remain honest and that the sponsoring company won't indirectly call the shots to a user's detriment; economically, Ripple's incentives are aligned to ensure they continue to act in the best interests of the network.

In summary, Ripple's XRP represents a design where centralization was a conscious choice to achieve certain performance and use-case goals. It serves as a foil to Bitcoin: it trades much of the censorship resistance and neutral governance away to gain speed and institutional acceptance. Whether that trade is worth it depends on one's goals – but it underscores the central thesis that decentralization is optional, and some projects choose to minimize it, for better or worse.

Others on the Decentralization Spectrum (Avalanche, Plume, Polkadot, Near, Tezos, Cardano, Sui)

Between the extremes of Bitcoin's maximal decentralization and Ripple's minimal decentralization lies a broad range of projects. Each of the following platforms finds its balance in the trilemma, offering instructive examples of how decentralization can be blended with other priorities:

> **Avalanche (AVAX):** Avalanche is a high-performance blockchain platform that balances decentralization and speed through its innovative consensus protocol. The network consists of multiple chains (X-Chain, C-Chain, P-Chain) and supports custom subnets. Avalanche's consensus enables fast finality (often ~1 second) and high throughput (thousands of TPS). The recently released Avalanche9000 upgrade dramatically lowers the costs and technical barriers for launching and validating new blockchains, empowering anyone to create independent L1s with custom validator sets and governance, which significantly enhances network decentralization.
>
> While Avalanche is permissionless in validator participation, Ava Labs (the founding company) still exerts notable influence over protocol development and upgrades. However, the codebase is open source, and community involvement is growing.
>
> Overall, Avalanche occupies a middle ground: it is more decentralized than many high-speed blockchains, although governance remains more centralized than Ethereum's, as it pursues scalability and performance akin to centralized systems.

> **Plume Network:** Plume is a newer blockchain (advertised as a Layer-1 focused on Real World Asset finance, or "RWAs"). It's designed to be EVM-compatible and to integrate real-world assets into DeFi. Plume markets itself as permissionless and emphasizes that it "promotes decentralization and transparency in the RWA lifecycle". Being permissionless means anyone can join the network as a validator or user without gatekeepers, which is a core decentralization principle.
>
> However, as a very new chain (Plume's documentation and articles started appearing in 2024), its actual degree of decentralization in practice is yet to be proven. New networks often launch with a limited set of validators - sometimes run by the founding team or investors - for stability, then try to open up. Plume's success in decentralization will depend on how many independent entities run nodes and how its consensus works. The encouraging part is Plume's stated philosophy is pro-decentralization. If it sticks

HIVEMIND HIVEMIND.CAPITAL

to being a public blockchain where control is distributed, it could bring decentralization to the realm of real-world asset management, which historically is very centralized (think banks controlling securities, etc.). One might imagine Plume enabling, say, a piece of real estate to be tokenized and traded without any single institution controlling the ledger of ownership. That's a powerful idea – decentralization ensuring the provenance of truth about asset ownership, traceable and not alterable by a single party. Time will tell how Plume's network decentralizes as more participants join.

Polkadot (DOT): Polkadot takes a somewhat unique approach with its "relay chain and parachains" architecture. The Polkadot relay chain provides security and consensus for a whole ecosystem of parachains (parallel blockchains) that plug into it. Polkadot uses a form of nominated proof-of-stake (NPoS) for its relay chain. It deliberately limits the number of active validators – currently, the maximum per era is 500[3] – to ensure the network can run efficiently. The design target has been about 1,000 validators for the relay chain in the long run. Why not have tens of thousands like Ethereum?

Polkadot's creators felt that a modest number of high-quality validators could provide sufficient security, especially since each validator in Polkadot had to do more work (validating many parachains). They also rely on a large number of nominators (regular token holders who delegate their economic stakes to validators) to decentralize the stake behind those validators. In effect, Polkadot's security comes from a wide distribution of staked DOT - there can be thousands of nominator accounts - even if the block-producing nodes are limited. This is a somewhat centralized approach to block production, mitigated by the decentralized stake input and Polkadot's rotation and equalization algorithms that prevent any single validator from always dominating.

Still, Polkadot is less decentralized than Ethereum or Cardano regarding node count. It has an on-chain governance system that token holders participate in to make decisions. That governance is another vector of (de)centralization: in Polkadot, it's more formalized; a common critique is it gives a lot of power to those with big token holdings or to the Foundation, though the system is designed to be as fair and transparent as possible.

Overall, Polkadot sits somewhere in the middle: it sacrifices some decentralization (limited validators) for higher throughput and cross-chain capabilities, but it tries to keep a check on that through community governance and by eventually expanding the validator set. Its approach underscores that decentralization isn't just raw numbers – it's also how those numbers are managed. Polkadot's approach could be seen as pragmatic decentralization: not maximal, but enough to maintain security, with plans to increase gradually as the underlying technology matures.

Near Protocol: NEAR is a smart contract platform that scales using a sharding solution called Nightshade; Ethereum also has sharding in the roadmap. For consensus, NEAR uses a custom Proof-of-Stake called Doomslug, which innovates to achieve super-fast finality, with blocks considered final after one round of communication. NEAR's consensus currently has several hundred validators for its main chain based on a Thresholded Proof-of-Stake (TPoS) – essentially an auction mechanism based on total NEAR staked with each validator.

They have a mechanism to add more, and they've introduced the concept of "chunk-only producers" which allows many more participants (hundreds or thousands) to assist with parts of validation without needing to validate every shard. The idea is to lower barriers to increase decentralization as the network grows. Like Polkadot, NEAR started with a manageable validator count to ensure coordination and then branched out. The NEAR Foundation and early backers likely had a lot of influence at the start (as is common in newer chains), but the project aims for more community-driven governance over time.

NEAR's focus is also on usability and developer experience, which means they want a reliable network - hence not pushing the envelope on open participation too quickly. NEAR is not usually positioned as a crusader for decentralization; rather, it pitches itself as a highly usable platform that is decentralized enough for web3 applications. The balance here is utilitarian – decentralize to the point that the network is trustless and secure, but not to the point that it hampers usability or performance. It's a careful walk on the spectrum, and NEAR is gradually upping its decentralization - in both technical and governance terms - as it matures.

Tezos (XTZ): Tezos is known for its on-chain governance and the term "baking" for its proof-of-stake validators. It has a few hundred active bakers (validators) – approximately 300 as of recent counts. Tezos was designed to be decentralized and to avoid hard forks by baking governance into the protocol. Stakeholders can vote on upgrades, which will automatically execute. Regarding decentralization, Tezos has a widely distributed token ownership with tens of thousands of delegators who delegate to bakers. The hardware requirements for being a baker are relatively low - Tezos prides itself on being able to run nodes on modest hardware, ensuring accessibility. With upgrades, Tezos aimed to improve performance (block times have been halved, etc.) while keeping baking accessible to maintain decentralization.

It's fairly decentralized, and perhaps more importantly, it's very community-governed. Decisions about the protocol come from proposals that coin-holders vote on. This prevents centralized development control because no single team or foundation can force changes without community approval. Tezos is sometimes under the radar, but it demonstrates that you can have a self-amending blockchain that stays decentralized and even increases decentralization over time; more bakers have joined since its launch, and the voting turnout shows broad participation. Tezos is an example of balancing innovation - like formal governance mechanisms - with decentralization by ensuring many independent bakers and voters.

Cardano (ADA): Cardano, like Tezos, puts a big emphasis on being decentralized and peer-reviewed in its approach. After a phased launch, Cardano reached a milestone where it became fully decentralized in block production.

In March 2021, it turned off its genesis nodes so that community stake pools produce 100% of new blocks. Cardano now boasts over 3,000 active stake pools which is an impressive feat. These pools are run by individuals and groups worldwide, and ADA holders can delegate to any of them. Cardano's protocol (Ouroboros) is designed such that at any given time, a certain number of pools (k parameter, currently 500) are incentivized to be the top performers, and stake gets distributed among them up to a saturation point to encourage decentralization of stake. This means Cardano does not want just one pool to have all the stake – it deliberately caps rewards if a pool is too large, nudging delegators to choose other pools and thus spreading out the power. This economic design has led to a wide distribution of stakes among hundreds of pools, giving Cardano a high decentralization in consensus.

No single entity has a majority, which is vital for robust decentralization. With thousands of nodes and a community of operators, Cardano is on the very decentralized end of the spectrum among major platforms. Its trade-off has been that it took a long time and a slow, research-driven approach to roll out all features, a recurring critique is it prioritized

[3] having been lifted from 297 to aid decentralization.

HIVEMIND HIVEMIND.CAPITAL

"doing it right" over "doing it fast."

For instance, Cardano was slower in enabling smart contracts - which went live in 2021 with the Alonzo upgrade - to methodically ensure the system would remain secure and decentralized with its extended UTXO model. Governance in Cardano is also moving towards full decentralization: a system called Voltaire went live in Feb-2025 to let ADA holders vote on proposals and funding, similar to Tezos' governance but with Cardano's flavor. In practice, Cardano's day-to-day operations are highly decentralized now. However, the direction of the project is still heavily influenced by IOG (Input Output Global, Charles Hoskinson's company) and the Cardano Foundation.

Over time, they plan to hand off more control to the community through voting and a treasury system. Cardano's philosophy strongly aligns with the belief that decentralization equals resilience and democratization of finance. They often highlight how no central party controls the network – a point of pride given global trends. The network has been very stable and secure, lending credence to the idea that decentralization doesn't have to mean instability. With its thousands of pools, Cardano arguably demonstrates one of decentralization's key promises: if any pool operator fails or misbehaves, the network carries on unaffected. Like a starfish that can lose an arm and regenerate, the system's health isn't tied to any single stakeholder.

Sui (and its cousin Aptos): Sui is a new entrant (launched in 2023) that uses the Move programming language (initially developed at Facebook for the Libra/ Diem project). Sui is a high-performance Layer-1 aiming for low-latency transactions, especially for certain parallelized use cases. It uses a delegated proof-of-stake system. SUI currently operates with ~100 validators, but the number is permissionless and adjustable. There is a required minimum stake of ~3mm units of SUI with voting power capped at 10% per validator to prevent dominance.

The Sui Foundation, to promote decentralization, has continuously supported a program to delegate SUI tokens to community-run validators to bootstrap them. This shows an awareness that left unchecked, new networks can quickly centralize e.g., all big token holders might set up their own validators and crowd out smaller ones. By delegating stakes to many smaller, independent validators, the foundation tries to ensure a broad set of operators can participate and earn rewards, thus securing the network.

Sui's performance goals are ambitious, but the team claims to have designed the consensus in such a way (Narwhal & Bullshark) that it can scale without sacrificing safety. Still, as a young network, the decentralization of Sui is an ongoing process. It's not as decentralized as older networks like Ethereum or Cardano, but it's trending in that direction as more validators come online and more holders stake to different operators.

Sui exemplifies a common pattern in modern "web3" startups: they start somewhat centralized - to get things off the ground quickly and coordinate initial development - then gradually hand over the reins. The real measure will be in a couple of years: is Sui governed by its community of token holders? Is its validator set large and diverse enough that no single entity can shut it down or corrupt it? The team's actions (like the delegation program) indicate they want that outcome.

Technically, Sui is designed for speed and scalability, so one challenge will be keeping the barrier to entry low. If Sui's transaction throughput grows massive, will validators need Solana-like hardware? If so, will there be enough incentive for everyday people to run nodes, or will it consolidate to data centers? These are questions Sui (and similar chains like Aptos) will face as they scale. For now, we can place Sui on the spectrum as decentralizing but not fully decentralized yet. It's more decentralized than something like a permissioned ledger, but less so than the veteran public chains. It's part of the new wave trying to achieve the coveted "web2 performance with web3 principles" ideal.

? Which corner of the blockchain trilemma do you think your favorite chain sacrifices?

Each of these examples – Avalanche, Plume, Polkadot, Near, Tezos, Cardano, Sui – shows a different blend of design priorities. Together, they illustrate that decentralization isn't a binary yes/no, but a nuanced attribute. Even within these, there are moving parts: network decentralization (nodes, validators), governance decentralization (who makes decisions about upgrades or funds), and supply decentralization (token distribution among holders, which affects economic control). A project might excel in one and lag in another.

For instance, Cardano and Tezos have very decentralized block production, but one could argue their development is still somewhat centralized around key entities. Polkadot has decentralized staking but somewhat centralized governance via its council (though evolving). What's key is that all these projects recognize decentralization as a virtue – even if they sacrifice some of it, they do so knowingly and often with plans to mitigate the risk. We rarely see new serious projects proudly proclaiming, "We are centralized!" – the trend is always to emphasize how they are or will be decentralized, which speaks to the community's values.

In the next section, we'll tie this technological spectrum back to the bigger picture: why does this decentralization matter for society? What philosophical or social currents drive this push, and what could a decentralized future imply for everyone?

Philosophical and Social Impact

Decentralization isn't just a technical design choice; it's a statement about how we believe power and trust should be distributed in society. The rise of blockchain and decentralized tech has unfolded against a backdrop of global shifts toward centralization in other areas – and a growing concern about that trend. Around the world, we've witnessed a resurgence of authoritarianism and concentrated authority: governments asserting tighter control over their citizens, large corporations - especially Big Tech companies - amassing unprecedented influence over communication and personal data, and centralized financial institutions exerting outsized impact on economies. In such an environment, the philosophy of decentralization offers a counter-narrative – a vision of empowering individuals and communities at the edges rather than a few players at the center.

The philosophy of decentralization offers a counter-narrative – a vision of empowering individuals and communities at the edges rather than a few players at the center.

One way to understand this is through the lens of generational cycles. In "The Fourth Turning" by Neil Howe and William Strauss, history is seen as a series of turnings, somewhat analogous to the seasons, of about 20-year phases culminating in an era of upheaval, crisis, and regeneration (the Fourth Turning – or Winter) roughly every 80-90 years that forces society to reinvent its structures. The authors predicted that the mid-2000s to 2020s would be a period of upheaval and systemic change. Indeed, we are living through times of crisis: financial meltdowns, political polarization, pandemics, and so on – all signals of institutions under strain. Decentralization aligns with the kinds of systemic changes Howe and Strauss discuss: when trust in institutions erodes, people seek new models. Bitcoin's birth in 2009, right after the 2008 financial crisis, is a prime example. It was a direct response to the "systemic failures" of centralized finance. Satoshi Nakamoto embedded a newspaper headline about bank bailouts in the Bitcoin genesis block

HIVEMIND HIVEMIND.CAPITAL

as a provocation – a rallying cry that we needed a currency outside central bank control. Readers of Howe and Strauss's work have often remarked on this as part of the Fourth Turning, where a new, decentralized alternative challenges an old financial order. In their framework, such crises usually produce a "systemic transformation" – and Bitcoin's promise of financial sovereignty, where trust is in math and code instead of fallible institutions, fits remarkably well. It's as if the world-wide loss of confidence in banks and governments handling money ignited a people-powered solution: cryptocurrency. Generationally, younger cohorts such as Millennials and Gen Z have been quick to adopt these technologies, perhaps because they grew up watching institutions falter with the dot-com bust, 9/11, 2008 crash, and COVID experiences; these shared defining experiences help define the turnings and generational barriers in Howe and Strauss' work. To them, decentralization isn't an academic concept; it's a practical way to take ownership of things that previous generations left to authorities.

Philosophically, decentralization connects to ancient ideas of liberty. It resonates with the Enlightenment notion that rights (like free speech, property, privacy) are inherent to individuals, not granted by monarchs or governments.

Beyond finance, consider free speech and truth in the digital age. The internet began as a decentralized network, but today a handful of platforms and algorithms controlled by a few companies dictate what information flows to billions of people. That centralization of information has problematic side effects: censorship, whether by governments pressuring platforms or platforms themselves acting as gatekeepers, echo chambers, and vulnerability to manipulation. Decentralized networks – like federated social media (Mastodon, for example), or emerging "web3" social platforms built on blockchain – aim to return control of content and identity to individuals.

The idea is that no single corporation or government should have the power to silence someone across the internet or to decide the truth of a piece of information unilaterally. By distributing hosting and governance, decentralized social platforms make it harder to impose top-down control. They can also improve the provenance of truth: for example, content or data anchored on a blockchain can be verified like "Was this photo altered?" and "Who originally published this information and when?". In a world rife with misinformation, having a tamper-evident record – a sort of global notary – can help establish what's real. It's not a silver bullet for truth, but it eliminates one common vector of falsehood: centralized alteration or deletion of records. Think of a government that rewrites history books – in a decentralized knowledge base, that becomes nearly impossible because too many independent nodes hold the original "truth."

Self-sovereignty is a recurring theme in the decentralization movement. It's the concept that individuals should have agency and ownership over their own data, identity, and assets. With centralized services, we usually rent or license access – your profile on a social network, your funds in a bank, your purchased media on a platform, all ultimately exist on someone else's servers and under someone else's rules. Decentralization flips that model: you own your private keys, you own your identity credentials, you own your tokens or coins, and you carry them with you; no central actor can confiscate or deny your access – barring illegal behavior where community consensus might act. This is a bulwark for freedom. For example, activists and journalists under repressive regimes use decentralized tools like cryptocurrency to receive support when banks are censored or use decentralized messaging and file storage to preserve information when websites are shut down. The mere existence of these alternatives creates a check on centralized powers. A government might think twice about arbitrarily freezing citizens' bank accounts if the citizens have an escape hatch via Bitcoin. Or if one country's internet blocks a specific app, people can switch to a peer-to-peer mesh or proxy that's not reliant on any single ISP.

The trend toward authoritarianism in some parts of the world has accelerated interest in decentralization. We've seen internet shutdowns used as a form of control; decentralization provides ways to route around such shutdowns (mesh networks, satellite Bitcoin nodes, etc.). We see mass surveillance of communications; end-to-end encrypted, decentralized messaging (like Signal's protocol, or even fully decentralized ones like Keet) fight back by removing central eavesdropping points. We see propaganda and information control; decentralized publishing and blockchain-based content timestamps fight that by ensuring a record of who said what when that can't be scrubbed. All these are concrete ways decentralization defends freedom of speech and the free flow of information.

Community Mesh Networks in Rural Argentina

In 2020, as the COVID-19 pandemic highlighted the urgent need for universal internet access, the Argentine nonprofit AlterMundi partnered with local leaders to deploy LibreRouter nodes in several rural communities, including San Vicente, Paraje Santa Cruz, and Chepes. Residents were trained to assemble and install these routers—often mounted on electricity poles—creating mesh Wi-Fi networks that connected dozens of households for communication, education, and local services, even in areas neglected by traditional ISPs. These networks used LibreMesh firmware, an OpenWrt-based system designed for ease of use by non-technical community members, enabling them to manage and expand their own connectivity infrastructure.

By 2022, Argentina's National Communications Agency (ENACOM) published its first regulation recognizing community networks, allowing organizations like AlterMundi to request licenses for non-profit operators and advancing the inclusion of grassroots digital infrastructure in national policy. Today, these networks continue to demonstrate how decentralized, community-driven technology can bridge the digital divide in underserved regions.

Importantly, decentralization also has a cultural or psychological impact. It fosters a mindset of participation. If you know that a network or community is decentralized, you inherently understand that it's partially on you and everyone else to make it work. This can encourage more civic engagement in the digital polis. Instead of being a passive user of a service, you might become an active node operator, a voter in governance, or a contributor to an open-source project. It's akin to the difference between living in a house you own versus a hotel – ownership (even partial or collective) often begets more responsibility and care. Decentralized autonomous organizations (DAOs) exemplify this: they allow groups to coordinate and make decisions without a central boss, often voting with tokens on proposals. Thousands of people worldwide have now experienced co-managing funds or projects via DAOs, which is a very different feeling from being under a hierarchy. It can be messy, yes, but also empowering.

We must address a real concern: Decentralization can be anarchic, and not everyone wants to be responsible all the time. Some fear that a decentralized world is one with less accountability – if "everyone is in charge," is no one in charge? Could that lead to chaos or failure to act when needed? These are valid questions, and the answers are still being worked out. However, advocates argue that decentralization doesn't mean lack of structure; it often means better alignment with community interests. Rules still exist, but they're enforced by protocol and consensus rather than by an authority's whim. For instance, a decentralized finance protocol might automatically enforce loan rules with smart contracts, treating a billionaire and a student the same by code. In contrast, a centralized bank might bend the rules for the powerful. That consistency can increase fairness and accountability – the protocol is accountable to its code and to all users equally. It's a different kind of order that is more rigid in following pre-set rules but flexible in that everyone has input into those rules.

HIVEMIND HIVEMIND.CAPITAL

Philosophically, decentralization connects to ancient ideas of liberty. It resonates with the Enlightenment notion that rights (like free speech, property, privacy) are inherent to individuals, not granted by monarchs or governments. A decentralized network "grants" you nothing; it simply doesn't have a mechanism to deny you, as long as you follow the protocol. That's more aligned with the idea of inalienable rights. Of course, with great power (over your own assets/data) comes great responsibility (don't lose your private keys!). This is a cultural shift we're witnessing: people are learning to guard their digital keys, to verify information themselves (e.g., "don't trust, verify" in crypto), and to organize communities without formal leaders. It's a learning curve, but it's happening at the edges of society and spreading inward.

> **The spirit there was very decentralized. The individual was incredibly empowered. It was all based on there being no central authority that you had to go to to ask permission. That feeling of individual control, that empowerment, is something we've lost.**
>
> **- Tim Berners-Lee**

We can also view decentralization as a response to the fragility of centralized systems. The COVID-19 pandemic, for example, showed how global just-in-time supply chains – efficient but highly centralized – broke under stress, leading to shortages. Some thinkers suggest more decentralized local production (e.g., 3D printing, local energy grids) to add resilience. Similarly, in finance, a centralized system where all transactions funnel through a few big clearinghouses can be efficient in normal times but catastrophic if one fails. Decentralized finance (DeFi) spreads risk and doesn't rely on any single clearing entity – trades settle peer-to-peer or via automated market makers. When one DeFi platform had issues, others kept running; there's no single Wall Street that closes at 4pm or halts trading in a panic across the board. This resilience is akin to the internet's original design to withstand nuclear war by having no central node. In a world where we worry about cyberattacks and systemic risks, decentralization is a defensive design principle.

A powerful quote from an advocate of decentralization in governance: "In crisis, democratic citizens must not exchange their freedom for safety falsely promised by power-hogging governments. Now is the time to rebel and decentralize the system." This was written in the context of political power grabs during crises – be it pandemics or security threats. The sentiment applies broadly: when fear mounts, there's a temptation to centralize authority ("for our own good"). Decentralization philosophy warns against this trap. Yes, centralization can bring short-term order, but at what cost? Often at the cost of liberty and long-term sustainability. By keeping systems decentralized, we maintain checks and balances. No one entity can as easily leverage a crisis to seize total control because power is diffuse. This is social resilience – akin to how a decentralized network can route around damage; a decentralized society can route around would-be dictators or oligarchies.

A real-world illustration: consider the provenance of truth and censorship. In 2022, during conflicts and protests in various countries, people turned to decentralized file storage (like IPFS) to preserve documents and videos that authorities wanted to censor. Because IPFS doesn't rely on one server – files are spread across many computers – it was much harder to erase those pieces of evidence. And once a file's cryptographic hash is known, anyone can verify its integrity (provenance) if they retrieve it. This is a decentralization win for human rights: war crimes evidence, for instance, can be made immutable and distributed, increasing the chance that truth survives even if regimes try to cover it up.

Linking back to "The Fourth Turning," one of the patterns in a crisis era is the destruction and rebuilding of institutions. Decentralization might be laying the groundwork for the rebuilding phase – where new institutions (or anti-institutions) rise that better fit the values of the new era. Perhaps the coming decades will see the rise of decentralized autonomous organizations as commonplace structures for everything from local governance to online communities. Perhaps national currencies will coexist or compete with decentralized cryptocurrencies, forcing more fiscal discipline. It's conceivable that we're in the early days of a broad societal shift where trust is moving from traditional vertical hierarchies to more horizontal networks. The outcome might not completely replace centralized authorities (we will always have some form of governments, companies, etc.), but those might operate with greater transparency and constraint because the populace has alternatives and can hold them accountable by "exiting" to decentralized options if needed. In that sense, decentralization can improve centralized systems by keeping them honest through competition.

To summarize the social impact, decentralization is a defense of core democratic and human values in the digital age. It stands for self-sovereignty (you control your assets and identity), freedom of speech (no single kill switch for your voice), and provenance of truth (history and facts recorded indelibly, not subject to Orwellian revision). It just so happens that these three principles are at the very core of public blockchain technology. It's a response to a historical moment where many feel disempowered by distant authorities or opaque algorithms. By distributing power, decentralization aims to align systems more with individual rights and community consent. It is not a panacea and introduces new challenges, but it's a crucial shift in aligning technology with the human-centric ideals of trust and freedom.

Conclusion

The debate between centralization and decentralization is as old as civilization, but in our era of rapid technological progress and social change, it has taken on newfound urgency. We've seen that decentralization in blockchain and technology is about far more than just architecture – it's about who we trust, how we govern, and what values we prioritize.
Centralized systems offer comfort in their simplicity and speed: one authority to trust and one pipeline to optimize. However, they also form single points of failure and control, which can be fragilities or even weapons. Decentralized systems, by contrast, distribute both the responsibilities and the risks. They can be slower, messier, and sometimes harder to understand. Yet, as we've argued throughout this piece, those inconveniences are often a worthy price for what we gain: resilience, transparency, and freedom from undue control.

Blockchain arose because the status quo failed in critical ways. It showed that removing central intermediaries can create a stronger narrative of a more robust and fair system for certain foundational things - like money. However, the principle extends beyond blockchain. The ethos of decentralization influences how we think about social media (protocols over platforms), how we secure information (from centralized servers to distributed ledgers), and even how communities self-organize. It asks us to reimagine systems such that people and peers, rather than distant authorities, hold the keys.

We see a spectrum of possibilities in examining examples from Bitcoin's pure decentralization to Solana's performance-tilted model, to experiments like Polkadot and Cardano. There is no one-size-fits-all: each domain might require a different balance. However, the overarching lesson is that decentralization is a vital design consideration, not an afterthought. It should be valued and preserved where it matters, especially at the core layers of our information and financial infrastructures.

Decentralization offers a path to earnest trust; trust that is established by math, consensus, and openness, rather than by authority or coercion. In decentralized blockchain networks, you don't have to trust the people, you trust the system that no single person controls. That's a profound shift, and it radiates outward: if we can do it for money, why not for voting? For identity? For content creation?

A cautious, balanced tone is warranted because decentralization is not a magic wand. It doesn't automatically solve human problems. You can have decentralized systems that still fail or even facilitate wrongdoing. But the assertive stance we take is that, overall, a world that values decentralization is one that values empowerment and robustness. It's a world less prone to catastrophic failures, less amenable to monopolistic control, and more aligned with democratic ideals.

As we conclude, recall the big picture: societies oscillate between centralization and decentralization,

HIVEMIND HIVEMIND.CAPITAL

and each swing corrects the excesses of the other. Today, after a long swing towards centralization, decentralization is the countercurrent pulling us back toward equilibrium. Where centralization has created brittleness or injustice, decentralization seeks to create resilience and fairness.

Ultimately, valuing decentralization means valuing trust, freedom, and resilience above raw efficiency. It's a conscious choice to sometimes do things the hard way (to run your own server, to double-check consensus, to vote on proposals) because doing so keeps power balanced. It's reminiscent of maintaining good health: it might be easier in the short run to eat fast food and never exercise (centralized convenience), but long-term health comes from a bit of discipline and care (decentralized effort).

In closing, the case for decentralization is a case for a more trustworthy world. When no single actor can pull the levers without consent, we all gain a measure of security in that system's integrity. When communities control the networks they use, those networks reflect the community's values, not just a CEO's bottom line.

As the Fourth Turning's crisis gives way to a new societal spring, the institutions we rebuild will hopefully incorporate decentralization at their core, making them stronger, fairer, and more aligned with the people they serve. ■