# Solana Deep Dive with Co-Founder Anatoly Yakovenko

(0:00 - 0:34)

What is your response to people who criticize Solana for being a VC coin, VC network? Solana is known for requiring specialized hardware and being expensive to run a node. Has that changed? Another concern by the community is that Solana is centralized. What are your thoughts on that? Can you define that in some objectively measurable way? So Breakpoint is a conference organized by the Solana Foundation for kind of the Solana ecosystem and it's mostly developers and kind of I think some venture firms and stuff.

(0:35 - 0:53)

They all come together, they show off their products or technical talks, you know, kind of, or just people having fun. Solana is kind of uniquely positioned in the industry to be non-charted, no layer twos, a single giant global state machine. There's a lot of benefit to that, but a lot of challenges.

(0:53 - 1:29)

The really cool thing that a single giant global state machine provides is composability and that is that every application that exists in one single environment is kind of like running in a single computer, a world computer. So if you were to like, let's say if I wanted to trade like 20 cents of dollars for however many euros that is, you can actually trade it across five different companies at the same time to get the cheapest possible price. And it would take like one millisecond to do that trade, like, you know, one second to settle it.

(1:29 - 1:49)

And the cost would be like a fraction of a penny. And there's no way you can do that in the real world, right? There's no way you're going to go to like five different foreign exchange desks and tell them, I'm trading 20 cents, give me your best price. And that's because the real world doesn't have that property of composability, right? Everything is in separate buckets and separate domains.

(1:50 - 1:59)

And this is what happens when you have Layer 2s and sharding and these other technologies is that they separate the environments. You can no longer combine them. So this is the big advantage of Solana.

(2:00 - 2:17)

And this is something that we think is really, really important for the benefits that crypto

provides around the world. Because once you eliminate that friction between companies, between marketplaces, finance becomes cheaper, faster, like everything's better. Oh man, there's like over 30 announcements happening.

(2:17 - 2:35)

Some of the stuff that I really pay attention to because I'm a systems engineer, it's like FireDancer. So they announced that they have a node running on TestNet that is running part FireDancer, part LabsCode. And that's a really huge milestone because getting that out to TestNet is like a big step.

(2:35 - 2:48)

It kind of feels like everything's downhill from here. And why it's important that FireDancer exists is because the whole point of public permissionless blockchains is to build this idea of decentralization. And that's kind of an OPEC term.

(2:48 - 3:13)

But if you really kind of look at it from an engineering perspective, it's really about eliminating all single points of failure, whether it's in the validators and Akamoto coefficient, all these other ways you can look at it. But one of those things is number of teams and implementations of the protocol itself. Ethereum is, I think, the only smart contract platform with multiple implementations of the protocols live.

(3:14 - 3:22)

So that's four clients. And Solana, I think, is soon to be the next one with more than one. So FireDancer is the second implementation of the Solana protocol.

(3:23 - 3:52)

So if you're not an engineer, how I can describe why that's really, really important is that if there's separate teams building in separate languages with separate tools, the same kind of protocol, they're still humans, right? There's still a possibility of them implementing something with a bug. But the probability of two different teams implementing the exact same bug in two different implementations of the protocol is virtually zero. And that means that now we have redundancy.

(3:52 - 4:06)

We don't have any single points of failure. That's really, really critically important for decentralization. And if we were to sum up what FireDancer is again in one sentence, how would you describe what FireDancer is? It's an even faster Solana.

(4:08 - 4:15)

Solana is already fast. It's even faster than that. I think another announcement earlier this week was the first smart wallet that was announced on Solana.

(4:15 - 4:36)

Can you describe what it is and how it may affect the Solana ecosystem? Yeah, this is something that has been in the makings for a while. And I think in the Ethereum industry, in the Ethereum ecosystem, it's called account abstraction. But this is a native feature that's been part of Solana, like the virtual machine from day one.

(4:36 - 4:54)

And Fuse is built by a really amazing team, Squads Protocol, that have built a formally verified multi-sig. And that multi-sig can now basically act as a wallet. And the wallet is implemented as a smart contract on Solana itself.

(4:54 - 5:15)

And that's really, really cool because it allows more flexible features and protocols to be added in the wallet that's running on Shade. And some of the interesting properties of this multi-sig is that you can set up a wallet without any seed phrases by using multiple devices. Because you have multiple devices, you have redundancy.

(5:15 - 5:37)

In case you lose one device, you can re-enable it. So you're starting to see a shift in crypto with these new technologies to get away from the old school, here's a piece of paper, write down your seed phrase and store it in your sock drawer. So we're finally at the stages of user experiences and technologies to make those weird UX problems go away.

(5:39 - 6:00)

I still can't explain to my parents how to set up a ledger or something like that. I would say the smart wallet technology, my parents are not going to understand. What they will understand is that you can set up two devices, their computer and their phone and maybe an iCloud account to now work as a multi-sig that controls their wallet.

(6:00 - 6:20)

In the past year, we've also seen a massive surge in compressed NFTs being minted on Solana. Can you tell us what they are and what they enable? Yeah, this is a technology that was shipped with a collaboration between Solana Labs, Metaplex and Helios and a bunch of other folks in the ecosystem. Like all the wallets had to support it.

(6:20 - 6:46)

So it's kind of a huge effort driven, I think, by John Wong from the Solana Foundation. And what compressed NFTs implement, the technical term is stateless accumulators. For technically minded folks, this is a accumulator like a Merkle tree that is running in the contract on Solana and it tracks the path ownership in that Merkle tree from the actual data.

(6:46 - 7:02)

So you don't actually have to store the NFT metadata on chain. You just store the root of the Merkle tree. The folks that worked on this built a really, hyper-optimized concurrent Merkle tree that allows for many different users to all access the same thing.

(7:02 - 7:19)

And it's super cheap. Because of that, we've seen costs for NFTs drop by like a factor of 10,000. So like there's a company that spun up out of this called Drip House that have invented a whole new business model.

(7:19 - 7:47)

So instead of selling NFTs, they actually sell a subscription to users who sign up and they get NFTs from the creators that they follow. And they have minted 50 million NFTs, I think at the cost of a thousand bucks. So this is impossible to do on Ethereum, really impossible to do even on layer twos if you really mint 50 million NFTs on any L2 right now, it's gonna cost you hundreds of thousands of dollars.

(7:48 - 8:09)

On Solana, it was literally a thousand bucks. Yeah, this means that like the cost of digital assets, like truly decentralized, owned like digital assets has dropped to the point where it's as cheap as like AWS database entries. So you can now then give them out for free, you can build whole new business models to try to attract users.

(8:10 - 8:24)

That's exciting to see. There's a bunch of companies trying to do this to onboard audiences. So like Dialect is another app that's doing this and they're literally issuing every chat sticker, you know, like stickers in Telegram or whatever.

(8:25 - 8:50)

Every sticker in the app is a different NFT. So like users collect them, they trade them and that's how they're trying to onboard their initial set of users. So that's pretty exciting to see like trying to apply Web3 technologies, like once the cost comes down to the point that it's as cheap as Web2, can you start scaling businesses and like onboard millions of users.

(8:50 - 8:56)

Last few weeks have been great for Solana. Volume is up, price is up. TVL is up as well.

(8:56 - 9:23)

Wanted to hear your thoughts on what will be the catalyst that will bring more activity and increase TVL to the previous prices. That's really hard to predict, right? Like I think startups and like kind of like product market fit, it's really unpredictable when it happens. And effectively like from how I focus on it is I try to help those founders like accelerate, like unblock them on growth and block them on product ideas.

(9:24 - 9:35)

Those are like the hard problems. If they have like an engineering problem, that's easy. Like that, I can fix that like out code if they have an engineering problem.

(9:35 - 9:57)

But like generally like the folks that we talk to, their biggest challenges right now are like regular startup challenges. How do I get product market fit? How do I get my first, you know, 100 customers, my first thousand customers? How do I scale my revenue from a million to 10? And these are like really fun, early stage company problems. They're all unique.

(9:58 - 10:10)

And like, I don't know, it's kind of, if I wasn't an engineer, like I would love to be like a seed stage investor and help those guys. So that's a very enjoyable, you know, part of my day. But it's really unpredictable.

(10:10 - 10:32)

Like I don't know what's gonna catch lightning in a bottle. What I hope to see is we see like a use case like Helium, which is a $5 data plan in Miami, go nationwide. And that means like we actually get to demonstrate to like, you know, entire United States, look, here's like an entirely crypto-based project.

(10:32 - 10:46)

It's building something that everyone can understand, like a wireless carrier. And it's doing it with crypto, it's doing it faster. It's delivering better data, you know, and cheaper data to every cellular customer in United States.

(10:46 - 10:56)

That's, my parents can understand that, right? Like, that's just what I wanna see

succeed. And like, I wanna see more of those breakout use cases. There's a couple, so Helium is one, Hivemapper is another one.

(10:58 - 11:13)

Think payments, like sling money and like applications like that. And like obviously Visa, those could be big breakout hits. But like payments is hard because it's a much harder regulatory challenge to go and build a global payments app.

(11:13 - 11:37)

How do you see Solana's role in the broader adoption of blockchain technology? And what steps is Solana taking to facilitate this adoption? Well, like it's really the ecosystem that's taking the step. Like me as a systems engineer, the best I can do is just make the network cheaper, faster, more reliable, more decentralized. And like myself and a lot of the core engineers, they're all focused on that.

(11:37 - 11:55)

But it's really the ecosystem that's like the founders, right? That like Solana, they like the value that it provides to them as a technology. Those are the folks that then build businesses that create value for consumers. And this is where I think like that value creation occurs and what brings mainstream adoption.

(11:55 - 12:19)

Like my parents are not gonna really care, right? Like whether it's running Solana or not. I mean, they'll care because it's me, right? But like from there, they're not going, I don't think they're gonna be like blockchain users, but what I hope they are is that they're like users of something valuable that was created because of this technology. So like if it's Helium, that would be awesome.

(12:19 - 12:38)

This year, we've seen rapid growth on layer twos on Ethereum. And I wanted to ask you how does Solana fit in the layer one race where Ethereum is attracting a lot of activity and development? What's unique about Solana is that it doesn't have any layers. It doesn't do the separation and it preserves this composability, which makes things cheaper and faster.

(12:38 - 13:03)

And we have a meme called only possible on Solana. So like Helium using NFTs to mint, like compressed NFTs to mint a million NFTs to represent their hotspots and connect that with the payments and services of the data rates coming out of their 5G cells. All that is happening on the same blockchain as USDC transfers that can pay for Helium data

plans.

(13:03 - 13:18)

So like all this stuff is happening in one world computer without any friction. And this is a major benefit to this sharded environment with layer twos. And you can see that in like just the technical specs of the network.

(13:18 - 13:44)

Solana does more transactions per day from applications alone than Ethereum and all the layer twos combined. So like I think they still have a lot of work to do to catch up on the technology front, both on price performance and like really everything else. I think like what's very different about Solana is if you go to like a Solana conference versus an Ethereum one, there's very few talks about scalability on the Solana conference.

(13:45 - 14:04)

Every founder that you meet is working in a consumer application, whether it's finance, they're looking for consumers to use their application. They're not thinking about how do I scale this? Or whether it's like NFTs or looking for traders, for creators, for whatever. Like so what I want to see is that like that payoff.

(14:05 - 14:21)

Like this is like the narrative that I want to see is like it's time to stop worrying about infra. Really has been time to stop worrying about infra since Solana launched. But like I want to see the fruit of that payoff and see these folks succeed and like have a runaway hit.

(14:22 - 14:38)

Like something like Helium would be magical if everyone was using that in the United States. So like this is what I'm spending my time on is like trying to help those folks, unblock them, do whatever I can. Yeah, you mentioned Helium a few times in this conversation, I think.

(14:38 - 14:54)

The reason I talk about Helium so much is because it's like an example I can explain to like my parents, a congressperson, like somebody that has nothing, knows nothing about crypto. You can tell them cheaper, sell your service and like sign me up. So I have two questions on the future of Solana.

(14:54 - 15:20)

What are you excited about? What's next? Hard answer is what I'm excited about, but this is because I'm a systems engineer. I think one is the reliability of having zero point, like no single points of failure is awesome. I think this is like really the most important thing that decentralized permissionless networks provide is that reliability in terms of like real hardcore, like physical decentralization.

(15:21 - 15:32)

And the fact that it's being built by really a rockstar team of like hardware engineers at a jump. These are the folks that built high frequency trading hardware. They're amazing.

(15:33 - 15:55)

They're like super systems engineers and they're demonstrating that without changing any changes to the Solana protocol, you can literally scale it to millions of TPS and modern day hardware. We're not even talking about custom hardware or anything like that. These are like CPUs that anyone can buy on Amazon and like set up a machine and servers and ready to go.

(15:56 - 16:14)

What that's telling me is that we're basically already kind of have the technology to put all of finance and decentralized rails. So it's going to happen. It's inevitable, right? Like it's done, right? In terms of like technology, we've actually solved all the proven, provably solved all the bottlenecks.

(16:14 - 17:05)

Now it's just about adoption, finding those use cases, finding real world problems that to solve and fixing them and product market fit, catching lightning in a bottle. The follow-up question was, what challenges are laying ahead for Solana? I mean, like I wish, my wish is that like Congress passed a stable coin bill because I think payments is such an obvious improvement using blockchain over any other rail, like in terms of technology, in terms of safety to consumers, in terms of cost reduction to merchants, like I think that's basically what's stopping us to really transform United States payments. Landscape and being in the US, that's kind of the market that I think first, but there are teams that are building on Solana that are trying to do this globally and I hope they succeed.

(17:06 - 17:23)

So that's one of the biggest challenges I think facing all of crypto. I think the other one is the, like, I don't know. The other one I would say is just regular startup, like finding product market fit, like getting those use cases up and running and scaling them.

(17:23 - 17:42)

What is your response to people who criticize Solana for being a VC coin, VC network? Well, like every blockchain has some entry capital that invested in it. I think the way that Solana is distributed is no different than anyone else. And like those initial conditions don't really matter over the longterm.

(17:42 - 18:06)

So like, as you can see, like if there's a centralized entity, it'll eventually fail and all that stuff gets distributed and like that's no longer true, right? Solana is known for requiring specialized hardware and being expensive to run a node. Has that changed? As we predicted, the cost of the hardware drops roughly every two years by 50%. I'm not surprised by that.

(18:07 - 18:12)

I hope no one else is. But like we started Solana, it cost about $1,100 a server. Then it went to 800.

(18:13 - 18:24)

Now it's 350 a month. I suspect my next yield might be under 200 a month per server. So that narrative, right, is sticking around longer than like Moore's law.

(18:25 - 18:46)

So like as hardware improves, it gets cheaper and cheaper to run the network. And like you see like announcements like Google Fiber is offering 20 gigabit networks up and down to the home. So like this idea that Solana only runs out of data centers, even that's going away because simply you're getting what people previously believed data center only speeds, you're getting those to the home.

(18:47 - 19:03)

And this is just a relentless march of hardware. This is really like kind of the whole point of the way we designed the network is that I spent my career as a systems engineer. As soon as you build the software such that it gets faster with hardware improvements, you're done.

(19:03 - 19:08)

You don't actually have to worry about that problem anymore. This is what I really mean about scaling. Like we're done.

(19:08 - 19:16)

Like we don't actually need to worry about scaling. We worry about reliability and stuff

like this. And those are all kind of optimizations that are happening.

(19:17 - 19:37)

So like from my perspective, I think like Solana is like, if we, if once Firedancer's out and there's multiple clients, we don't have to do any more core engineering work. I think there's still improvements that you can do, but really like the network is done. Another concern by the community is that Solana is centralized.

(19:38 - 19:56)

What are your thoughts on that? Can you define that in some objectively measurable way? So that's the follow up question. When people say that they're unable to say what exactly makes it centralized. So when you actually measure it in any objectively measurable parameter, it's oftentimes better than Ethereum.

(19:57 - 20:05)

And in some ways, like maybe at most, only half as good. So like number of validators on Solana is like 3,000. Ethereum is about 6,000.

(20:05 - 20:15)

And what are the other better ways compared to Ethereum? So you can look at the Nakamoto coefficient. I think on Solana is like 23. I think it's 20 on Ethereum.

(20:15 - 20:24)

This is like the minimum number of operators that it takes to shut down the network. And it's a liveness failure. It's not like a failure to safety.

(20:25 - 20:39)

So the way that the real physical, like I have this meme that like economic security is a meme. Like this is what I talk about on Twitter all the time. And this is because the security of the network really comes from the full nodes.

(20:39 - 21:00)

Any single copy of the ledger, right? Doesn't matter if it's staked or not. Doesn't matter if it's a RPC for a monkey's NFT DAO or it's a node run by Circle or it's Binance or it's just your home computer. Any single copy of the ledger has all the signatures from everyone else in the network.

(21:00 - 21:10)

And it can provide a proof of the particular ledger and state transitions that the network

came to. So it's enough to validate the state. Just any single copy.

(21:10 - 21:22)

So that large number of validators on Solana about 3,000. Any one of those that survives an attack, that's enough. Like one, any one of them, right? This is what really gives the network security for safety.

(21:23 - 21:30)

And liveness is a different property. Bugs happen, network outages happen. That doesn't kill the network.

(21:30 - 21:46)

It just stops block production. And even on Bitcoin, when like the Chinese miners shut down, you had a two hour gap between block production. It's not like Bitcoin was dead, right? It just literally didn't make blocks because of how Bitcoin is configured, because of how Solana is configured.

(21:46 - 21:56)

If there is congestion that blows up the network, all the nodes basically halt. They stop making blocks. So safety is not touched, but like liveness, you can have impact.

(21:57 - 22:07)

So Nakamoto coefficient is the minimum number of operators that could halt the network. But that doesn't mean that the network can restart. You literally can, any single copy can be used to restart it.

(22:07 - 22:21)

In terms of like stakers, Solana has 300,000. Ethereum has about six, 700,000 stakers, roughly half that. Like these are numbers that are kind of organically increasing.

(22:21 - 22:30)

That's simply people use the network and stake in and do their activity. Ethereum calls validators, stakers. So we call full nodes validators.

(22:31 - 22:45)

They call, what we call validators, they call full nodes. What they call validators, we call stakers. The best thing about crypto is every layer one has their own terms for everything, right? There's roughly 3,000 Solana validators.

(22:45 - 23:09)

There's roughly 6,000 Ethereum full nodes. Another question from our community is, has Solana found a solution to the network outages? Yeah, if you've been paying attention, there's been like 10 months with a hundred percent uptime and no congestion. And this is because last break point, we shipped local fee markets and we just got them to, to like live on main net like at last break point.

(23:09 - 23:41)

So over this last year, you saw that the network can handle in isolation, separate fees for different events in the network all happening at the same time. And the best test of that was like when Helium was migrating from their layer one to Solana, they literally minted a million NFTs at the same time while MadLads had their big kind of very popular launch that had like more volume than all the NFTs, even on Ethereum. There was no congestion, there was no fee spikes like you see in Ethereum when you have popular events.

(23:42 - 24:07)

And that's because the way Solana is designed is that not only can it do composability of multiple applications at the kind of execution layer, that actually now translates to the economics of the fee markets as well. And this is kind of like the big improvement that we shipped last year and like all the congestion issues that people saw last year effectively gone. Final question from the community Coke or Pepsi? I neither.

(24:08 - 24:14)

Sugar water is bad for you. What do you drink usually? Water. Just water? LaCroix.

(24:14 - 24:22)

I mean, if you've seen the podcasts and stuff, I am like downing cans of LaCroix the whole time. I like the lemon cello. That's my favorite probably.

(24:22 - 24:29)

You know, this hackathon just ended. There's going to be another hackathon, surprise. So start building something really cool for the next one.

(24:29 - 24:58)

It's the best way to like, I think if you're just an engineer and you don't know how to start a company, it's the best place to go actually meet other folks that are like thinking about startups and crypto and like will connect you to VCs and try to help you succeed. What would you like to see being built more on Solana? More consumer facing stuff. I think

social finance, like folks really trying to build like Venmo, WeChat competitors, all of this like kind of like really cool experiments.

(24:58 - 25:20)

I think we need more of those because I think those really connect users directly to decentralized finance and deliver value to them. And like I think a moderate success in like social finance, 10, 20 million users would transform the entire industry. So I have actually brought my Solana Saga and I'd love you to sign it for me.

(25:20 - 25:28)

Is that possible? So here's the pen. It's a bit broken, but. Oh, it's beautiful, man.

(25:28 - 25:33)

Yeah, I'll just put it down here. Where would you like me to sign it? I think. Oh, wow.

(25:33 - 25:36)

I think maybe here. Oh, yeah. Wow.

(25:36 - 25:43)

Or maybe the back as well. Let's do both. Awesome.

(25:43 - 25:48)

And one more here as well. That'd be great. Oh, that's not even visible.

(25:50 - 25:51)

Thanks a lot. Thank you so much.