EPISODE 1239

[INTRODUCTION]

[00:00:00] JM: A token can represent almost anything in Ethereum, lottery tickets, points in an online platform, fiat currency and much more. These tokens must follow a standard called ERC-20 to have the same type and value of any other token and behave just like the Eth. The platform Opyn lets users buy and trade decentralized finance, DeFi options, on Eth and ERC-20s. Options represent underlying assets with predefined or strike prices and expiry dates that can be bought and sold. Opyn provides options protocols through smart contracts that are powerful and capital efficient using options help secure against volatility and flash crashes. They typically have lower margin requirements and they can yield interest bearing collateral. In this episode we speak with Aparna Krishnan, a co-founder of Opyn. We discuss options trading and how it differs from trading pure cryptocurrencies, developing and using smart contracts to define DeFi protocols and the unique benefits of using Opyn for options trading.

[INTERVIEW]

[00:01:06] JM: Aparna, welcome to the show.

[00:01:07] AK: Thank you for having me.

[00:01:10] JM: Let's start off with a brief overview of what an option is. Many people are familiar with the basics of trading, buying and selling stocks. Can you explain what an option is?

[00:01:23] AK: Yeah. So an option gives someone the right but not the obligation to do something. So what that something is depends on the specific option. That's why it's called an option. So broadly speaking, two types of options, a put option and a call option. A put option – At least financially these are like the most common options. A put option gives you the right but not the obligation to sell your assets at a specific price, and a call option gives you the right but not the obligation to buy a specific asset at a certain price.

[00:02:05] JM: And options have been around for a pretty long time on the traditional trading markets as far as assets that are outside of the traditional trading market, specifically crypto assets, how have the option markets been served in recent memory?

[00:02:23] AK: Yeah. So around crypto, the biggest like option markets are Bitcoin options and Ethereum options. Bitcoin obviously is like the bigger market right now and these are currently served through several centralized exchanges probably the biggest and most popular being Deribit. I guess the downside of how things work right now is that on Daribit only like certain people in certain parts of the world can access the platform and use their products. So that's kind of where Opyn comes in, where our goal is to build decentralized options which are just a primitive piece of the internet that exists. Anyone from anywhere should be able to use them.

[00:03:17] JM: So options have historically been managed by centralized providers. Why does it matter that – Well, actually, first we should define. Can you explain what the difference between a centralized options scheme and a decentralized options scheme is?

[00:03:33] AK: Yeah. So the biggest difference I would say is like where is this hosted. So if you think about like if you built an application or a website today and you hosted it on AWS, Amazon could shut you down, and this is kind of what happened with Parler. Yeah, actually this is what happened with Parler like maybe a few months or a few weeks ago. With a decentralized application you're basically putting something on the blockchain and the blockchain is sort of managed by people all around the world so there isn't really one person who can say, "I'm shutting this application down because it requires consensus amongst like 51% of the people to remove any of those applications."

Unlike in the case of Amazon where like the company as a whole can just decide to shut down an application. So that's really what makes something centralized or decentralized. Again, I don't really think it's like black and white. I think it's more a spectrum. If you look at a lot of newer blockchains that are coming out, they still have this narrative if we're going to be decentralized, but at the present moment they may not be as decentralized as Ethereum or Bitcoin is.

[00:04:52] JM: But it's certainly conceivable why something like Parler could get shut down, because that's this this contentious controversial platform where people talk about all kinds of racy things. But options, trading options, why would that need to be decentralized? Like why would options be anything that would be potentially censored?

[00:05:14] AK: Yeah. So this is a very interesting question, and I think even with something like Parler, maybe to some segment of people it makes sense what would be shut down, but that's not necessarily true for all segments of all people. Like there are people who still use the application, and if it got shut down they would be very upset and very hurt by it. I think coming back to options and like just financial tools in general, I think historically financial tools and services are quite under the control of governments. So if you take a country like Venezuela or Argentina where the currency is hyper-inflating. People don't trust the government. The government could very well not want other financial services to exist. In that case, your only alternative is sort of these decentralized tools and services. So you kind of need a way of getting around this big trusted – I guess you need a way of getting around governments when you can't trust governments anymore. And, yes, maybe in the United States you have a great government and you can trust the US dollar, but that's not true of every country in the world.

[00:06:31] JM: So, again, I can understand this on a currency basis, but I mean the options are not really like a government-managed abstraction, right? Like currencies are managed by governments, but options are not managed by governments. They're managed by corporations. And don't we traditionally have a little bit – Like corporations are not going to screw us in the same way that governments would screw us, right?

[00:06:56] AK: Well, think about like the 2008 crisis. Who were the people who got arrested? Who were the people who like had to pay? And there is now such a thing as too big to fail. And certain corporations like some banks today are really too big to fail. They could still continue taking the same risks as they did in 2008 and there really isn't much punishment. It's kind of like if the government stepped in and is like, "All right, Facebook, you messed up and you leaked everyone's data, but that's okay. We'll still step in and save you." That's kind of what the current financial system is like.

I guess, yes, maybe like governments themselves are not running options directly, but they're still in a sense regulating or like managing which corporations can provide access to these tools and services and like restricting who can access these tools and services. And when you think about it, like even something like the accredited investor, like standards, why can someone who does really fully understand options but may not necessarily like have that much money not trade options? That doesn't make very much sense to me. And I think that holds true if like any sort of financial tool or services. Like all sort of derivatives have the same sort of philosophy.

[00:08:20] JM: Well, in any case I'm playing the devil's advocate a little bit. I think it's cool that there is a decentralized options trading platform, but let's talk about how to build it now. So options are the ability to have these different buy and sell, call and put, well, options on assets. So there's typically a wide range of options that are available for any given instrument. So tell me about how these options get made available to users across the Opyn platform, which is what you're building?

[00:08:59] AK: Yeah. So the Opyn platform – Opyn is fundamentally just a piece of infrastructure on the Ethereum blockchain. So I guess there're a few different layers. Most users access Opyn through our frontend interface, but really anyone can build their own frontend to the piece of infrastructure that's on the blockchain. That piece of infrastructure, the first version of it, is called the convexity protocol. Version two is called gamma protocol.

The way version one works, it's physically settled, fully collateralized options that don't really require oracles. So let me break down what that means. So when it comes to paying someone out for an option, there's two different ways you could do it. One is you could kind of exchange. So let's say I have a put option on Eth with a strike a hundred. That just means I have the right to sell my Eth for a hundred dollars. There are two ways I can go about settling this option. One is I can come with the Eth and get a hundred dollars out. So I have to come in with one Eth. Or the second way of settling it is if the price of Eth is below 100, I could ask for the difference in price. And if the price is above 100, I get nothing. So the two are different.

So the first way of exchanging Eth for a hundred dollars is called physical settlement, and the second way of just getting paid out the difference in price and strike price is called cash settlement. The first way of settling doesn't require any sort of oracle or any sort of on-chain

source that tells you what the actual price of this asset is. The second way of settling requires an on-chain way of telling you what the price of this asset is. So our version one of Opyn is physically settled options which doesn't require an oracle, and version two is cash settled options, which currently do require an oracle, but the reason they are cash settled is so that you can use options as collateral to create more options. So such a position is called a spread, and basically you would only need to put the difference between the strike price of the option that you put down as collateral and the option that you're creating as – I guess it reduces the amount of capitals that you have to lock up to create a new option.

[00:11:50] JM: And let's talk a little bit more about the usage of these options. Who is buying and selling them?

[00:11:57] AK: Well, a lot of them are anonymous users, and I don't really know them personally. I'm guessing a lot of them are retail users, or I guess in decentralized finance what we call them are whales. So these big anonymous users who just come make big orders and then disappear. Right now I think we haven't really seen institutions come in yet, but I think that's going to be the next stage.

[00:12:31] JM: And clarify a little bit more like why are they buying these options. How does it fit into an overall investor strategy?

[00:12:38] AK: Yeah. So that's a really good question. So there're obviously a lot of different things you could do with options. If you're buying an option you might use it as a way of hedging your risk against – So let's say if you're buying a put option. You might use it as a way of hedging yourself against like an asset price tanking. So that's an insurance use case of options. If you're buying a call option, maybe you're using that as a way of getting leverage. So maybe you're using that as a way to determine the future price of Eth, and like if it really goes up you paid a small amount now and you get a big return later.

If you are selling these options, if you're selling a put or call option, you might use it as a way of passively earning interest. So you might choose to sell like out of the money put or call options just to sort of get a steady source of premium on every option that you're selling. There're a lot of different strategies that people use them for, and options are really powerful instruments

because you can create any sort of financial payout with options. So there's a lot of different stuff that we've seen people use them for.

[00:14:03] JM: At a high level, what goes into building a options trading platform on top of Ethereum?

[00:14:10] AK: Yeah. So the biggest challenge with building anything on Ethereum is like building secure solidity smart contracts. With building smart contracts, it's a totally different approach than it is building any sort of React application because it's almost back to building a rocket. And if you build this and it has a bug, once you've launched it you really don't get to go back and undo things and you might have killed someone in the process. In this case you don't really kill someone. You might end up losing user's money.

And so the biggest challenge is with figuring out how you secure these smart contracts. Sometimes it's through doing security audits, which means having other people in the community take a look at your code and try to break it. Sometimes it's through doing formal verification, which is trying to formally prove that your system is safe and that it works in a certain way. And those are sort of like the biggest challenges we face on a day-to-day basis.

[00:15:23] JM: Can you give me an overview of the architecture? Like how do smart contracts fit together to create a decentralized options platform?

[00:15:33] AK: Yeah. So I guess maybe I could give you an overview of like the full stack first and then we could chat a little bit about the smart contracts. So, one, there's like Opyn smart contracts, which allows someone to create an option. So someone can go there, lock up collateral and create an option. But just because they created an option doesn't mean they've sold the option. So that then brings us to a second set of smart contracts, which is an exchange, which is where this person trades the option. This is the part we're still building out, and currently we use 0x and Uniswap V1 to sort of trade these options as an exchange venue. Sometimes users can also just directly trade with each other through an OTC interface. Then we kind of need some price source which tells us what is the price of different assets. That's where we use Chainlink, which tells us what the price of Ethereum currently is or what the price of Bitcoin currently is, and regularly pushes that onto the blockchain.

Now to interact with all these different smart contracts we need an interface, and that's where our React frontend comes in. And then to sort of allow like different, I guess, regular updates to the smart contract and keep the system well maintained, we need some bots, which is where our servers and like the whole JavaScript stack comes in. So there's a lot of different moving parts.

With the smart contracts alone, like would you want me to dive deeper into like the V1 contracts, V2 contracts? What do you think?

[00:17:22] JM: Well, let's maybe walk through the anatomy of a contract creation and deployment. So if I want to create like an option on – I mean, can I just create an option on like, I don't know, Algorand? Can I make a put option on Algorand. Just spin it up in Opyn and have other people – And then that'll spin up some infrastructure on the backend?

[00:17:49] AK: Yeah, actually you can. Well, on V1, you can. On V2 we do have certain assets whitelisted, but you could just tell us you wanted to create an option on X-asset and we could whitelist that asset for you and then you can go ahead create that option.

So the way to think about it is there are certain markets for which you can go ahead create any option for. For example, if you wanted to create an option on Ethereum, you can go ahead create any strike price, any expiry date and we don't really need to whitelist anything. If you wanted to create an option on a new asset that isn't whitelisted, that's a different product offering. So we would need to make sure the risks work out okay and then you could create that option. So basically you can create an option on any token that is an ERC-20 that there exists a robust price source for.

[00:18:48] JM: Okay. So let's say I want to create my own option contract. What do I do and what happens on the backend?

[00:18:58] AK: Yeah. So if you want to create your own option contract on say like COMP, or Wrapped Bitcoin, or another ERC-20, you go to Opyn's factory contract, which is where you create the options, and you just call the function, I think create new product. I don't remember

what it is at the top of my head, and that's pretty much it, and then you've created a new option market. And in that market you can start having users create those options and then trade it on different exchange.

[00:19:37] JM: And can you describe how that propagates through the Ethereum infrastructure that you've built?

[00:19:42] AK: Yes. So all of this exists on the Ethereum blockchain, and all of these different moving parts are smart contracts on the Ethereum blockchain. So when you are doing something like go create a new option market, you're calling a function of the smart contract that is deployed on the Ethereum blockchain. And so you're deploying a new market on the Ethereum blockchain. And then when you're trading in this new market on the Ethereum blockchain, you're maybe using a venue like Uniswap or 0x. And so everything that you're doing is actually just happening on Ethereum, although you might use like a front end or some other interface to access this infrastructure.

[00:20:32] JM: Gotcha. So can you walk me through what happens on one of those Ethereum smart contracts or the set of Ethereum smart contracts? Like one thing I'm trying to learn is just a little bit more about how the software architecture of different smart contracts works. Like do you have multiple smart contracts that orchestrate together to run the software for an option? Or how does that work exactly?

[00:20:57] AK: So each option is represented as an ERC-20 token. And so the way it works is when you're creating a new product, you're interacting with sort of the whitelist module, which then goes ahead and white lists a new set of like asset collateral underlying combination. Once you have that whitelisted, then you can go ahead and create OTokens, or like OTokens, which are an ERC-20 token, for a specific product. And each of those are represented as a token on the Ethereum blockchain. So every option is a token on the blockchain. And all of these tokens are fungible within the same market, but are non-fungible across different markets.

So the Ethereum put option with strike 100 is one ERC-20 contract, and all the tokens created under that are fungible with each other. But the Ethereum call option with strike 1000 is a

separate market and a separate ERC-20 contract and options in that market are not fungible with the put option contract, or not fungible with a contract of a different strike price.

[00:22:28] JM: And how do the contracts actually work? Like how do you make it such that once I've purchased a put option that put option will do what it's supposed to do? How is it verified that it's going to do what it's supposed to do?

[00:22:47] AK: Yeah. So all that logic happens in this controller contract, which is like the giant brain, which manages each of these different markets. So when someone creates a new option, and I don't mean a market, I mean like is going to sell a new option. They have to put up collateral. All the collateral across all the different markets are stored in one main pool, which is the margin pool contract. And this pool contract can only be accessed by the big brain, which is the controller contract, which determines who can be paid out what amount and like manages all the accounting and bookkeeping. So the controller contract actually isn't doing all the math. The math is happening in a margin calculator contract, which tells the controller contract like, "Hey, this person –" Or like tells the controller contract this is how much you can pay out one option of this type. This is how much you can pay out one option of this other type.

And so if a user is interacting with the system, they're interacting with the big brain, which is the controller contract. And if, for example, they're trying to settle their option after expiry, they would go to the controller contract and be like, "Hey, I want to settle my option," and the controller would then ask the calculator, "How much should this person get when they're settling up?" And the calculator tells the controller that and then the controller pulls that amount of money from the margin pool and sends it to the end user.

[00:24:33] JM: Okay. So when I'm in possession of a contract and that contract – Well, I guess if the contract expires, or if I'm in possession of essentially a token that is created against a contract and that contract expires, my token is going to be worthless. Otherwise I'm going to need to do something with that token before the contract expires, and all of that is managed by the smart contract.

[00:25:04] AK: Yeah, by the big brain controller.

[00:25:06] JM: The big brain controller, right.

[00:25:09] AK: Every interaction with the Opyn V2 is happening through the controller, whether that's like adding collateral, removing collateral, settling your option that you own. All of these are happening through the same interface.

[00:25:26] JM: Can you walk me through one more time like what all happens across that big brain? Like what is that big brain orchestrating? Like I put in money, I'm going to get a tokenized contract back. Walk me through that full transaction again.

[00:25:42] AK: Yeah. So I guess there are two – Okay, two broad types of users. One is the option seller and the other is the option buyer. So the option seller first needs to create an option or mint an oToken before they can sell it. The selling happens on an exchange, and that's for now like when I say option seller, I just mean the person who's like minting the option. Not necessarily like the part where they go ahead and sell the option. So they're just going ahead and creating oToken.

To create this oToken they go to the controller and they're like, "Okay, this is how many oTokens for this particular market that I want to create." So the controller then takes collateral from them, puts it into the margin pool. From that specific contract that they want to create oTokens, it creates oTokens and sends it to them. So that whole orchestration happens by the controller. Now if the same person comes back and is like, "Actually, here are the oTokens. I want to close my position before expiry." It can take the oTokens back from the seller and then burn them, release their collateral from their vault and give it back to the seller.

If instead I'm a buyer who bought these oTokens on a different exchange, I could go to the controller after expiry and say, "Hey, I think my options are in the money. Can you settle them for me?" And then the controller will like take my options, burn them, for that specific market decide – Ask the calculator how much it should pay out, and then based on that, payout money from the margin pool.

And so sort of the broad actions, there are a few different actions that the controller can take. Actually this is a really cool feature of Opyn V2, which is you can flash mint infinite number of

options. So there're a few operations you can take and it doesn't matter in what order you can take them, in any order as long as the end state is a safe state. So you can mint an option, you can add collateral, you can remove collateral, you can burn an option, you can settle a vault, or exercise an option, and you can do all of these actions in any order. And as long as the start state and end state are safe, it doesn't matter.

[00:28:14] JM: How do you test the functionality of the entirety of the options platform?

[00:28:20] AK: Yeah. So this is actually quite complicated with V2, and a big part of – So we have several different things that we do in the testing process. One is unit tests. So anytime anyone writes a module, just write unit tests. Then we have integration tests where we test interactions between different modules. So between the controller and calculator, between the calculator and the oracle. And then on each of these modules, especially like the more complicated ones, like margin calculator, we fuzz the calculator on a bunch of random different inputs. So we built our own like in-house testing engine, which throws a bunch of random inputs based on all possible paths that the calculator can take and make sure that we've covered each of those scenarios. But even beyond all these, we do internal audits where everyone on the team audits the code base. Makes sure the implementation matches the spec that we've written out and there are no other attacks that are possible based on like other common DeFi exploits. We also have external auditors take a look at our code. And beyond all of this, also formally verify the code uh with Certora.

[00:29:53] JM: And did you find any issues after you went live?

[00:29:58] AK: So far we've not found any high or critical vulnerabilities after we've gone live.

[00:30:04] JM: That's amazing.

[00:30:05] AK: We've done an audit with OpenZeppelin, with PeckShield. In fact, PeckShield audited the code after it was live and formally verified the code with Certora. But, again, I would say like security is a continuous process and I think like DeFi changes so fast. And so we continue to revisit the security of our code base every month just to keep up with like all the

different attacks happening in DeFi and make sure it's not vulnerable against any of the newer attack vectors that are coming up.

[00:30:44] JM: So today, are there centralized options platforms that compete functionally with Opyn, that compete functionally with your decentralized options platform?

[00:30:57] AK: Yeah, in terms of like capital efficiency, in terms of like gas fees, there are a lot of centralized alternatives which make it a better experience for users, especially big institutions. But I do think for users who live outside certain countries, they don't even have the option to access these centralized exchanges. And so Opyn is sort of like the only alternative for them.

[00:31:29] JM: Got it. So this would be like people in like developing countries or people who are just don't have bank accounts or what are you talking about exactly?

[00:31:38] AK: Oh! I mean, I think – Well, I don't actually know where Deribit is accessible. I know it's accessible in like some parts of Asia, but not like all countries in Asia. So if you're an options trader and you want to do trade crypto options and you live like not in like the select countries that they have offerings in, it doesn't have to be a developing country. It could be like – I don't remember if they're accessible in Japan or not. But, yeah, it could be like maybe you live in Japan and you just want to trade options and it's not accessible, or you live in Canada and it's not accessible.

[00:32:18] JM: What is it like to try to build a DeFi team these days? Is the competition for talent just tremendously difficult?

[00:32:28] AK: I would say every DeFi project is hiring and like there are a lot of awesome stuff that's getting built at the same time. That said, I think when an amazing group of people comes together to build like something truly that everyone's passionate about, I think everyone can feel the energy. And I think like I would say it's not that hard to find talent. I think maybe like for some roles where there're very, very few people who can do that role, it's hard, but I would say as a general case maybe not so.

[00:33:12] JM: What are the hardest engineering problems you're dealing with right now?

[00:33:16] AK: Yeah. So a lot of the hardest engineering problems we're focused on is around, one, like layer two scalability or even like figuring out if we want to do a layer one and like how we're going to go about that. And obviously doing something like that is going to be much more complex in scope. So figuring out how we secure something that big in scope. So that's one whole realm of things.

The other set of things we're working on is around capital efficiency and making it lucrative enough for institutions and other like big traders to use on-chain solutions instead of like Deribit. So that requires a lot of on-chain computation. So thinking about like how do we do all this computation? But also like secure it while like keeping it gas-efficient. So like sort of solving within all these constraints, that makes it a very very tricky problem.

And then our biggest, most exciting thing that's coming on our roadmap, is figuring out how we build an on-chain options exchange. So the AMM problem for normal tokens has been really well done, well solved by like Uniswap, Balancer, etc. But options have DK, which means as time tends to expiry for the option, the option reduces in value. And so none of these on-chain AMMs work well for options. And so a big area of research and engineering for us is figuring out how to build an option-specific AMM.

[00:35:07] JM: Can you explain that problem? That AMM problem in more detail?

[00:35:12] AK: Yeah. So right now if I'm a liquidity – So let's take the way Uniswap works. Uniswap is a constant product AMM. If I provide liquidity to Uniswap, I might provide like some portion options, some portion maybe USDC or like Eth. So let's say for simplicity it's Eth. Any sort of smart trader will continue to arb against me as the option tends to expiry. And right before expiry, like any sort of Ethereum left would be swapped out for all the options and after expiry I'll be left with a bunch of worthless options.

So the only way to make that to me, I, as liquidity provider, after expiry and left with only options, which are all worthless, and maybe I made some fees but the fees are definitely not enough for me to compensate my losses on the Ethereum that I've put down. And so right now it's unprofitable for any sort of LPs to use Uniswap for a product like options. And so we're kind of

figuring out, "Can we create an AMM where you provide liquidity, but as time passes you sort of like – The AMM itself knows to take out some of the Eth and like set it aside and reprice the option to a lower value because it has data decay," and that way you don't lose out all the Eth at expiry to a smart arbitrager.

[00:37:03] JM: Now it's worth noting that you are a company. There's a company built around this protocol. So what is the value to the company of the platform? How do you monetize the platform itself?

[00:37:19] AK: Yeah, a big part of how we see monetization is once we have an AMM, we can take a protocol fee on the AMM. So any trade that happens, we get a small percentage of that. That's one path. Another path is like adding a protocol fee to anytime someone creates a new option. Right now we haven't done that because we think like the fee on exchange is maybe a better alternative. And beyond all this, maybe there could be a token, but that's still something we're trying to decide and figure out.

[00:37:57] JM: So it's 2021. We're in the midst of a huge surge in cryptocurrency industry interest and there're a lot of developments going on. I mean I see a lot of opportunity to be built on top of the things that are being built right now, like the protocols, and decentralized exchanges, and derivatives, and options protocols. I just love to get your vision for where we are and where we're going and kind of what's next after this phase of infrastructure gets built.

[00:38:34] AK: Yeah, that's a really good question. And I think right now there's still a lot of infrastructure to get built. I can say this from firsthand experience where I think we have at least five to six years of infrastructure building to be done even just like in the derivative side on-chain. In terms of where I think defy is headed, we at Opyn really believe – We're all really excited about building an inclusive fair and open financial system. And a big part of that is starting with options right now and derivatives right now.

I think in the next like five-ish years, hopefully that's a market that we've conquered and we can tackle more interesting other sort of risks that come up and like help build hedging tools for those risks. But right now I think for the next five-ish years it's probably going to be derivatives.

[00:39:46] JM: Are you seeing a lot of main street derivatives trading companies get involved in crypto derivatives trading or crypto derivatives infrastructure investing?

[00:39:59] AK: Yeah. In fact a lot of the investors who invest in like centralized exchanges and centralized derivative companies invest in on-chain derivative products. And also a lot of these companies themselves invest in like – Or have a like fund which invests in DeFi products. So it's very interesting to see what's going to happen there. I'm just curious to see like where that leads us in the next few years to few months.

[00:40:35] JM: What are the challenges of company building in the crypto infrastructure land that you would warn people about if they're considering building a company in crypto?

[00:40:47] AK: So crypto has cycles of like extreme hype and extreme lows, and I think right now we're at the peak, or, well, I can't predict the market, but it feels like we're nearing a peak. And I think the biggest challenge is remembering to stay focused. Remembering that you created a plan for a reason and you have to stick to the plan regardless of where the market is in the sense of like if you need to do security, you need to do it. You can't just launch a token and get hype investors, because it's very easy to build a product that goes to the moon today and goes back to the floor tomorrow. And we've seen that trend happen over and over and over again in crypto and you don't need to do that yourself to learn from it. I think remembering to stay disciplined and like do the right things and do the right things by your users I think is the biggest challenge but the most valuable thing on your side as well.

I guess maybe one more thing I would say is crypto has a very like love-hate relationship with the rest of the world. Like either people love you or people hate you and it's going to be like all of the emotions all the time, and it requires a lot of faith in the future and faith in the long term vision behind where crypto is taking us to really stick through both the highs and the lows. I personally feel like those who stick through the lows are the ones who truly believe in crypto and a lot of amazing stuff gets built during the lows, which is why there exists the highs. And so like sticking through it even when crypto prices drop is I think the biggest signal of perseverance and like belief in this long-term mission.

[00:42:49] JM: Great. Okay. Well, that sounds like a good place to wrap up. Aparna, thanks for coming the show. It's been great talking.

[00:42:54] AK: Yeah, I enjoyed it. Thank you for having me.

[END]