EPISODE 606

[INTRODUCTION]

[0:00:00.3] JM: In the tech industry, we've all grown to fear lock-in. Lock-in is a situation in which you have no choice but to pay a certain provider for some aspect of your computer services. Since computers are so fundamental to our lives, we sometimes have no choice but to pay the provider of that lock-in for their service. Think of a few service providers in your life who have no serious competition. What's your relationship to that service provider? Do you feel like you're paying too much money? Do you wish that you could switch? This is how many people feel about their internet service provider.

An internet service provider is the company that provides you with the last mile of physical infrastructure that connects you to the rest of the internet. Different forms of ISP include cable ISPs, satellite ISPs, fiber ISPs and copper DSL ISPs. The medium of delivery varies, but the functionality is the same. The company is crucial to your internet access. In many geographic locations, there are very restricted options for which ISP you could use. Why is that? Many people assume that there's some physical, or regulatory barrier to starting an ISP. In fact, there are fewer barriers than you might think.

Adam Montgomery is a Co-founder of Necto, a company that provides an ISP starter kit. If you want to start your own ISP in an apartment building, or in your neighborhood, or wherever you are, the Necto ISP starter kit can help you get off the ground. That might sound a crazy idea, but in this episode, Adam explains why it is not so crazy, why the technology around ISPs is more broadly accessible than many people believe.

As always, if you have feedback, or suggestions on the show, or ideas for show topics, or really anything you want to talk about, send me an e-mail, jeff@softwareengineeringdaily.com. I'd love to hear from you.

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Thanks again to Segment for sponsoring Software Engineering Daily and for producing a product that we needed.

[INTERVIEW]

[0:04:32.8] JM: Adam Montgomery is the Founder of Necto. Adam, welcome to Software Engineering Daily.

[0:04:37.5] AM: Thanks for having me, Jeff.

[0:04:38.5] JM: What is an ISP?

[0:04:40.1] AM: Oh, so an internet service provider, or ISP is a company that sells internet service to either residential, or business clients. Mainly what they're responsible for is what's called the last mile delivery. That's getting basically to the home, or physical address of their subscribers. Going out from there, the internet takes on more of a life of its own, but what they're responsible for is going from that home to a transit provider out to the wider internet and providing connectivity services to those subscribers.

[0:05:15.7] JM: What's required to build one of those ISPs?

[0:05:19.4] AM: Really what you need is some expertise basically on networking, and some way to – some sort of technology, or mechanism to deliver the internet, as well as the capabilities to support those subscribers and keep everybody happy, keep everybody billing and all those aspects; marketing, customer acquisition and retention.

Yeah, as far as technically what they need, they really need a – now the ability to provide internet to those customers. Pretty common ways in the past have done that, like starting with dial-up providers, DSL, fiber, fixed wireless is what we use here in San Francisco. There's a few mechanisms there to do that last mile delivery, and then being able to keep the trains running and keep the pipes flowing and keep the internet and connectivity working for your customers.

[0:06:08.8] JM: You've referred to that term last mile as being something that is descriptor for the ISPs. What other parts of the life cycle in traveling a message on the internet, a packet on the Internet, traveling from one person to another? Where does it cross over into an ISIP and where is it crossing over from? Can you give us more of a lay of the land of how a packet travels through the internet?

[0:06:36.9] AM: Yeah, yeah, definitely. If you start at your device, or your computer, you're transmitting usually over like a Wi-Fi network possibly in your home. Then where you consider the point where it transfers from your in-home network to your ISP, so that is – that would be at the modem usually, is a modem or router combinations, where that point where it crosses over. Basically yeah, what you're sending is yeah, packets of information, and that transits over whatever the physical medium that the – your provider has set up through their switching gear, through their routing gear, and then out to the wider internet. Really how you think of the internet is really it's just – it's just a collection of computers and switching gear owned by different people.

What you do when, and the wider net is called like a autonomous system, is like a set of switching gear that belongs to an individual company. Then what you do is that, when that packet is going out to go reach whatever that final destination, like say you're trying to reach, you know, you're in the US and you're trying to reach like somewhere in Korea, you go across those various autonomous systems. You can think of each of those groups of computers as its own ISP, because it takes – similarly, it takes traffic in from its customers and it sends it out to a destination. It's almost like a sequential ISP for nested relationship there between all these different companies, and then it just follows usually a similar path on the way back.

You're really transiting across a bunch of, you sort of have one ISP, but your ISP might have an ISP and similarly like that. That's how the internet – how you get connected to all these different computers. It's not like one ISP has to negotiate with somebody in like transcontinental cable, or anything like that. You have one person that you deal with and then that person deals with one or multiple people to provide internet service going out that way.

[0:08:32.4] JM: There are cable ISPs, there are fiber ISPs, there are copper DSL ISPs, there's satellite ISPs, how do these different ISP delivery methods differ?

[0:08:45.3] AM: Yeah. A lot of them does – the ones you mentioned there, they're the physical medium that you use for that last mile. With a satellite, you're transmitting wireless signal over like usually K bands to provide that last mile connectivity. The big difference between those different ones is throughput and latency usually.

With the satellite, if you're going to a geostationary orbit satellite, you'lll actually run into issues with speed of light as how much your latency is going to be bounded by. If you're going over a cable, or fiber, like fiber would have a lot more capacity for a lot more throughput capacity. Depending on what that medium is, is really determining those two aspects of your experience, as well as reliability based on how that physical medium is set up.

[0:09:33.9] JM: I know the term throughput. What is thoroughput?

[0:09:37.0] AM: Oh, throughput, sorry. Yeah, that's a Canadian thing.

[0:09:39.9] JM: You meant throughput. Okay, I'm sorry. All right. You could coin that term if want at some point. Is there a best delivery method among these different ISP hardware mediums?

[0:09:52.6] AM: If you look at it on the cost-benefit basis now, it's a tradeoff every time. If you're somewhere and you just have no other way to reach another connectivity point, like satellite is your best option. Between say, if cost was constant, fiber would be the gold standard, but cost isn't constant and fibers are very expensive to run. It's really always just a tradeoff between those factors and looking at the specifics of the deployment on whether which one is best. That's usually how – you have to almost look at it on a cost basis, because that's – at the end of the day, there's a lifetime of the equipment and there's payback periods. If you had unlimited money then you can make different decisions, but given the realities, you have to look at that trade-off.

[0:10:37.3] JM: Americans have very little choice over which ISP they can use. Why is that?

[0:10:45.8] AM: Yeah, that's interesting. There is a large amount of the US that is not really in a competitive marketplace. I think those are vestiges of the cost of what it used to cost to lay this infrastructure. If you're looking at having to provide service to every single home in America, it's an extremely costly endeavor. There used to not have the technology that we have now to be able to provide service to an area at a really, really low cost.

If you're having to put in cables into the ground, that's really expensive. If you have a – you can get a lot of basically return to that scale, if you can – efficiency of scale rather, if you are like a

big company and you're putting these cables in the ground along with the more government-funded monopoly situation that like AT&T found itself benefiting from. Yeah, that's why that there, there hasn't been that huge shift.

What we're seeing now and the reason that we got started is that the technology has really caught up and been able to provide that really cost-effective service and enabling just anybody to be able to start their own ISP. What we see now is the issue is no longer, “Am I big enough company to afford a billion dollar outlay?” It's, “Do I have the expertise? Do I have the capability to service these customers?”

We found really now that the thing that's really constraining the market is the network engineering and the technical aspects of how to run these businesses. There's probably a lot of people ought to be listing that, that didn't really know you could start an ISP. I didn't know that originally. The fact that you can is something that you can and that you – if you have the support to be able to do the technical sides of things, then you can make a good amount of money at it, is something that has really only been enabled recently with the change in the technology.

What we do is try to bring and bridge that technical gap and say like, “Okay, we can wrap this all into one thing.” If you can talk to customers, if you can do the sales, if you can handle the business parts of running a business, then we can handle the internet part of it.

[0:12:54.3] JM: We will certainly get into that. A little more on the state of affairs; today, Comcast is often referred to as a monopoly. I certainly feel like my relationship with Comcast is antagonistic. Whereas, most of the service providers that I use in my life, I feel like I have a choice and therefore, there is not that antagonistic relationship. I do feel the service providers where I have an antagonistic relationship, there seems to be a high correlation with ones that are sometimes referred to as monopolistic. Is Comcast a monopoly?

[0:13:33.2] AM: I mean, I'm certainly in certain areas. I would say it would be pretty close. Probably in a lot, it's monopoly duopoly. Yeah, there's just a lot of areas where there's just not a lot of choice. With the lack of competition, you get a lot of some of the issues that we see now, where it's just – there's not that same focus, there's not the same drive to the customer

experience part of it. Yeah, whether we'd meet the technical definition or not, it certainly puts people in a position where they feel like they're left without options.

[0:14:03.3] JM: I think monopoly is not necessarily a problematic situation to be in from a legal standpoint. Antitrust is where it gets worrisome. Antitrust is where a monopoly will undermine the competition. Does Comcast or any other large ISP engage in antitrust?

[0:14:24.6] AM: To call it antitrust, I don't know. There's certainly – certainly you hear stories about if they – if you're laying infrastructure and you're trying to get on power poles, and you have – if you have Comcast already on the pole, there's probably certain competitive measures that they would take out. Whether it's antitrust or not, that's out of my wheelhouse. There's certainly issues with their scale that make it hard to compete with them in certain areas.
[0:14:50.7] JM: In San Francisco, there are more ISPs than most places in the US. Why is that?

[0:14:58.8] AM: Yeah. I think it's a lot of people that have – so some of the ice piece that we have out here, like there's Monkeybrains, Webpass. I think it would just have to be the culture of the area, I guess that some people have this, like the hacker mentality of like, in LA, "Hey, we can do this. There's not a reason that we have to be beholden to these big guys." I think that it's got to be a function of the culture, and the fact that there's a lot of people out here with really high requirements for internet access, a lot of software engineering community out here. I think the combination of the two has made it a really good area to start an ISP.

[0:15:38.7] JM: Now, I have been following Google Fiber out of the corner of my eye, but I don't have a great understanding for what challenges they ran into, what the state of Google Fiber is today. Can you tell me about Google Fiber? The reason I bring this up is just because I think it's an interesting data point along the historical timeline of how hard is it to build an ISP and what do you need to build an ISP.

[0:16:07.6] AM: Yeah. A lot of the things that we've heard about from Google Fiber is really just running into cost issues. If you're rolling out fiber across the US and a large amount of these cities, you know what? It's pretty expensive. Being able to do it cost-effectively and managing that construction process and that build-out process is certainly a skill set. The issues that we've heard is mainly related to cost that has just been – it's been hard to get fiber in the ground cost-

effectively and get these spun up. That's a risk you take, if you're going to want to shell out that much money and lay fiber across that much area. That's what we've heard, and we've heard that there's – it certainly, seems like it's slowing down the deployment speed for Google Fiber.

[0:16:57.2] JM: Google Fiber, a potential provider of fiber. How does that differ from an ISP?

[0:17:05.4] AM: Google Fiber in those cases would be the ISP. There's sort of two – the person that owns the fiber and the person that provides the internet service over the fiber, doesn't necessarily have to be the same person. Here in San Francisco, there's initiative they're looking at right now for what's called an open access fiber network. What that is, is where the city takes on the capital expenditure of laying all the fiber, and in San Francisco looking to try to get fiber to every home. They take on that laying that fiber and then somebody else, another like a private company then takes on responsibility for what's called lighting that fiber and providing service across the glass that's basically in the ground.

In this case, like in that case with Google, they own the fiber and light fiber in the open access networks that they're looking at half and came on here in San Francisco. Those could possibly be separate companies.

[0:17:57.4] JM: If Google Fiber had a hard time, but you're making the argument that an ISP is easier to set up today than it was in the past, what's the gap there that I think listeners may sense? There's obviously something there to bridge the gap, right?

[0:18:19.3] AM: Yeah, definitely. That's a more cost-effective way of getting the internet service. If you're looking to put like – what we do is we're not advocating our operators to go in and put fiber in the ground day one, much the same way that you have a lot of independent ISPs here that they didn't start with fiber. If you want to try – and starting with fiber is a pretty – a high-risk move, and it's not really necessary in a lot of areas. A lot of the areas that we see now, there's plenty of places you can serve internet that it wouldn't make – it wouldn't be very cost-effective for another company to try and lay fiber and provide service that way.

What we can do is we can provide service over fixed wireless equipment, and then that can provide, it can provide up to gigabyte speeds using a much, much less effect, or much, much

less costly deployment mechanism. That's really the piece is that the technology around that side on the more cost-effective side has gotten so much better. Fiber technology is obviously, like it's improving to what they're used to light it, but the stuff that you can use to be able to provide these residential and business services, the equipment there has gotten a lot easier to – a lot easier to afford and to operate.

[0:19:29.6] JM: Fixed wireless. What does that mean?

[0:19:31.4] AM: That means that you're providing service over a – like to fixed residences, homes and businesses over wireless, like RF basically. What we do is we have distribution towers that we basically attach antennas to, and then we go to individual customer homes and we set up a small antenna on their roof. Then the communication between the tower site and that antenna is what provides them the internet service.

[0:19:59.2] JM: Who owns those distribution towers?

[0:20:01.2] AM: We lease them and we own the equipment on them and then lease the towers. If you own the building, obviously you can attach towers on yours. In a lot of cases with our operators there, they own buildings and then they attach the distribution gear to that building.

[0:20:14.3] JM: Okay. There's a distribution tower. Is that like a tower where there's internet cable coming up through the tower and you have to attach some distribution? I'm sorry, this is not hardware engineering daily. I know almost nothing about this domain, but do you have to just put the distribution device up on top of the tower and that's piping up something that the tower itself has dominion over?

[0:20:44.2] AM: Yeah, yeah. Yeah, it's interesting. Yeah, there's two ways you can get into a tower. You can actually reach that. You can actually – Yeah, the tower needs to have internet connectivity, so there's two ways you can get into the tower is, one is you can – you could pull fiber directly into the building that has the tower site on it and provide it with data that way. Or you can actually wirelessly beam connectivity to that tower. You can create basically a network of these tower sites wirelessly, and on someone's, you can pull fiber directly into and then power it that way.

Yeah, it's like yeah. It is like a hardware and infrastructure thing, but it's the other thing. You can almost think of it like water. They're pipes that you need to be able to connect the pipes together, and they have to have a water source at the end of the day, so that's – there's a couple ways that you can provide that water source.

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[INTERVIEW CONTINUED]

[0:23:27.8] JM: My apartment building when I moved in, I think I was told that Comcast was my only option, even though I live in San Francisco like you. Why is that?

[0:23:39.6] AM: In the building, so there's two potential things there. One is that, if you're an apartment building and just that one provider is the only one that has pulled service into the building by choice, in San Francisco that's usually rare. A lot of cases, the building operators, there's certain rules governing whether how building operators have to basically allow other providers to provide service, but there's also a lot of gray area and wiggle room around there, where building owners can make it difficult for other providers to get into their building.

Usually, one of those two; in San Francisco, given how competitive it is, most buildings here would have at least one provider and more providers looking to get in. It could be issues with the building potentially not wanting other ones in there. It's not uncommon for certain providers to pay money to building owners, either under an access agreement, or a revenue share type thing. There's a few things there that can prevent you from getting competitive service even in a competitive market.

[0:24:45.6] JM: We'll get into Necto. Eventually, I want to give people even more of a thrust for why this might be relevant to them. Net neutrality, that's something that I know is important to you. What is the connection between the number of ISPs and net neutrality?

[0:25:04.5] AM: Yeah, with the net neutrality, I think there's two ways that you can get at the underlying goal of net neutrality, which is just like, we want to be able to not be throttled either arbitrarily, or for profit by our internet service providers. There's two ways to accomplish that. One is the regulation that they had with net neutrality bringing ISPs under Title II that has now been rolled back. The other way is just by providing you choice, so that if one of the provider that you were using, or you're thinking of using has these practices in place where they're going to effectively decide how to deal with your traffic in order to optimize their profits, you can say like, "Okay, well if there is – who else doesn't do that and have some choice in how you spend your money and how you – who you buy service from?" There's two ways there to get at that underlying goal.

[0:26:01.3] JM: Why is net neutrality so important? Why shouldn't certain packets be cheaper than others to send? I think, my understanding of net neutrality is that net neutrality would mean that you can't discriminate between one packet and another. You can't say under any conditions that this is Netflix traffic, therefore I'm going to charge you more than if this is Comcast

entertainment network traffic. Why is that important, that certain packets shouldn't be cheaper than others to send on the internet?

[0:26:33.5] AM: Yeah. Well, so if have you applied to how the phone system that is covered under Title II and you're buying your phone service from Comcast, and they've decided now to throttle your phone calls to like say, DirecTV to push to their cable network service. If you wanted to call DirecTV and try and get service, now you have like a wait time to be able to talk to them. Similarly with data packages, like if you have – you're using Netflix and one of the – your internet provider has a competing TV service, something like Netflix is going to use a decent amount of bandwidth. They decide, "Okay, hey, we have this fast lane for our TV and then we have this other lane for Netflix and other competing video providers, and it's going to run a lot slower."

To the extent that you can drive profit and what doesn't – certainly it doesn't feel to a consumer a very fair way, that's really where I think the most important piece of having that a net neutral traffic policy.

[0:27:39.8] JM: If there were multiple ISPs, would you be so in favor of net neutrality as an absolute policy?

[0:27:48.9] AM: I don't think necessarily regulation in a lot of cases, especially when you're trying to encourage businesses to get started is – it's certainly not the best tool in every case. To the extent that a competitive market would create situations where you don't have to rely on the regulation, whether or not that regulation still has the cost-benefit to make it worthwhile, a competitive environment will help you achieve to a large extent those same ends.

[0:28:16.3] JM: Yeah, because I can imagine a world where if I can pick and choose between my different ISPs, I would want the ISPs to be able to say this ISP is going to be cheaper for you if you are not using Netflix, because I'm not a huge Netflix user, so I don't have all this high-bandwidth video traffic. Therefore, I would love to get a lower-cost network connection.

[0:28:46.9] AM: Yeah, and in certain cases too, they used to have with dial-up providers, you could have ad supported internet. Yeah, if you have the same breadth of options you have with

dial-up, or you just have effectively dial phones functions like an open access network where you can just pick from any provider going over the phone system. Yeah, if you have access to all those, like that same number of providers and someone's offering a plan that you'd rather go with, then that's great, and it works for you and no one else has to fall asleep with that decision. Everyone gets to make their own.

[0:29:19.3] JM: When you look at that price of Comcast per month, so average consumer looks at the price, they see $60 a month, $80 a month, a $180 a month if Comcast has found some naive person to hook. I'm sure there are plenty of people who are paying some absurd rate for internet that they're not using, because of this dire situation. How cheap should it be, like if you – let's say you were in charge of just making things break even, you try to make a break even ISP. How cheap could you make it?

[0:29:55.1] AM: Yeah, so the big thing is you have – you're putting out capital. You're expending, like doing capital expenditure in order to make money back to pay it back. It fits into like, you know, like well yeah, how quickly should my – if I go and put 20, 50 grand into something, how quickly should I get that paid back? What's my risk that I don't get it paid back? How much should I be compensated for that risk?

If you had to take out those factors, if everything's free, internet service itself, the actual like, the moving of the bits is pretty cheap. If you're looking at – you can get a gigabyte pipe from one of these providers that's dedicated for $2,000 a month and you can fit potentially a lot, like hundreds of customers on that, then actual numbers that it costs per your cost to hit each subscriber is really, really low. It's something in like dollars range. It's all these other things of dealing in the physical world and the risks of the business is where you have to build in extra cost to be able to make sure you don't lose your investment.

[0:31:06.1] JM: All right, let's start to move towards Necto and the business that you're building. To reiterate, historically it's been quite hard to set up an ISP. Why has it gotten easier? Why has it gotten cheaper?

[0:31:22.5] AM: The technology is the big thing that's improved on the – mainly on what we've seen and that's gotten us really excited about it is on the fixed wireless side. There's been leaps

across the whole slew of network and technology; you have like software-defined networking now, the commoditization of a lot of the switching gear. Cisco's decoupled their operating system for their switches from their hardware. You just see now that just a lot of these – just these efficiencies from a mature set of networking appliances that has driven a lot of cost decrease.

On the wireless side, you're just seeing these huge leaps and bounds. There's [inaudible 0:32:07.2] released this – a 10-gigabyte satellite point-to-point radios to basically between 2 points, you can be putting up to 10-gigabytes of traffic across them. The reliability of these things has gotten so much better. The usability. Yeah, really the cost has been the big thing. It's like a cost to reliability/speed ratio has improved dramatically, especially over just the last few years.

[0:32:32.2] JM: If I want to set up an ISP today, what does that take? What are my requirements?

[0:32:37.0] AM: Yeah, so you need – well, you need a customer base, an area that you want to serve. What we do is we take out the technical side. It's like what your requirements for you, are just being like having the access to – having the access to customers and infrastructure. Infrastructure for us means that you just need, what I was talking about earlier with the tower sites. You basically need areas to broadcast your internet to these individual homes. What we look for are people that can talk to and acquire customers, sell to customers, provide a good customer service experience and provide the – what we call the vertical assets, like the things that are tall that you can strap these antennas to, to be able to serve your customers.

From there, what you do is you buy a bulk bandwidth subscription effectively from an enterprise data carrier, and then really that's pretty much it. You just need to be able to do the handiwork of getting these antennas installed and to be able to talk to the customers. There's not a – it's mainly around having the market and the hustle, are really the qualifications. This benefit, or a competitive advantage in getting either customers, or these vertical assets.

[0:33:54.3] JM: When you're setting up that ISP, if I'm setting up my ISP in my apartment building, or something like that, is there software I need? Is the software all open source?

[0:34:04.7] AM: Yeah, the software and the management are the parts that we provide. What we do is we centralize that, the networking engineering piece and the monitoring and we create the software to be able to manage the network. That's the piece that we come in and provide, so that you don't have to learn how – well, what we teach a lot about how it works, but you don't have to know, understand the network engineering aspects of it. We use software where we can and network engineering expertise where we need to.

[0:34:35.1] JM: The product that you offer is an ISP starter kit. That's what Necto Lab offers, so that if I run an apartment building, I can set up my own ISP. Maybe I have a neighborhood that happens to not have internet for some reason, or I just want to set up a competitive ISP, I can set that up. That's what Necto Lab does. You also have Necto, which is within your same company, which is your own ISP. We'll break down these a little bit further, because you mentioned the software aspect as being a competitive advantage. The fact that you wrote software for the hardware that exists, so you saw the opportunity in terms of the hardware, the lower costs, perhaps the demand for this, there's a lot of demand for this thing, because people are really disenfranchised with the state of things in terms of ISPs.

When you started this, what was the state of the software? Did you look at it and like, this is terrible software, or it's just all closed source, or like, and are the devices that you need to interface with, are they hackable enough to be able to run your own software on it? Tell me about it being able to have software dominion over this range of hardware devices that you do not own the supply chain for.

[0:35:57.8] AM: Yeah, so good news. Yeah, the other devices are hackable enough for us to be able to bring some automation to them. As far as the current – the state when we started, there's – so a lot of the ISPs, it's pretty common for these ISPs to do their – roll your own software for it. Now there's some software packages that help with that, but a lot of the state of if you're looking for surely for open source software, a lot of it is pretty old and a lot of it is geared towards the use case of more like a enterprise, a larger enterprise monitoring their network, or like a hosting company and companies like that that have – that act in some ways like an ISP, that they need to monitor a large amount of devices across a wide network, across multiple sites possibly.

Yeah, the state of the software wasn't – it wasn't certainly too great when we started. Yeah, we've had to – we had to build some stuff to be able to – be able to yeah, you can configure these devices remotely. Yeah, all in all, it's not a huge market, like providing ISPs, because they're not a – the number of ISPs are been shrinking, so there's not a lot of open source software for startup ISPs. That's the stuff that we build is the pieces that they need in order to manage and create these networks.

[0:37:24.6] JM: This ISP starter kit, it consists of some hardware and some software. What is in the ISP starter kit? If I have an apartment building, I decide I want to start my own ISP in it, what do I get from your kit?

[0:37:39.0] AM: Yeah, yeah. The starter kit is amorphous. It wraps in a few things, like you need – Yeah, there's the hardware to actually be able to get it, to get it up and running, there's a software to manage it, but really there's the pieces of like, "Okay, where can I put these antennas? What customers can I reach? Who can I buy these, the upstream connections from?" A lot of it too is us helping the operators get started with that. We will go out and get bids for them for their bulk bandwidth buy. We'll evaluate potential tower sites with them and say like, "Okay yeah, you can reach these many customers from this way. This is in your way here," and build out a network map for them, help them with the distribution side and say like, "Okay, here are some of the ways that we use to market to our customers that work. You can use these, or you can use your own."

Help you with the branding and setting prices, and then bringing in the expertise that we've had to go out and find from people on how to run ISPs, what's the best way to have them set up, what are issues you're going to run at, run into doing different things. On a large sense, it's like, we help them start. It's not like, we just ship them a box and be done with it. We want to get to that to a point, where it's more self-service. We help them start completely. That's really what – that's to us what the starter kit is. It's not just like a – not just like a box of equipment and some software.

[0:39:08.5] JM: Somebody buys it, and then they're setting it up in their apartment. Do you come out and help them set it up, or do they just talk to you over the phone while they set it up? How does that work?

[0:39:22.8] AM: Yeah, for the first few, I'm going to go out there and set it up with them. Me and some other people from the team, we'll get it all set up for them. A lot of these sense, cases too like they're going to run into different circumstances, and our thing is to be able to learn from all these operators just the same way that we can teach them. They're going to run into different situations and we're going to wrap that together and create a greater community around how to run these ISPs and how we can all learn from each other and run into the these problems together.

[0:39:54.1] JM: You know what I think would be cool for that, if you wanted help with the remote installation process, there was a company that came on the show a while ago called Scope AR, and what they do is – it's like an AR headset, where I think the widest use case is people who are setting up factories, or setting up assembly lines and then there'll be some person that has expertise that is not co-located with the person, who is setting up the assembly line. It would be cool if you had five AR devices, and every time somebody got an ISP starter kit, you could also send them one of these AR headsets and then help them set it up over the augmented reality system, so you could see things from their vantage point, help them set up whatever kinds of hardware they need. Then maybe they could send back the AR device. Anyway, I don't mean to backseat drive, but just something that came to mind.

[0:40:56.0] AM: Yeah, that would be really cool. I can see that in our office, a bunch of us walking around with AR headsets on, yeah, tinkering with networking equipment. I think it would be pretty cool.

[0:41:03.7] JM: Well, you don't actually need the AR headset on your side. You just need the customer who is setting it up has the headset and you can just be looking at your laptop and seeing things from their vantage point and you can put an arrow on the screen and be like, “Hey, you should put that there,” from their vantage point.

[0:41:22.0] AM: Okay. Yeah, that's way better. Yeah, I would be worried that we'd be running into each other, but yeah, that sounds like that would be a really cool thing to try out.

[0:41:28.3] JM: Yeah. Anyway, okay so if they get this thing in the mail and then what do they do? What do they have to set up? How much stuff is involved? Are they hanging wires from the ceiling, or are they having to nail things in?

[0:41:41.0] AM: Yeah. When you get them set up, so they're setting up the tower site, so what we do is we'll come out for the first ones and teach them how to do that, how to get, them how to get them set up, and same thing at the customer locations. Yeah, definitely like – it's like physical installations are similar to what how Comcast works, and where you would be going out to the individual homes, you put antennas on their roof and yeah, you run a cable into the – at the home and connect them to a Wi-Fi router to there. Yeah, there's definitely – Yeah, there's definitely like a light construction aspect to it. Yeah, that's how we get the infrastructure piece stood up.

[0:42:22.8] JM: Okay, the infrastructure piece getting stood up, and then how does the internet get delivered – let's just go through it. I'm a customer, I've set it up in my apartment building that I own, give me the end-to-end where the internet gets delivered to the end customer through that ISP that I've set up in my apartment building.

[0:42:44.1] AM: The first thing is we get the connection, the both bandwidth connection. Basically, like the same way that your customers are buying internet from you, you're buying internet from somebody. That company will pull fiber into one of your tower sites effectively, one of your – like your central tower site. We get that connected into our stack, the equipment that we ship out to them in a box, and then out from that stack we start running into – like we run up to the top of the tower and start broadcasting internet out.

What we do is then – so we have a wireless receiving equipment on the top of the tower, and then that connects them to either other towers, or directly to customer homes from there. Then from that tower site, the customer home has a connection to – connection to those tower sites via that antenna, and then that link there, that pathway from our bulk bandwidth provider into our

stack, up to the distribution antennas, across to a customer antenna, into their home, into their Wi-Fi router, that's the link right there.

[0:43:46.3] JM: How big can these ISPs be? How big can my apartment building be, or can the apartment building deliver to the apartment building and the entire neighborhood that it's around? Is there any limitation to how big they can build their ISP?

[0:44:02.3] AM: You just have to size whatever the bulk bandwidth that you're buying from. You just have to make sure that you have enough basically for the number of customers you're serving. Usually the size pipes that we're buying initially are enough to serve several hundred customers. As you get more, you can, you basically, you can buy more or buy more at different tower sites and inject more bandwidth into your network that way.

That's how you – Yeah, you can just, and you just scale up from there. That's just yeah. There's not really a physical limit outside of that. There's how far the antennas will travel, realistically how large of a service area you want to try and cover. Yeah, other than that, there's not like a technical limitation on how big they can be.

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[INTERVIEW CONTINUED]

[0:46:26.3] JM: You said you've set up an ISP. Actually no, you didn't say that. I read that you set up Necto, and then Necto Lab again is starting your own ISP. Was Necto the genesis for Necto Lab, where you started to try to run your own ISP and then you found out, “Oh, this would actually make more senses if we just had a kit.” What was the genesis for having these two businesses, the ISP and the build-your-own-ISP business?

[0:46:57.3] AM: The idea from the beginning was how do we enable other people to do this? We call just call the whole thing Necto. They're like separated domains for our SF ISP versus our – the operator network. Yeah, the idea from the beginning was how do we help other people do this? Because the original thing as a co-founder was looking at like, “Okay, why does – why in San Francisco is with the most competitive internet certainly in the area, have – is he having such trouble getting good customer service and good quality internet?”

I started looking into like, “Okay, how do we – is it possible to start an ISP?” It turns out it is. The thing is just going through, like looking at how to do it, it's certainly possible, it's very lightly regulated, but the technical knowledge gap is just the biggest issue preventing it; the wireless gear, all these things have gotten so much better, but there's not – we're not seeing how we saw with when AWS has made it so much easier to stand up web servers. We’re not seeing like a Cambrian explosion of ISPs.

It turns out, because all this knowledge is just hidden away. Thankfully being in San Francisco, you can – there's a lot of people out here with a lot of experience on network engineering experiences for ISPs. It turns out yeah, that there's – it's possible to start them, but just most people don't just because of that skill gap. Yeah, that was the genesis. It was always from the beginning, like all right, we need to figure out a way to – we need to run our own if we want to help other people do their own. We wanted to run into all the problems first, we want to really know what it's like to run an ISP before we're trying to help other people run their own.

[0:48:42.8] JM: What's the type of customer that ends up buying an ISP starter kit?

[0:48:49.1] AM: Yeah, interesting. The people that we've been talking to so far, we see a lot of people that have own either property, multiple properties, rental properties and especially in areas that they don't have very good internet service now. That's been the – that's been one big one, and the other one is just people that have experience in providing, like the consumer, like the end support, like they're tech savvy and they have business experience, and getting into the infrastructure piece, it interests them. They have the customer acquisition skills, customer support and retention skills, and it's just the yeah, it's just the network engineering piece that they need help with in order to be able to start an ISP.

[0:49:32.7] JM: The apartment buildings that already have access to an ISP, like a Comcast or a CenturyLink or something, are you seeing any of these buildings that say, "Hey, actually if we set up our own ISP, that's an additional revenue stream," as opposed to feeding customers to Comcast. Are there apartment buildings that set up their own ISP and then it starts to become a good revenue stream for them, as opposed to just feeding customers to Comcast, or CenturyLink, or whoever is the rival ISP in the hood?

[0:50:09.9] AM: Oh, yeah, yeah. That's definitely something that we want to enable. They have the access to the customers there, and they can provide better service, and they already have a building relationship, especially with the customers. Yeah, that would be an ideal customer for us for sure, and one that we're targeting.

[0:50:28.0] JM: You wrote about the fact that people have an impression that there is some legal barrier, or regulation against setting up an ISP, and there actually is not, right? There's not really much limitation to who can set up an ISP.

[0:50:46.7] AM: Yeah, it's actually – it's really surprising. I thought the first thing was like, "Okay, we have to go to the federal government and get an ISP license, or something like that." There's no ISP license. Anybody can sell it. There's one that's called a form 477 by the FCC, that you have to fill out twice a year. It's not super involved and yeah, especially yeah, the net neutrality and that Title II regulation was the first really substantial set of regulation that you need. Yeah, there's no – I figured that there was some regulatory body just because there were so few of them, but yeah, it turns out that's not the case.

[0:51:18.0] JM: If I was a privacy advocate of the strongest flavor and I'm worried about my ISP snooping on me, is that another use case that you could potentially address?

[0:51:31.9] AM: Yeah. I mean, what we do is we – since we have control of that software stack and the routing stack and that thing, we can we can make sure we're just not building software that would enable the sorts of interception and packet inspection, that people would be concerned about if they were doing that. Honestly, I think the best thing is – like encryption using HTTPS, there's still – like you're transiting traffic across other people's networks. It's not just necessarily your ISP. There's other people in between you and those end computers like I was talking about.

You really want to look for technical solutions there where possible. It's less and less identifiable as you go further out to an extent, but yeah, it's – you're not just crossing your ISPs network, you're crossing a lot of other people's network as well, and you don't – there's not a lot of transparency into exactly whose network you are crossing. Technical solutions implemented by the clients and the servers I think are the best solution there.

[0:52:32.6] JM: Are you only serving people in San Francisco, or can you serve somebody in Montana, or Canada, or South America?

[0:52:40.1] AM: Yeah, so we – our ISP, the one that we're running ourselves is just in San Francisco, but yeah, we're expanding out from that. The operators that we have now are – we have one in South Dakota and we're looking to bring on some more in California right now. Yeah, we're definitely not trying to keep it just in San Francisco.

[0:52:59.1] JM: In South Dakota, the person would have to find one of these towers to set up with a distribution device, right? One of these – is it like a dish?

[0:53:12.6] AM: Kind of. What we use mainly for – well, the South Dakota one in particular, he's serving on several commercial buildings together. In that case, he doesn't have to go directly to customers, like residential homes yet. Between those, yeah, it does look like a satellite dish, those links are at – it's like millimeter wave, like 60 gigahertz links between them. Yeah, they look like an enclosed satellite dish, and about – I think it's about 35 centimeters wide or so, the ones that were we're using there. Yeah, they look like satellite dishes, but they're capable of running multiple gigabytes across them, so it's a bit of a different ballgame from a DirecTV.

[0:53:52.5] JM: Did you have to fly out to South Dakota to help this guy, or was he able to do it himself?

[0:53:57.4] AM: That's coming up and he's getting the fiber drop-in now, so he's – so we'll probably be out there in a few weeks.

[0:54:03.2] JM: Cool. As you get more and more customers, what are the economies of scale as a business, and what does the business structure look like more generally?

[0:54:18.3] AM: Yeah. Things that we get from adding more operators is obviously more learning across a wider network of people running internet service providers. There's not just internet. If you have an ongoing recurring relationship with a customer, there's a lot of other things you can do, there's like IOT devices. We think there's a lot of ways that a lot of different revenue models that you can layer on top of internet, and that there's a lot of learning you get from offering internet and from having different types of plans and doing different things across the network.

Also larger like, we have to buy bulk internet too, so the more people we have buying bulk internet, the better deals we get there, same with the equipment. Yeah, really getting that network of operators that also have unused bandwidth. We end up with like – you end up with a pretty wide edge network effectively at a bunch of different operator locations. There's a lot of cool things that that enables, so we're looking forward to the things that we can do as the network grows.

[0:55:23.1] JM: Okay. I'm really excited about this business. I think it's really cool. I'm a fan of what you're doing. I have a few questions about the future that don't really have anything to do with Necto, and I'm hoping you can give me some speculation.

[0:55:37.2] AM: Excellent. All right.

[0:55:39.2] JM: I've heard that self-driving cars could potentially increase the bandwidth requirements far beyond what we have in the United States, is that true?

[0:55:53.4] AM: As far as what they would use – I mean, I guess if they had a learning model, or something, it would seem to me that the self-driving cars would need to communicate with each other more than they would need to communicate with some central base. Maybe that's naïve, but yeah, I wouldn't – because there's not like yeah, I mean, if you're trying to ship that many map data, it wouldn't seem like there would be a lot of – I couldn't think of a huge case for bandwidth back to a central server from a self-driving car. My gut feel would be that it wouldn't outweigh the adoption of Netflix streaming across the United States. I wouldn't be worried about their – maybe that's naïve, but I wouldn't be worried about it.

[0:56:36.3] JM: Let's say it did. Let's say they had, I don't know if this is the case, but let's say self-driving cars are constantly capturing 360 video around them and they're trying to stream that 360 video back to a data center for as close to real-time training and redeployment of trained models due to that 360 video detecting something interesting. If there was a massive bandwidth increased requirement because of video – because of cars needing 360 video, how would that change the game of internet service providers?

[0:57:12.0] AM: I think that would really help a distributed model. If you can do that, assuming you do that processing, distributed that you could have basically your server farm, like your AWS instead of being all in one datacenter would spread out across a bunch of different operators, data centers that have a bunch of different basically access, like Rackspace and bandwidth, my thinking was is that you could create a distributed network there to do that edge processing and do whatever you needed to do with that data, and then be uploading it for like, I guess, storage later if you wanted to, to archive it somewhere else, but that you would be able to whatever that real-time component is, you could have an edge server that would be able to do that real-time processing right away.

[0:57:56.7] JM: Now I wonder if you had these set of routers that are connected to Necto, where you have dominion over the software stack, I wonder if you could do something interesting in terms of "edge-computing," because if you see that they're maybe not using some amount of bandwidth from your vantage point with your monitoring ability, maybe you could make it – you could say, "Hey, if you want to farm out your spare bandwidth to other things, maybe you could have some market within that." Anyway, I'm sure you've thought of this thing. I think that's probably one of the economies of scale aspects that may come down the pike later on.

[0:58:45.5] AM: Yeah, like having – because that's like, if you think of a CDN, or an edge network is, that's different data centers that are really close, but we have the potential to be like an ultra-localized edge network, or CDN. It's like, you don't even have to go out to the outside internet to get a cache thing. That's something that could really speed up access speeds to our customers, or provide those benefits you're talking about.

[0:59:08.6] JM: How long till we have some of these other mediums? You hear about satellite internet being deployed to developing countries, or of course, the balloon thing. How long till we have those kinds of developing internet technologies being served to production traffic?

[0:59:33.0] AM: Yeah. The interesting ones we see are – so there's a couple – a couple companies we're seeing [inaudible 0:59:37.5] doing smaller, I think I believe geostationary satellites. The other one is like SpaceX is they're doing that one web constellation. With the one web, you get over the latency issue of going to geostationary orbit. Both of them are pretty

interesting and things we keep our eye on. Estimates I've heard are like years basically, but yeah, I don't have necessarily an in to know of whether that's true, but we definitely keep an eye on the FCC filings and see where it's looking like.

They're there in testing right now. My guess would be hopefully single-digit number of years, hopefully sooner, because that opens up a huge amount of possibility for us to buy backhaul in areas that we wouldn't be able to provide, like we wouldn't be able to service, because we wouldn't be able to buy bandwidth from anybody. If we can buy bandwidth from them, that opens up huge markets to us.

[1:00:33.7] JM: Facebook has some technology in this category that I think is cutting-edge. They've got the – or I don't know how cutting-edge it is in in terms of developments, but at least in terms of implementation, I think they've done some innovative things, like the drone that I think lasers down internet to people. Then they also have this thing that they ployed in San Jose, I don't know if you've seen that, but it's kind of local internet thing, but you put it on street poles and the street poles are communicating bandwidth with each other or something like that. My sense is that Facebook is doing some interesting things. Have you seen anything specifically out of Facebook that caught your eye?

[1:01:15.5] AM: Yes. It's like Facebook and Google both. Yeah, I have these connectivity. Well, obviously that's one of their big barriers to growth now is just getting people online. They seem like they could work. I'm a little curious about what the business model will be behind it, about whether they're going to provide full-blown internet and be like an internet service provider, or if it's going to be like, you get to use Facebook and Facebook related properties.

Yeah, I think it sounds like they're experimenting with the technology on both. I haven't seen, I don't think anything that would be yeah, anything that would be something that would be super exciting necessarily to me, but I think it's cool stuff and I'm glad that they're working on it for sure. They definitely have some – especially Facebook has some interesting things on the – I think they have some open source networking stuff that they're doing, so there's got to be some – there's definitely some cool work going on in there.

[1:02:08.0] JM: I know this is very far outside of your – what you came on here to discuss, but when Facebook was doing the zero rating internet face – freebasicsinternet.org thing, there were people who felt that that was going against net neutrality in a way that made them uncomfortable. How did you feel – how do you feel about the zero rating services as an opportunity to provide lower bandwidth internet communications to people?

[1:02:36.9] AM: Yeah, I mean the zero rating is really just throttling by a different name, like lowering the cost on something versus raising the cost on something. Lowering costs on one thing versus raising the cost on something else is the same thing. You end up with – the differential is really what makes the difference. I think pitching it as a zero rating, and then potentially making things that aren't zero-rated much more expensive, you end up getting the same thing. I think it's probably sounds a bit of a better marketing pitch, but you end up with the same thing where it's like certain traffic is treated preferentially to other traffic, and that's yeah.

[1:03:13.5] JM: I hear you. Okay, well Adam, thank you for coming on the show. It's been great talking to you. I am fascinated with the company you're building and I wish you and your co-founder, and I think you have one employee at this point, is that right?

[1:03:28.3] AM: We have two, three, two, three now. I guess yeah, we like to have to – there's five of us now. Yeah.

[1:03:33.2] JM: Wow. Okay, well congratulations. I'm excited to see where you take Necto.

[1:03:37.9] AM: Oh, thank you. Yeah, I appreciate that. Thanks for having me on.

[END OF INTERVIEW]

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