Tech**Crunch**

Extra Crunch

1 napkin and 22 lines of code, or how NS1 rewrote the rules of internet infrastructure

NS1 EC-1 Part 1: Origin story

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I**t's the most** important primary layer in the modern tech stack for internet software, and its most intriguing evolution was written on a napkin in a New York City bar and translated to just shy of two dozen lines of Python code.

Such is the nature of tech innovation today, and such was the birth of NS1. Kris Beevers, along with Jonathan Sullivan and Alex Vayl, wanted to rebuild the core addressing system of the internet — the Domain Name System, or DNS — and transform it from a cost center into a critical tool for software reliability and cost savings. It was a smart idea back in 2012 and gained much steam a few years later when a fortuitous outage at a competitor left hundreds of websites stranded.

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NS1 may make the networks of the internet more reliable. But the story of the company is also built on the back of a durable social network of engineers who met at a little-known NYC startup named Voxel. That startup would go on to become, unintentionally, an incubator for several massive enterprise companies and exits.

Chance encounters, bold engineering and lucky breaks: It's the quintessential startup tale, and it's changing the face of software delivery.

"You learn a lot because you're doing way more than you rightfully should."

NS1's story begins back at the turn of the millennium, when Beevers was an undergrad at

Image Credits: Nigel Sussman

Rensselaer Polytechnic Institute (RPI) in upstate New York and found himself employed at a small file-sharing startup called Aimster with some friends from RPI. Aimster was his first taste of life at an internet startup in the heady days of the dot-com boom and bust, and also where he met an enterprising young engineer by the name of Raj Dutt, who would become a key relationship over the next two decades.

By 2007, Beevers had completed his Ph.D. in robotic mapping at RPI and tried his hand at co-founding and running an engineered-wood-product company named SolidJoint Research, Inc. for 10 months. But he soon boomeranged back to the internet world, joining some of his former co-workers from Aimster at a company called Voxel that had been founded by Dutt.

The startup provided a cornucopia of services including basic web hosting, server co-location, content delivery and DNS services. "Voxel was one

of those companies where you learn a lot because you're doing way more than you rightfully should," Beevers said. "It was a business sort of built out of love for the tech, and love for solving problems."

The New York City-based company peaked at some 60 employees before it was acquired in December 2011 by Internap Network Services for $35 million.

"Voxel was a really formative experience not just for me, but I think for almost everybody that was there," Beevers said. Indeed, the company's tech-centric culture and penchant for entrepreneurship would prove a wellspring of future NYC-based startups.

Dutt would leave Internap to start Grafana, an open-source data visualization vendor that has raised over $75 million to date. Voxel COO Zachary Smith went on to found bare metal cloud provider, Packet, in 2013, which he ran as CEO until the company was acquired by Equinix in

NS1's early office at 25 Broadway in New York City.

March 2020 for $335 million. Meanwhile, Justin Biegel, who spent time at Voxel in operations, has raised nearly $62 million for his startup Kentik. And of course, NS1 was birthed from the same alumni network.

"It turned out to be a tremendous incubator for a bunch of people to go on and start new companies based on their experience at Voxel," Dutt said. "In retrospect, that was one of the best possible educations in internet infrastructure and scaling distributed systems."

The experience of growing Voxel taught critical lessons. One of those lessons, according to Dutt, was that you can have a really cool product that's technically compelling, but unless you have a really solid go-to-market engine around it, no one will care.

"We were a bunch of engineers and we had the typical technical founder mindset of, like, "Hey, if we build a better mousetrap, the world will beat a path to our door," he said. "Nope, that's not the way the world works, right? So that was definitely a big lesson."

Another big lesson was the importance of having capital to meet windows of opportunity. "We were constantly struggling to meet payroll and to buy new servers, and we could only grow as fast as our organic cash flow allowed," Dutt said. "In retrospect, if we had been better capitalized, we could have taken that company a lot further."

Those key lessons were not lost on Beevers when it was time for him to build NS1.

Singaporean satay, and cat pics for everyone at the speed of light

Beevers' big idea behind NS1 emerged from a content delivery network (CDN) that he helped build at Voxel.

As the name implies, a CDN is a network service that helps distribute and deliver content, say, pictures of cats. Users want to see a cat picture as soon as possible, and the host delivering that cat pic also wants to deliver it just as quickly, with the best experience while minimizing costs. That was an optimization puzzle and infrastructure challenge that Voxel figured out with its own CDN offering.

His stint as the principal software architect at Voxel saw Beevers living in Singapore from 2008-12. He was out one evening with CEO Dutt, eating satay on a street and talking about the challenge of how Voxel was steering traffic across its own CDN infrastructure to accelerate traffic. That meant optimizing DNS.

DNS is a service that connects IP addresses for a single server, like 212.82.100.163, to a domain name like techcrunch.com. When the world wide web was just getting underway, most websites were hosted on a single server since there just wasn't enough scale that required anything more advanced.

Over time, however, websites had to manage millions of connections with users, far outside the capabilities of even the highest-performance server.

Top websites needed dozens, then hundreds, and today millions of servers to operate, and DNS therefore needed to evolve as well. Today, DNS directs traffic at sub-microsecond response times to specific servers based on who is connecting and what the user wants to access.

A decade ago, Voxel needed to define a complex set of traffic steering rules that would optimize the best route to serve a request from one of their users. What Beevers and Dutt realized was that Voxel's customers had the same kind of traffic steering challenges with their own infrastructures.

Beevers really liked the idea of having some form of service that could help organizations optimize traffic and DNS. He recounts that there were only a few internet properties at the time that performed well across the world. Google was one of the few, and it achieved it with a massive investment in moving code and data centers closer to major population centers around the world.

"By the time I left Singapore in 2012, everybody recognized that users in Singapore matter just as much as the users in Ashburn, Virginia, just as much as the users in Amsterdam and Europe and South America and Africa and so on," Beevers said. "You can't beat the speed of light, so you've got to put the code and the data closer to those audiences."

Beevers would soon recognize that the very problems he had solved within Voxel were problems others had as well, and that realization would become the spark for NS1.

Name Server 1

After years in Singapore, Beevers returned to New York City in 2012. On a crisp day in early 2013, Beevers and Jonathan Sullivan, a co-worker from Voxel, went out after work to Fraunces Tavern, which was located just around the corner from Voxel's headquarters in lower Manhattan.

It was at that tavern over a frothy stout that the initial sketch for what would become NS1 was drawn on a napkin that Beevers says he still has … somewhere. The idea built on the conversation that Beevers had in Singapore a year earlier with Dutt, except this time, it wasn't just idle conversation — it was the beginning of a new enterprise.

In the days that followed, fellow Voxel co-worker Alex Vayl joined Sullivan and Beevers to start NS1. Beevers says each of the co-founders had a particular strength: his strength was software development, while Vayl brought marketing expertise and Sullivan delivered operations know-how.

The three didn't have to go far to christen the newly founded company.

At the core of DNS are name servers, which act as directories connecting human-readable domain names to numeric IP addresses of servers. Commonly and historically, sites and internet service providers (ISPs) have listed the first name server in a domain record as "ns1," for Name Server 1. For instance, TechCrunch's first name server is ns1.techcrunch.com and connects users from "techcrunch.com" to the IP address of one of our servers.

It made for an obvious name for the new start-up, and as it turns out, Beevers already owned the domain name NS1.com. It wasn't something he came up with and bought in 2013 either — he'd actually bought the name way back in 1996.

"I'm like most other technologists, when I have free time, sometimes I'm like, 'What cool domains can I think of?' and so I bought the domain," Beevers said. "It was as simple as that."

Call it prophetic or happenstance, NS1 was underway.

From Python on the couch to raising venture dollars

From a technical perspective, the genesis of NS1 was 22 lines of Python code that Beevers wrote while sitting on his couch in his NYC apartment to sketch out what would become NS1's filter chain technology. That's the company's main engine for steering DNS traffic based on a set of rules and policies — the idea inspired by working on the same challenge at Voxel.

Those 22 lines have obviously ballooned into many more lines of code over the years, but for Beevers, they are emblematic of the company he created: NS1 is all about trying new things and experimenting. The first 22 lines of code were good enough that Beevers could host his own and friends' personal domains, and it kept improving and growing.

"That iterative approach really helped us get going," Beevers said.

The co-founders put together an initial seed round for NS1, which saw participation from Dutt, formerly Voxel's CEO. Dutt says he didn't invest in NS1 as a charity or out of a sense of altruism to help out Beevers. He instead emphasized that it was a very capitalistic move and he was confident Beevers' experience and talent would lead to a profitable outcome.

It was really only after NS1 began making money that Beevers went out looking for venture capital to scale the business. He built the company's first official pitch deck with Dutt, hoping that

a well-tuned pitch and the team's ample technical acumen would let the company lock in a round of financing quickly.

It didn't work out that way, however: The journey to the first venture round was a tedious endeavor and involved over 70 pitches.

Beevers says he approached the process with iteration in mind, much like he had with expanding the initial 22 lines of code. "We're experimentalists and iterative as a company," he said. So, he and his co-founders took home lessons on what they needed to do better after each pitch.

What they learned from feedback was that it was critical to have a stronger education piece. DNS may be an acronym widely known in tech circles, but it's one of those technologies that very few engineers — let alone VCs — had ever thought deeply about. Investors needed to understand what had changed in the world that made NS1's technology stand out, and why DNS was an interesting part of the tech stack ripe for innovation.

But even with those questions satisfied, Beevers still had to answer why NS1 was positioned to execute on his vision, and why incumbents like DynDNS, which were already providing DNS services, were unable to do it.

"Eventually we found, of course, investors who were receptive to that idea, technical enough to get it right and willing to engage with our team enough to believe that we could address this challenge," Beevers said. Ultimately, NS1 closed a $5.4 million Series A round led by Flybridge and Sigma Prime on April 7, 2015.

A year later, in September 2016, the company raised a $23 million Series B from Deutsche Telekom Capital Partners, Telstra and Two Sigma. Beevers explained that he was purposeful about partnering with big players in the telecommunication ecosystem like Deutsche and Telstra.

The logic was simple: The two telcos have large footprints and great connectivity, particularly in EMEA and Asia, and NS1 wanted to improve its capacity and performance in those markets at the time. Both telcos also had some experience with security, which was becoming increasingly important at that time, and was a factor that would become absolutely critical a few weeks after the Series B closed.

Into the fires of the DDoS armageddon with DynDNS

"What happened between the B and B1 funding round was the DynDNS attack — which was an infamous internet event," Beevers said. "It was on

October 21, 2016, I remember the day, because it was sort of an inflection in our business. Dyn was a tooth-and-nail competitor at the time, you know; obviously not so anymore."

DynDNS back in 2016 was a major managed DNS service provider. On that linchpin date, it was the victim of a volumetric distributed denial of service (DDoS) attack, which involves attackers seeking to overwhelm a service by flooding it with a massive surge of sustained traffic. TechCrunch and other media outlets reported on the DynDNS attack at the time, which crippled large swaths of the internet, including Twitter, Reddit, Spotify, GitHub and SoundCloud, among others, and made the websites inaccessible.

"Almost immediately after that event, our business changed quite a bit," Beevers said.

Engineers recognized after the 2016 DynDNS attack that they had to have more redundancy in their DNS infrastructure. Beevers recalled that there was a large groundswell in demand for NS1 services as organizations realized they needed another managed DNS option. That impact extended into 2017, when NS1 raised its $20 million Series B1 in September from GGV and Salesforce Ventures.

Over the next two years, NS1 grew its product and services lineup, pushing beyond its core managed DNS roots into adjacent areas of enterprise networking. It also raised more capital to back its forays. It raised its $33 million Series C backed by Dell and Cisco Investments in October 2019, and a $40 million Series D led by Energy Impact Partners in July last year.

Beevers said that the 2020 fundraise was part of the continued realization at internet companies that the world is changing really quickly and the network is at the core of everything. It's a realization that he's known for years — all the way back when he bought the NS1.com domain name in 1996 and when he scribbled on the napkin at Fraunces Tavern in 2013.

"What makes DNS such an interesting opportunity is that it is totally pervasive. Every application on the network speaks DNS; everything on the internet starts with typing something [dot] com in your browser and pressing enter, or in your app, it's connecting to app.whatever.com," Beevers said.

DNS alone isn't what makes NS1 a successful enterprise vendor — it's just a conduit for the company's true value and promise of making applications and services run better. In the second part of this EC-1, we take a deep dive into the technology and services that NS1 provides.

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WTF is NS1? It's DNS, DDI, and maybe other TLAs

NS1 EC-1 Part 2: Product development and roadmap

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We are not a DNS company, despite the name, and despite everything we're talking about," NS1 founder and CEO Kris Beevers says.

That might sound counter-intuitive, given that the company's flagship product offering is literally called Managed DNS. The issue and the challenge NS1 actually solves today goes much deeper, and by positioning itself as being about more than DNS, the company helps to differentiate itself against what is, by any measure, a very commoditized technology.

Across its product portfolio, NS1 leverages data and injects software-defined intelligence, automation and real-time decisioning policy to steer and optimize traffic at the DNS layer.

NS1 looks at DNS differently from the competition: It doesn't consider it as just a conduit to connect traffic; instead, DNS is treated as a routing system that can direct traffic very effectively.

Across its product portfolio, NS1 leverages data and injects software-defined intelligence, automation and real-time decisioning policy to steer and optimize traffic at the DNS layer, Beevers says. It does all this by a core technology known as the filter chain, and it is foundational to NS1's current success.

In the first part of this EC-1, I spoke about how Beevers wrote 22 lines of code to sketch out that filter chain technology, bringing NS1 to life. I will now look at how the company has expanded beyond DNS into what's known as DDI, a key technology stack for managing internal networks within companies. We'll also talk about NS1's open-source efforts, and why
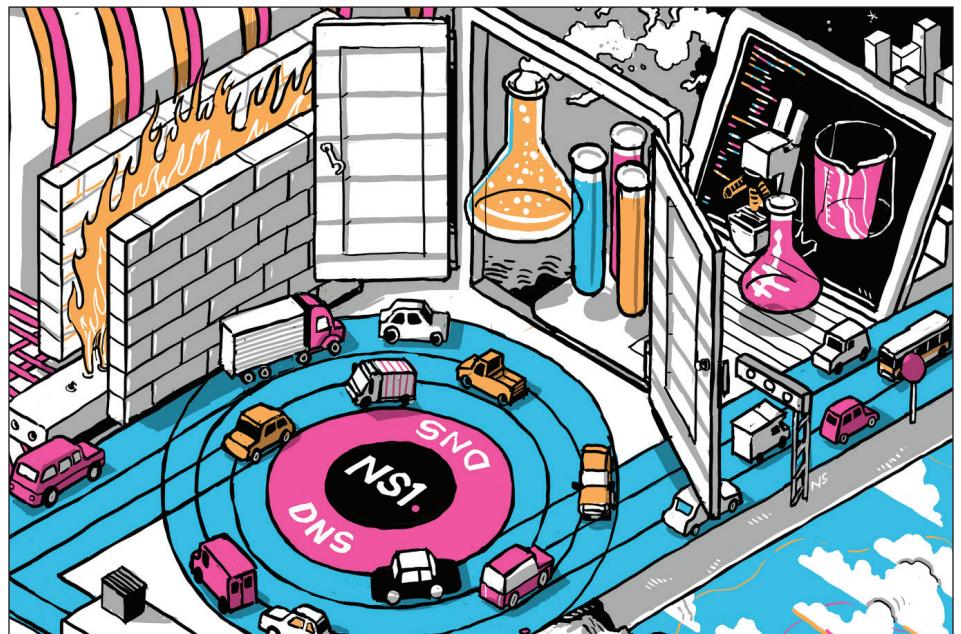

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experimentation remains a bedrock principle of the company's engineering culture.

Managing external traffic: DNS and active traffic management

"Something that I will say very often to our team and to our customers in the market is, we're not here to make DNS better; we're not here to make DDI better, which is another realm that we play in now," Beevers said. "We're here to turn those technologies into leverage to solve much bigger problems that equate to connecting applications with an audience more effectively, at better scale, driving better performance and experiences with security and reliability."

The first set of services that NS1 developed face outward, meaning that they help organizations with traffic that comes from outside their own networks, such as a reader visiting tech-

crunch.com or a viewer turning on Netflix. Those services include Managed DNS, which provides a globally distributed DNS service, and Dedicated DNS, which offers a redundant, secondary network for DNS.

DNS' core function of connecting IP addresses to domain names is critical to the day-to-day operation of the internet. It has long been thought of as a networking concern that is managed and operated by networking professionals who typically focus on ensuring that traffic gets to where it needs to go.

NS1's filter chain technology takes DNS further. It integrates rules into DNS queries so that it can take different factors into account to help optimize the best way to deliver a given query. Gartner analyst Gregg Siegfried feels it provides a real point of innovation.

"Normally, you think about a DNS query very much like a database lookup," Siegfried said.

That is, when a user or an endpoint requests a given domain, the DNS system looks up the DNS record, which then in turn identifies where the traffic should go.

"The filter chain is something that allows you to add some conditional logic in that lookup — and at scale," Siegfried said. "That's a very, very powerful capability, whether you use it for global load balancing, geofencing or georouting. It's what caught my eye from the beginning about NS1."

This is useful in many cases. For instance, many countries today have decreed that data from their citizens should only be served from data centers located domestically. NS1's filter chain could be set up to direct queries from such countries to data centers located locally, ensuring that a company meets its governance requirements.

Another example would be a filter chain designed to prioritize premium customers over free customers for a SaaS tool at times of high network congestion.

While the filter chain is the technological core of NS1, it's not a product itself. Rather, it is the foundation upon which the company has built its commercial services.

One of the key lessons learned from the DynDNS outage in 2016, which we talked about in part one of this EC-1, was the need for companies to have redundant DNS providers. NS1's Dedicated DNS is an entirely different network for DNS, designed to add just that sort of redundancy to this layer of the tech stack. The thinking is that for organizations that want highly resilient DNS operations, they can deploy both Managed DNS and Dedicated DNS from NS1 and be assured of resilience and redundancy, without having to engage with another vendor.

To capture a share of the global market, NS1 has also set up a dedicated Managed DNS for China service, which is built to help organizations optimize traffic inside the country.

The most performance-sensitive customers, however, need a product even more advanced. Internet congestion can change rapidly, and a high-quality and reliable route a few milliseconds ago might suddenly become impassable. That might not matter in the realm of video streaming, where an annoying buffering hiccup can be alleviated relatively quickly, but it could have life-or-death implications in applications like healthcare, self-driving cars and drone piloting.

For these customers, NS1 has developed a product it calls Pulsar. This service provides granular, data-driven steering of traffic for applications. It can also answer questions like: "What is the response time for a user on Verizon's wireless

network in New York right now?" or "What was the response time to Amazon's East Coast data center over the last five seconds?"

Pulsar Active Traffic Steering works with a variety of mechanisms, including using data provided by the customer with beacons that NS1 calls real user metrics. These beacons are enabled when organizations embed a piece of JavaScript in their website code that sends back telemetry data. Pulsar can integrate NS1's data set with the telemetry data from a customer's beacons to pinpoint specific problems and shape traffic accordingly.

In short, across all of its DNS offerings targeting external traffic, NS1 is doing a lot more than providing basic DNS services that simply look up addresses in DNS records and forward traffic to a destination.

Managing internal traffic as NS1 moves into enterprise DDI

The internet has expanded exponentially over the past couple of decades, and that holds true for internal networks within enterprises as well. Some organizations have tens of thousands of employees and even more devices, all connected to a corporate network.

In the enterprise world, the acronym DDI represents three technologies — DNS, DHCP and IPAM. Enterprise networks need to provide private IP addresses, which is what a DHCP (Dynamic Host Control Protocol) server does.

Such networks also have to connect to internal named resources as well as have a corporate DNS to enable address lookups both internally and externally. Finally, enterprises have to manage all their addresses with an IP Address Management system (IPAM). Thus, DDI forms the foundation of the modern IT stack within an enterprise.

The DDI market is often a different buyer within an organization than website or application DNS. DDI is often deployed inside of an organization's firewall, which is intended to be a perimeter protecting what goes on within the enterprise from the outside world.

To expand its addressable market, NS1 entered the DDI space in May 2019 under a product rubric it dubs "cloud-native network services." It was a bold new front for the company, but it wasn't an immediate success.

According to NS1 COO Brian Zeman, who was hired in 2018 after sales and leadership roles at digital infrastructure management vendor SevOne and risk management company Prevalent, NS1 entered the DDI space a little too early.

"We were able to build a pretty great go-to-

market early, and then we had to spend some time educating and figuring out which verticals we should speak with first," Zeman said. "Now that's all caught up, but I wish we could have waited a few months to build out our channel. It's paying dividends now, but I would probably have waited a few months to invest there."

Beevers has a different view on the foray: "Did we enter the DDI market too early? I'm going to give an unequivocal 'no,' because I'm a startup guy, right? The way startups work is, you get out there, engage with the market, put your technology and your ideas in contact with the market, get visibility and then iterate based on what you find."

However, Beevers did admit that the company initially attempted to address the market in its entirety, ranging from stodgy enterprises to forward-leaning Silicon Valley firms, which just didn't work.

"The only time we've ever done the wrong thing in any market — and DDI is a good example here for us — is in trying to play too much to folks who don't really want to change," Beevers said.

NS1 soon corrected course on DDI and figured out its path to market, which included a key sales partner. In June 2020, NS1 inked a major partnership with Cisco, bringing its DDI solution to Cisco's Global Price List.

That lets Cisco and its partners easily sell and integrate NS1's products with Cisco's technologies. With enterprise software sales, the channel is a cornerstone of success, often as much or even more so than direct sales.

Zeman sees DDI as the second core market for NS1 after Managed DNS. The vision is to consider the two products as flip sides of the same coin, connecting internal and external traffic to the edge. From there, NS1 can build new products that leverage the underlying infrastructure it has already sold to its customers.

DDI and its prospects are also high on the list of priorities for NS1's chief product officer, David Coffey. He feels the movement into DDI is about leveraging what makes NS1's Managed DNS platform effective and applying that behind the firewall.

Modern corporate enterprise infrastructure has changed in recent years and increasingly uses container, microservices and Kubernetes-type deployments, where IP addresses are ephemeral and there is constant movement and rebalancing.

With a strong engineering and product management background, including stints at Forcepoint, McAfee and Intel, Coffey is all for automation. "Companies achieve global scale on the

back of automation," he says. "Our DDI's software-first, API-driven approach — as well as our integrations — allows you to achieve global scale and the dynamic that you want from your automation, and the capability to understand what's going on."

VPN traffic steering and new product development

As part of NS1's ongoing partnership with Cisco, it has also built a VPN traffic-steering service launched around the time the partnership was announced in 2020.

A virtual private network (VPN) is an encrypted data tunnel that enables users or employees to securely access corporate resources remotely. NS1's VPN Traffic Steering service helps companies route traffic across a global network of VPN gateways.

Demand for VPN services surged after the pandemic hit in early 2020 and organizations had to move to working remotely, and NS1 moved quickly to build its own VPN service.

It didn't have to do all that much, though, as most of the building blocks were already in place. "It is a very natural use case of our existing Managed DNS technology and steering," Beevers said. "It's just a simple slot-in-place that leverages the fact that DNS is everywhere." This is exactly the kind of experimentation and product iteration that Beevers continues to want to inculcate in the company's culture.

From a go-to-market operations perspective, as NS1 looks to continue to foray beyond Managed DNS and DDI, Zeman has a pair of connected "North Stars": applications and audiences. "Where's the audience, and how do I connect it to the application," Zeman said.

Zeman expects the position of those North Stars to shift in the coming years as different market demands emerge. For example, the need for VPN traffic steering to address audience and application needs spiked during the pandemic, which helped to drive the growth of that service.

One thing is for sure: The internet isn't getting used any less, and that means there are strong secular tailwinds for NS1 as it continues to iterate on its current products and enter new markets.

Research, open source and experimentation with NS1 Labs

Unsatisfied with its commercial ventures, NS1 is also keen to experiment in open source as well. As a company built iteratively by an engineer, NS1 has a focus on helping developers and DevOps teams. It ties together its experiments and open-source efforts under the auspices of NS1 Labs.

Open-source projects created, led or sponsored by NS1 don't necessarily imply a path to some form of commercial service, according to multiple NS1 executives, including Beevers. While such projects might not always connect to commercial services, they often are the result of internal efforts within NS1 and help to build useful utilities that its customers — and everyone else — can benefit from.

Helping to lead NS1 Labs is Shannon Weyrick, who currently holds the title of VP Research in the Office of the CTO, though that's not the first (and likely not the last) title he'll have at NS1. Weyrick was the first employee to join NS1 after its three co-founders, back in March 2014. Over the last seven years he has been a software architect, director of Engineering, director of Technology, and VP of Architecture. Weyrick had previously worked at Internap from 2012 to 2013 and met Beevers there after the Voxel acquisition.

At a high level, NS1 Labs has created projects to solve specific needs that emerged in its own operations — be it observability, testing or policy development.

For example, the Flamethrower testing utility, publicly released in April 2019, was started as a way to test the resilience of the core NS1 DNS server after a rewrite. The PktVisor (pronounced "packet visor") observability tool, released in October 2020, was built after NS1 experienced its first distributed denial of service (DDoS) attack and realized it needed more visibility into its network operations.

Weyrick's team is now building a new tool known as Orb that builds on the data PktVisor can observe, enabling users to set traffic policies based on data.

Not all of NS1's open-source efforts are homegrown, though. The newest effort to join the NS1 Labs roster is the open-source DDI project known as Netbox, originally created by developer Jeremy Stretch when he was working at cloud startup DigitalOcean. NS1 hired Stretch in April 2021 and he is now helping support the ongoing development of Netbox.

Netbox has a large and growing community of users and with the support of NS1, Beevers is hopeful it will grow even further. It's not entirely clear (yet) how or if NS1 will build a commercially supported set of services for Netbox, but Beevers certainly hinted at it potentially happening.

As far as what's next for NS1's open-source and experimental efforts, it's all about thinking about the next "moonshot," Weyrick says.

When looking forward, NS1 is looking toward the horizon, but it's not a uniform horizon from a single perspective. Weyrick explained that the first horizon, NS1's commitments to current customers, is what most of the company is focused on. The company sees two more horizons — horizon two might be a year or two out and a third horizon might be three to five years from now.

"In the office of the CTO we've carved out specific time to think about horizons two and three and where things can go," Weyrick said.

Before NS1 can get to those other horizons though, it has to face a competitive market that has no shortage of rival vendors. In the third part of this EC-1, I analyze the landscape that NS1 operates in and how the company positions itself and competes for market share.

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The fight for the future of DNS is white hot

NS1 EC-1 Part 3: Competitive landscape

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Since its inception, one of the toughest challenges NS1 has faced is the simple fact that DNS is a mature market category with venerable and well-established incumbents. When Kris Beevers and his two co-founders started the company, quite literally every company and internet user already had some form of DNS technology in place. It's a decades-old technology after all.

Beevers and everyone associated with the company is keen to point out time and again that NS1 isn't a DNS vendor, but rather a suite of products offering application and traffic delivery, performance and reliability. NS1 in its early days had to constantly preach that message and educate its potential customers on how its offering provided something different than the incumbents with years of performance history.

> Because DNS mostly "just works," some organizations don't put a serious amount of thought behind it, assuming that all of the services and capabilities out there are roughly equivalent.

In the first two parts of the EC-1, we looked at the origins of the company and its core product offerings in DNS and DDI. In this section, it's time to look at the broader market and the competition facing NS1 and what that portends for the future of the company.

Everyone owns a product they don't fully understand

Hosting providers typically offer basic DNS services that "just work" out of the box, creating a large challenge for any vendor in the managed DNS space. Eric Hanselman, principal research analyst with S&P Global Market Intelligence,

Image Credits: Nigel Sussman

said that among some organizations, there is an expectation that DNS is just part of what happens on the internet.

"I think the largest misconception that I find about DNS in general, is the lack of understanding of how critical it is to the performance and the customer experience of just about everything that organizations do today that is technology related," Hanselman said.

He observed that because DNS mostly "just works," some organizations don't put a serious amount of thought behind it, assuming that all of the services and capabilities out there are roughly equivalent. "By doing a little legwork and investing a little bit to better understand overall infrastructure performance, improvements in DNS can help a lot," he said.

The misconception about the value of managed DNS is also something that Gregg Siegfried, senior research director at Gartner, sees often. He says some organizations erroneously think they can just set up a couple of DNS servers inside their own

data center and end up with a service equivalent to what a managed DNS provider enables. "That comes up, surprisingly often," he remarked.

In short, this is a unique market. Every company touching the internet needs DNS, but many don't realize it's ripe for optimization or improvement. Defaults and inertia are the first competitor for any new entrant, and NS1 is no exception.

A clouded landscape for managed DNS

Two major groups emerge when we look at the landscape for managed DNS. In the broadest terms are the services provided by major public cloud platforms such as Amazon Route 53, Microsoft Azure DNS and Google's Cloud DNS. Then you have independent providers of managed DNS services such as Cloudflare, Neustar, Akamai and, of course, NS1.

Notably, DynDNS, which played an inadvertent, key role in helping accelerate the growth of NS1, is currently in a state of extended

Matthew Prince, CEO and co-founder of Cloudflare.

transition. Oracle acquired Dyn in November 2016 shortly after it was the victim of a massive distributed denial of service (DDoS) attack a month earlier. Oracle was set to retire the Dyn Managed DNS service in May 2020, but has since rescheduled its closure to May 2023. In its place is now an Oracle DNS service integrated with Oracle Cloud Infrastructure.

While all the public cloud providers attempt to bundle their services together cohesively, DNS is one layer where independent providers can compete effectively and may even be preferred by some firms.

Hanselman of S&P said that organizations need to decide how they want their infrastructure to be built and to what extent they want to have individual providers be part of their stack. In his view, providers like NS1 have a very useful role as intermediaries for organizations that have to deal with a complex collision of environments that might involve multiple cloud and content delivery network (CDN) providers.

Unlike DNS offerings from the public cloud providers, which emerged organically as those platforms evolved and expanded, the history of independent providers is much more heterogeneous, with vendors arriving at different points as the internet matured.

Neustar has one of the longest histories in the managed DNS space, thanks to its 2006 acquisition of UltraDNS, which was one of the first managed DNS vendors, entering the market back in 1999. The company has further bolstered its portfolio with the acquisition of Verisign's Public DNS service in November 2020.

Gartner's Siegfried commented that he sees Akamai, and to an extent, Cloudflare, as different from Neustar in that they are both based on CDNs. NS1 does compete in some areas with Cloudflare and Akamai, but NS1 Chief Product Officer David Coffey feels the solutions are complementary. In Coffey's view, while CDNs are always trying to improve their own performance, by combining NS1 with a CDN, organizations can further accelerate and improve performance.

NS1 and Cloudflare are the cloud-native upstarts in the managed DNS space, according to Siegfried. Both Cloudflare and NS1 are newer entrants that enable container-based microservices environments. Older managed DNS providers weren't designed to handle this type of architecture, and while they may perform adequately depending on a customer's needs, newer offerings will likely have an advantage.

For Siegfried, among the key pieces of differentiation and innovation for NS1 is the company's filter chain technology, which we talked about extensively in part two. The filter chain inserts conditional logic into DNS queries instead of just doing a lookup against a directory to find the right location to send a web request. That chain of conditional logic can then better optimize and direct traffic.

So where does this leave NS1? Adoption of

multicloud infrastructure is a major secular tailwind, since companies want to avoid the vendor lock-in that can come with buying an integrated cloud managed DNS offering. As more companies migrate their web architecture to microservices, NS1 and Cloudflare increasingly become a clear favorite against other offerings in the market.

Then there's the performance consideration. NS1 hopes to attract more customers as more companies consider the value of performance in the DNS layer. Of course, its competitors aren't just twiddling their thumbs, and they are attempting to add conditional features as well. The future looks bright for the company, but hardly guaranteed given the size and scale of the competitors in this arena.

Into the enterprise as NS1 competes in the DDI/VPN space

Competition in the DDI market (DNS, DHCP and IPAM, explained in part two) is very different compared with DNS. Here, NS1 isn't really competing on a battlefield of well-funded competitors; the fight here is more against corporate inertia.

IT staff managing IP addressing inside of enterprise environments have long chosen one of two simple approaches: They either use whatever basic capabilities Microsoft provides via its Windows Server that is widely deployed across enterprise environments, or a basic spreadsheet to keep track of addresses. One view here is that the market is relatively "blue ocean" with the right education and sales strategy.

"I'm continually surprised at the companies that manage their IP addresses on a spreadsheet," Siegfried said. "Whether they end up with something like NS1 DDI, or they end up with one of the more traditional products, I certainly try and get them off a spreadsheet if at all possible."

Among vendors, Infoblox, Bluecat and EfficientIP all have what Siegfried referred to as a "classical" appliance architecture. They each have roots in some form of hardware appliance to help enable DDI services. Men&Mice, in contrast, is founded on an overlay architecture, meaning that it deploys on top of an existing network in a software-defined approach.

NS1, in Siegfried's view, has a somewhat unique architecture for its DDI services, which could be challenging for some users. "If you're coming from a spreadsheet, it's going to be a little daunting to look at what NS1 DDI is going to bring to you," Siegfried said.

NS1's Coffey says that the modern DDI space isn't about being better than what Microsoft provides or competing against a spreadsheet. Rather,

it's about enabling automation for highly scalable deployments using DevOps-type workflows. In other words, the company doesn't just want to build a better mousetrap, it also wants to target an entirely different customer need within the same market.

NS1 is a good option for companies that are using existing DDI products and are looking for something more agile, according to Siegfried. Environments with lots of containers, different public cloud providers and data centers, as well those that have a lot of users who use their own devices, are well suited for NS1's offering.

It's important to note that NS1 only launched its DDI service in 2019, and so how it fits into the market and whether it can expand the TAM in this category will be a key variable to watch in the long term.

But what does the money think?

Raj Dutt, NS1's first investor and an observer on the company's board, feels the cohesiveness of the NS1 managed DNS platform is a key differentiator.

"[NS1] started as just DNS and I think they've evolved to be more of a general traffic management platform," Dutt said. "There are a lot of other vendors out there — Akamai is one of them — that have approached the space by bolting different things onto what's a relatively old, legacy platform."

In his view both as an investor and as a user of NS1 at his own company Grafana, NS1's platform provides what he referred to as "conceptual integrity" in contrast to other DNS vendors. In his experience, the NS1 platform capabilities feel cohesive and his developers like using the platform.

"We're using [NS1] for pretty mission-critical stuff — we're using them to ensure our availability,

which means their availability has to be super high," he said.

Meanwhile for Tyler Jewell, managing partner at NS1 investor Dell Technologies Capital (DTC), there are some clear points of differentiation, though that wasn't his first thought about the company. He stated that NS1 was initially not what he called "an intuitive investment" for his firm.

"They had been identified as a DNS and DDI company, which was increasingly commoditized technology," he said. In his view, the opportunity in Beevers' vision is around connecting users with applications in a way that is most efficient with the lowest round trip latency.

"If you want to provide this phenomenal application experience, you have to minimize latency, and the way to minimize latency on a global internet basis is that you have to have visibility to global internet traffic, and then provide intelligent decisions," Jewell, who also sits on NS1's board, said.

"What you realize is that DNS is the world's on-ramp to the internet, and nothing can get onto the internet without having gone to DNS first."

DNS' importance is not lost on big cloud vendors like AWS, Google and Microsoft Azure, which is why they all have their own DNS services. The market may have incumbents and big cloud vendors selling what might seem like the same type of service, but for Jewell, the NS1 approach adds more dynamism and intelligence, which can make it attractive to users that need an edge in performance.

"All systems on the planet depend upon DNS, sure, but there's a difference, you know, with almost all historical DNS being static — meaning you ask for a location and it gives you a predictable response back," he said. "NS1 is dynamic, in that it can give you a range of responses based

upon intelligence that it collects from around the internet."

Finally, looking specifically at the DDI market, Jewell sees a strong group of competitors and incumbents that have been in the market longer, but believes that NS1's software-based approach will appeal to organizations that need more agility for internal operations.

Future-proofing competition

While analysts and investors alike see differentiation in NS1's services, NS1 VP of Marketing Kathleen Rohrecker emphasized that the company has a lot of respect for its competitors. "Other companies have pieces of what we do, but we don't have everything that others have, and others don't have everything that we have," Rohrecker said.

The focus for NS1 isn't about having more features; it's about having an integrated set of features. NS1 COO Brian Zeman emphasized that when going into a prospect's environment, it's not about comparing 17 features from one platform against another.

"We focus on where the world is going," Zeman said. "What are you going to need in that world? You need APIs, you need to be cloud-native, you need to be able to roll out applications quickly, and you need to centrally manage them, but with a lot of agility at the edge."

"We're talking to a prospect about what they need, what their problem is, the value we can bring, and then we're also giving them a future-proof solution."

That's the pitch to customers, but exactly who is attracted to that message? In the fourth and final installment of the NS1 EC-1, I go deep into the customer use case, explaining how and why customers choose and run NS1.

TechCrunch

Outages, pandemics and the reengineering of traffic on the internet

NS1 EC-1 Part 4: Customer development

Sean Michael Kerner@TechJournalist

Sales in enterprise infrastructure is all about meeting a customer's requirements. But what happens if customers don't even realize they need a startup's product in the first place?

In the first three parts of this EC-1, we looked at the origins of NS1, how the company built its DNS and DDI services, and how it competes in a hypercompetitive market. This fourth and final part is where the "rubber meets the road" — the actual customers. Without customers, there is no money, there is no growth and there is no NS1.

NS1 kicked off with the idea that DNS could be used for more than it was previously. The company's technology has continued to evolve since its initial inception and now uses DNS as a leverage point to help organizations like Pinterest, Roblox and hundreds of others improve application delivery.

As we saw, the challenge for NS1 is that most customers are relatively content with their existing DNS service. It's a space that has many offerings from legacy as well as public cloud providers, and for most customers, there's never an urgent force pushing them to upend the fundamentals of their network.

NS1 has had a couple of lucky breaks. The first, as we will see with Pinterest and Roblox, was a major outage of one of the company's largest competitors, DynDNS, back in October 2016. That failure brought NS1 immediate attention from network architects, turning a relatively staid layer of infrastructure into a critical area for re-architecting.

Beyond that outage, NS1 has been able to educate its customers on why a more flexible base for DNS is important for performance. We inter-

Image Credits: Nigel Sussman

viewed Roblox extensively to understand how the children's gaming platform has engineered its systems in light of its feverish growth amidst the COVID-19 pandemic.

Finally, we will look at how NS1 continues to expand its product lineup, and what the future holds for the company. NS1 now serves more than 760 customers, including many of the world's most trafficked applications, such as LinkedIn, Dropbox, JetBlue, Fox and The Guardian. It has become a major infrastructure leader, and an "unusual outcome" likely awaits.

One outage to topple them all

There are a lot of different reasons why any enterprise or organization would choose to buy services from NS1.

Every business and internet user on the planet already has access to DNS in one form or an-

other. NS1 doesn't sell merely DNS services, as the company repeated time and again in every interview and briefing, but instead sells network resilience and performance. Sure, DNS "just works" in many cases, but "good enough" isn't good enough when microseconds count and users demand and expect to always be connected at the best possible speed.

In 2017, Roblox was using DynDNS for managed DNS services. When Principal Traffic Engineer Adam Mills joined the gaming company, Dan Williams, VP of Corporate and Production Engineering at Roblox, suggested they change to NS1, since he had seen it in production at his previous employer Dropbox. The October 2016 DynDNS outage was not the primary motivation for the company's transition, though it was a factor. The big issue, according to Mills, was the actual technology itself.
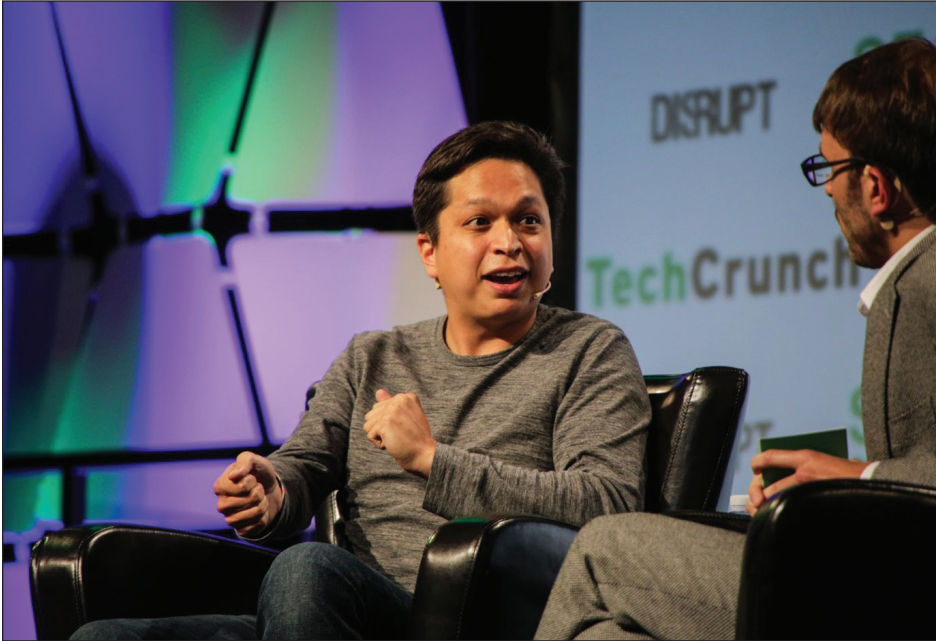
"It wasn't great. There was no amazing API

Ben Silbermann, co-founder and CEO of Pinterest at TechCrunch Disrupt SF 2017.

framework and there wasn't a way to dynamically configure the things they had," Mills said of his experience with DynDNS. "It was a little antiquated."

In his view, DynDNS back in 2017 was little more than a basic DNS service that connected traffic to locations without any other capabilities. Roblox wanted to use DNS as a key component of its network operations to direct users to the best servers according to their location, with geotargeting as a key goal. That would improve game performance and therefore the user experience.

Roblox already had data centers in major regions with an active user base, enabling connections as close to players as possible. What it needed was a more intelligent layer for determining how to connect a user to its platform. Roblox built its own infrastructure stack for the game platform, but building its own DNS service was not a game Mills had any interest in playing.

"We're a video game company, so we really weren't going to do DNS," Mills said. "I mean, at the time the traffic engineering team was basically two people, so we weren't going to be deploying our own DNS implementation to solve this problem." NS1 provided the necessary APIs and performance while allowing the traffic team to optimize performance to the platform's needs.

The DynDNS outage would prove to be the gift that kept on giving for NS1, and it was an even stronger impetus for change at social networking giant Pinterest. Scott Beardsley, engi-

neering manager at Pinterest, explained that after the outage, it became painfully obvious that there was a need to have a secondary authoritative DNS provider to ensure the company's uptime performance. Pinterest chose NS1.

Beardsley referred to the initial engagement as providing "dumb DNS" — basic managed DNS that helps route traffic to the right location. Over the last five years, however, Pinterest has moved beyond that simple use case to adopt and benefit from NS1's Pulsar product, which allows a traffic engineering team to adjust where traffic demand goes algorithmically and in real time.

"Pinterest has a lot of content, as you can imagine, and serving content can be expensive," Beardsley explained. "So we needed a way to optimize some of our costs by routing to multiple CDN vendors." With Pulsar, Beardsley said that Pinterest has a feedback loop from users on how they are experiencing the social network so it can optimize traffic delivery across its CDN providers for availability, performance and cost.

How Roblox used traffic engineering to thrive during last year's growth spike

When the COVID-19 pandemic first hit in early 2020, kids (and plenty of adults) around the world found themselves at home and with a lot more time to play games. For Mills, it was also game time: to prove that the online game creation platform could survive a deluge of traffic that it had not planned for.

"We were about to get hit with millions of new players and kids just staying at home that had more available free time," he said. "We were going to have capacity constraints as we had already forecasted for the year, and we had not put this at all in our forecast."

So how did Roblox handle the traffic? It was a combination of DNS traffic steering from NS1 and highly performant infrastructure that Roblox itself built over several years.

The actual game application and platform itself had been evolving since at least 2017 when Roblox built its own infrastructure platform, led by Williams (whose story is well told in another Extra Crunch article). Mills joined at about the same time as Williams and helped to lead the traffic engineering efforts.

Traffic engineering is a particularly vital function at an online gaming company. There are a lot of different things that make a game fast, including the processing power of the gaming server, connection speeds, graphics capabilities as well as myriad other factors. But at the most basic level, the first step for any online game is actually being able to connect.

"You can easily plot player engagement time to how fast the website is — it's a one-to-one ratio," Mills said. "If the website loads fast, people stay engaged longer."

Keeping a nine-year-old engaged is a key motivation for Mills and his team at Roblox. The company's gaming platform tends to skew toward younger players and Mills himself noted he has kids of his own that enjoy playing Roblox.

"What ends up happening with a nine-year-old, as does with anybody, is if it doesn't load, they'll just go someplace else; they'll immediately pivot to the other game," he said. "Reliability is important even for a nine-year-old."

A key part of what helps Roblox with its traffic optimization is NS1's Pulsar Active Traffic Steering technology, which I described in detail back in part two.

Mills explained that Roblox directly gathers its own latency metrics from players' browsers as they fetch game assets and connect to the platform. The combination of the company's user data and broader internet connection speed data from NS1 affords a very accurate picture of performance for any user. Pulsar then uses all the available data to direct users to the best possible server per their location.

Figuring out some of the capabilities of NS1, and Pulsar in particular, involved a lot of trial and error. That wasn't necessarily a bad thing, as Mills said he wasn't particularly fond of reading documentation and needed to figure out

how things worked for himself. To NS1's credit, he noted that whenever there was an item that didn't quite work as he wanted or a capability that Roblox needed, NS1 was responsive in helping to figure things out.

"I said, 'Hey, this is what I found as a customer,' and they're like, 'Oh, well, we'll fix that' and then like, you know, three or four weeks later they came back and said, 'Okay, we made a new version of the code that does what you want it to do,'" Mills said.

Aside from figuring out how things work, he also had to figure out what didn't work. Back in 2017, Roblox initially started out running the NS1 Managed DNS service. After three years of solid service, Mills and his team decided it was time to have a secondary DNS provider, to help enable resiliency. "It's not like we don't like NS1 or think that they're doing a bad job, but sometimes in some regions, everybody has an outage — it happens," Mills said.

That caution proved to be well warranted. In 2019, Mills said that Roblox had an outage in São Paulo, Brazil, with NS1. His team opened trouble tickets with NS1 and they were able to respond, but it took time.

DNS redundancy is critical, and that's where NS1's Dedicated DNS comes in. The service provides a set of servers on a separate network, and also pushes updates with a different deploy cycle than NS1's Managed DNS service. Mills said that the model means it's highly unlikely that both NS1's Managed and Dedicated DNS would ever both be broken at the same time.

As to why Roblox didn't choose a different DNS altogether for a secondary, Mills was unapologetic in stating that he just couldn't find any other provider that had the same traffic steering capabilities.

"Google has PoPs (points of presence) and they have tendrils in every single market, but as a startup company, you're not going to have that infrastructure [on] day one," Mills said. "We didn't have that infrastructure three years ago and we still don't have that infrastructure today […] being able to provide DNS and in a robust way and having a company like NS1 that offsets that

engineering effort to speed up your connections is great."

Finally, Mills noted that one key attribute of NS1 is its ability to play nice with the rest of Roblox's tech stack. After all, DNS and traffic steering is just one part of a larger set of tools that help to make the game platform work. Among the other technologies that Roblox uses are the open-source Ansible configuration management platform as well as Hashicorp tools such as the Nomad application workload scheduling system and the Consul service networking platform. Mills uses Ansible to help configure and automate deployments, while the Hashicorp technologies are used on Roblox's infrastructure to manage applications.

How NS1 is routing its own future

NS1 kicked off with the idea that DNS could be used for more than it was previously. The company's technology has continued to evolve since its initial inception and now uses DNS as a leverage point to help organizations like Pinterest, Roblox and hundreds of others improve application delivery.

At this stage of its growth, NS1 founder Kris Beevers says he's not looking for more funding, at least not yet. Whether an IPO or an acquisition is in the cards is also unknown at this point.

Raj Dutt, the first investor in NS1, former CEO of Voxel and current CEO of Grafana, isn't worried about whether the startup goes public. "My hope is that they just continue to make decisions that ensure that they're going to be a long-term, viable, sustainable, dominant company in their space," he said. "I'm not sitting here being like, 'Man, I wish that there was an exit for my investment'. … I'm just like — play the long game Kris, that's what you should do, that's what I want you to do."

Dell Capital's Tyler Jewell hasn't put an IPO date for NS1 on his calendar either, though he did specifically tell TechCrunch that he's expecting an "unusual outcome" for NS1. That basically means an exit where investors get a significant return either via an acquisition or IPO. "Our job

here is to capture as much of the opportunity as possible and to just stay focused on that, and then all the other stuff will happen, when and how that should happen," he said.

Regardless of the future public or private status of NS1, there continues to be opportunities for product expansion and riding secular growth trends.

The company last month announced NS1 Connect, a new platform meant to integrate and bring its services together in a more integrated manner. Users will be able to manage multiple NS1 services from a common interface, which makes for a setup that will also provide new cross-selling opportunities.

Jewell said he sees increasing demand as the volume of video collaboration in 4K as well as augmented reality (AR) and virtual reality (VR) is likely to grow in the coming years. All that workload, like all other internet workloads across the entire history of the internet, will rely on DNS to connect. NS1 and its backers are also optimistic about the continued growth of Internet of Things (IoT) as devices proliferate at the edge of the network.

As the company moves forward, what's next isn't necessarily about taking a dramatic leap, but rather about continuing to iterate, experiment and adapt as it has since day one.

"One of the things that I really believe in business, life and everything else is, you try something, you get some data, you create the feedback loop, and you iterate on that for what you're trying next," Beevers said.

Over the last nine years, since he first scribbled down the idea behind NS1 on a napkin in a NYC bar, Beevers has seen a lot as the company he founded moved from being an idea to being a foundational substrate for the internet.

"There's a million things that I would do differently with the benefit of all the data that we have from what we've learned in the last seven or eight years of business. But we didn't have the data," Beevers reflected. "What I am proud of is the way that we continue, eight years into our business, to experiment and tinker the same way as I did with the first 22 lines of code that I wrote on the couch."