NYDIG

Developers **of Bitcoin**

Greg Cipolaro
GLOBAL HEAD OF RESEARCH

Ethan Kochav
RESEARCH ANALYST

Executive **Summary**

Bitcoin is a decentralized monetary system, a peer-to-peer network moving trillions of dollars a year without the intervention of a trusted third party. But at its core, the Bitcoin network is a collection of software programs simultaneously running on tens of thousands of computers around the world, continuously updating a shared ledger called the blockchain. While Bitcoin is best known for its ingenious use of technology, its defining characteristic is ultimately the power accorded to its user base. This report looks at the technical development of Bitcoin and the active community of open-source developers who update, maintain, and enhance the Bitcoin code and its greater ecosystem.

Who is Satoshi Nakamoto?

Satoshi Nakamoto is the pseudonym for the individual(s) responsible for the creation of bitcoin, the first successful de-centralized digital asset. For many years, Satoshi's identity has been the source of intense media scrutiny. Although many individuals have been linked to or thought to be Satoshi, Satoshi's has never been positively identified. In the early days of Bitcoin, Satoshi interacted with the community through mailing lists, message boards, and direct email. However, Satoshi has not been heard from in over a decade, and Satoshi's contributions have been supplanted or augmented by a community of open-source developers. Although it may be hard for some to accept that the identify of Satoshi is unknown, all that's needed to appreciate the elegance of the Bitcoin network is a high level view into Bitcoin's code and the commu-nity that supports it. The code has been available for public inspection, criticism, and analysis for over 13 years now. It has withstood the test of time and continues to evolve, while its community has become bigger and more vibrant over the years.

Bitcoin's Prehistory to Its Open-Source Development

The Bitcoin network was born on January 3, 2009, when Satoshi mined the Genesis Block and encoded the now famous message "The Times 03/Jan/2009 Chancellor on brink of second bailout for banks," an apt reference to that day's headlines from the London Times. Looking back, it was a momentous event for open-source technology, one that would ultimately serve as the Big Bang for the entire digital asset industry. But at the time, none of this was evident, and Bitcoin's birth was likely witnessed only by Satoshi. The original idea for Bitcoin was first passed around several months earlier on October 31, 2008. That Halloween, Satoshi sent an email to a mail list populated by cryptography enthusiasts called the Cryptography Mailing List. "I've been working on a new electronic cash system that's fully peer-to-peer, with no trusted third party," the email started. Satoshi then went on to describe the technology's properties and reference a paper "Bitcoin: A Peer-to-Peer Electronic Cash System" hosted on bitcoin.org, a website registered a few months earlier on August 18, 2008.

The responses to the announcement were mixed, with a touch of optimism and a healthy dose of skepticism. Over the next couple of months, Satoshi, who had admitted Bitcoin had taken a couple of attempts over a few years before its current iteration, sought feedback from others, distributing a pre-released version to some of the mailing list subscribers in what could be considered Bitcoin's first act of open-source development. However, Bitcoin would not be available in its final first version to the public until January 8, 2009. It was five days after Satoshi mined the Genesis Block when v0.1 was published on the open-source software hosting site SourceForge for anyone to download. Computer scientist Hal Finney would be the first recipient of a Bitcoin transaction, when on January 12th, Satoshi sent him 10 bitcoins.

Early Bitcoin Development Contributors

The early SourceForge page set up by Satoshi acknowledged contributions to the project by a handful of individuals, although the code was written entirely by Satoshi. The named contributors include Hal Finney, the first recipient of a bitcoin transaction; developer Laszlo Hanyecz, who is famously the executor of the first real world commercial transaction using bitcoin, 10,000 bitcoins for two Papa John's pizzas; enthusiast David Parrish; Finnish college student Martti Malmi, who built early bitcoin community forums and helped communicate Bitcoin to the first adopters; and the pseudonymous madhatter2. Including Satoshi, there were 6 contributors who received attribution, but only Satoshi was directly updating the code.

DEVELOPER	USERNAME	ROLE/POSITION
David Parrish	dmp1ce	N/A
Hal Finney	hal	N/A
Laszlo Hanyecz	laszloh	Developer
madhatter2	madhatter2	N/A
Martti Malmi	sirius-m	Developer
Satoshi Nakamoto	s_nakamoto	Project Manager

Early Community Building

In the early stages of Bitcoin, all code updates were implemented by Satoshi, with individuals communicating privately with Satoshi via email or publicly on the Bitcoin mailing list. A number of chat channels and message boards devoted to the development and support of Bitcoin sprang to life, with Satoshi frequently engaging with the community through these venues. However, with code development heavily centralized around Satoshi, developers eventually became frustrated with the bottleneck that the founder represented. Through 2010, Satoshi's contributions and engagement with the community began to fade. Eventually, Satoshi handed off project management to a developer named Gavin Andresen, who ported the code over to GitHub. GitHub allowed for easier contributions from the developer community, resulting in a more open and inclusive process. WIth the introduction of GitHub, any member of the Bitcoin community could suggest changes, while certain developers became "maintainers" who could actually approve changes to the Bitcoin code. New maintainers are added via a consensus of current maintainers.

Satoshi Steps Away

By the end of 2010, less than 2 years after the launch of Bitcoin, Satoshi became distanced from the project. Satoshi's last public message was in December 2010, the same month in which Satoshi last contributed code to Bitcoin and Gavin Andresen set up the GitHub code repository. In stepping away from Bitcoin, Satoshi made Andresen the de facto "lead developer" of Bitcoin. In a final email to developer Mike Hearn, Satoshi declared "I've moved on to other things. It's in good hands with Gavin and everyone."

Bitcoin's Path to Decentralization

With Satoshi stepping away, Bitcoin had passed guardianship, technically and spiritually, from its creator to the community, though this would not mean that development was fully decentralized. Over the next few years, Andresen led the Bitcoin project. In his leading role, he would occasionally exert his influence despite objections from some in the community, most notably when he introduced the Pay-to-Script-Hash soft fork into the code.

In 2014, Andresen relinquished his role as "lead developer" (though he kept his administrator access) to Dutch developer Wladimir van der Laan to focus on his role as "Chief Scientist" of The Bitcoin Foundation, a non-profit (now mostly defunct) dedicated to promoting the use of bitcoin as cryptographic money for the benefit of users worldwide. Van der Laan viewed his role less as a leader and more as a coordinator, so his "reign" tended to be more consensus-based. Several years into

HISTORICAL MAINTAINERSHIP

Source: Andrew Chow
*Current Maintainer
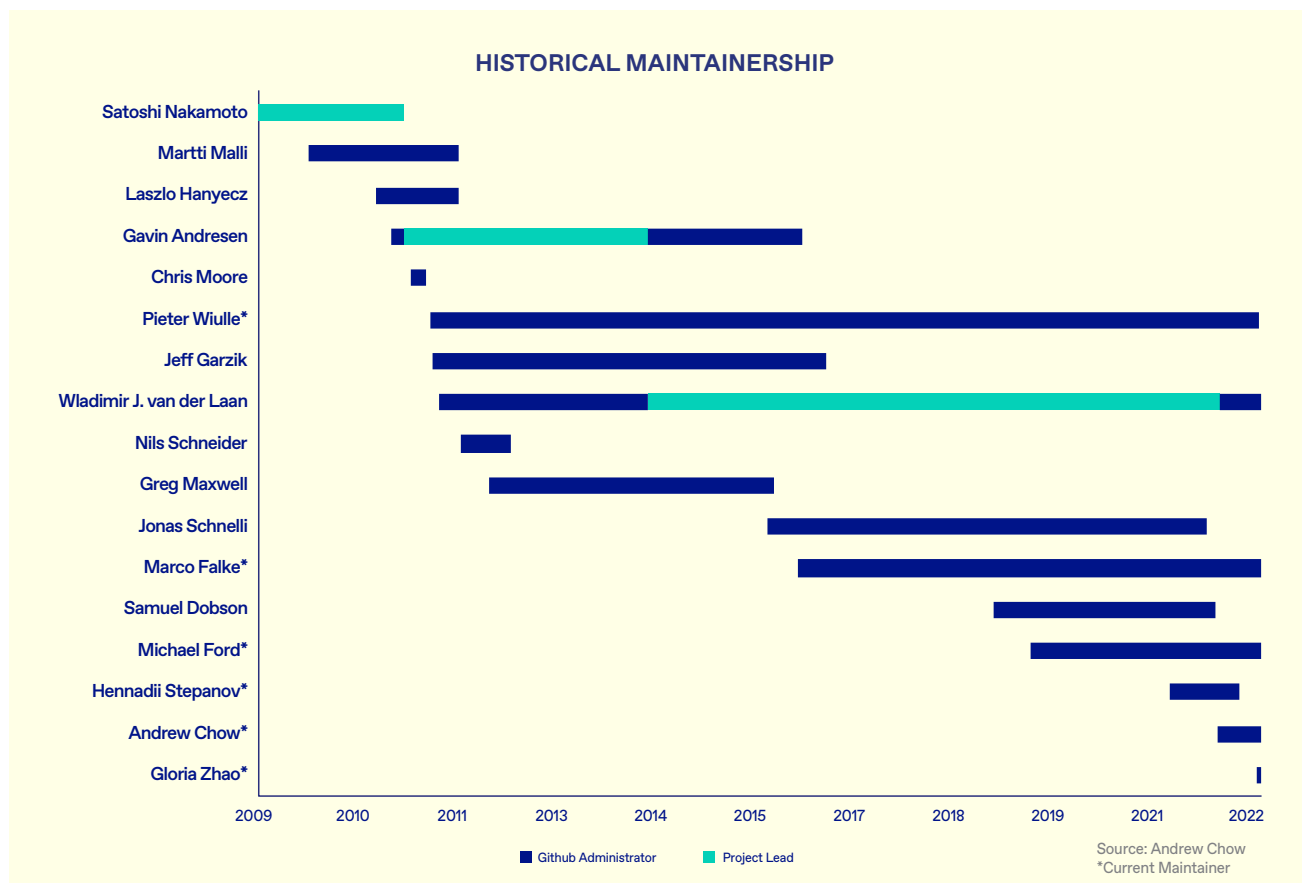
his role, his leadership was challenged by the biggest schism in Bitcoin's history. The "scaling debate," a philosophical and technical impasse over whether or how Bitcoin's transaction throughput should be increased, embroiled the developer community for years, only resolving itself after the Bitcoin Cash hard fork in August 2017. At the peak of this debate, Andresen, who advocated for a larger block size, had his administrator access to the Bitcoin code revoked by van der Laan (although Andresen had not been active on Bitcoin Core for many months). This debate was eventually resolved when the so-called "big blocker" community coalesced around a forked coin called Bitcoin Cash, which allowed for larger block sizes. Four years later, in 2021, van der Laan himself announced intentions to step down as lead maintainer and has since announced his intention to step down from the maintainer role altogether. The role has not been replaced by an individual, but rather by a group of developers, meaning that Bitcoin has gone even further down the path of decentralization.
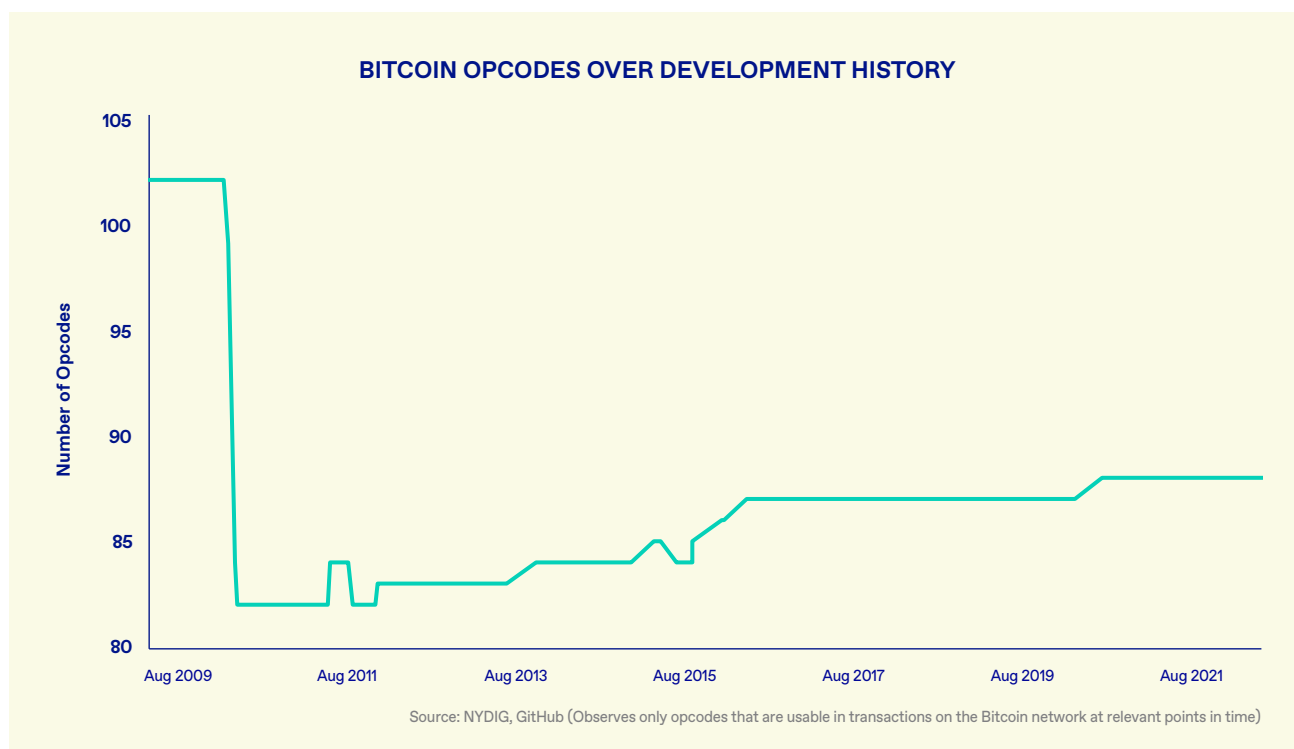
How is Bitcoin Updated Today?

Today, Bitcoin is a fully open-source software project, built and maintained by developers from around the world. There are many ways to contribute Bitcoin's code, including engaging in discussion on the mailing list, one of the forums, or IRC chats; participating in meet-ups and study groups; and suggesting updates to the software itself through GitHub. Major updates to Bitcoin typically start as Bitcoin Improvement Proposals (BIPs), which are design documents that outline proposed code changes. These proposals are then debated by the community, developed, and rigorously tested before being merged into Bitcoin's code. The review process in Bitcoin is very involved, and the level of scrutiny is a significant differentiator from other cryptocurrency projects. It takes a notoriously long time for changes to get merged, requiring reviews by multiple maintainers — those developers with authority to make changes directly to Bitcoin Core's code — and an open comment period afforded to the community. The total review process for consensus-related changes often takes months or years. The reviews span cryptographic analysis, economic theory, usability assessment, software design, and, finally, code.

Every now and then, a series of changes to Bitcoin's code are aggregated together and formed into a runnable version of Bitcoin called a "release." Until the release of Bitcoin Core v22.0 in September 2021, all final releases were cryptographically signed by van der Laan or Andresen (Satoshi never signed his releases). Those downloading Bitcoin Core could verify the code's authenticity by checking it against the lead maintainer's widely available public key. With v22.0, Bitcoin added the ability for users to check Bitcoin's authenticity against the keys of other trusted developers in addition to van der Laan. In that release, the signers were 0XB10C (an anonymous developer), Andrew Chow, Ben Carman, Antoine Poinsot, Duncan Dean, Stephan Oeste, Michael Ford, Oliver Gugger, Hennadii Stepanov, Jon Atack, Aaron Clauson, and Will Clark, though this group will likely vary going forward. This process verifies that these developers have personally signed off on the exact version of the code that users are downloading.

These developers' public keys verify Bitcoin Core's authenticity, ensuring that its code has not been tampered with. However, Bitcoin is an open-source project, and anyone can make code contributions, so processes must also be put in place to ensure that the collaborative code process results in functional and non-malicious code. Bitcoin's source code resides on GitHub, a website and tool for collaborative software development. Proposed changes to Bitcoin's code are effected through "pull requests" by developers, which are manually reviewed and, if ultimately accepted, "merged" into the codebase by the maintainers. Pull requests are generally composed of several smaller individual code updates called "commits," which we will quantitatively measure in the following section.

Bitcoin Got Simpler (and Safer) at First, Before Adding New Functionality

The development of Bitcoin, while itself an original concept, has generally favored security and safety over technical novelty and flexibility, especially relative to other blockchains. From its insistence on backward-compatible upgrades to the way the developer community comes to agreement on decisions, Bitcoin has focused on being an electronic payment and store-of-value system for the digital age. To that end, Bitcoin developers actually removed features in its earliest days in the name of security and have only cautiously added new features since. One way of tracking the complexity of the Bitcoin network is through something called opcodes. While Bitcoin Core is coded in C++, its operation relies on something called Script, a simple programming language that allows for validation of transactions on the network. Opcodes are the basic operational components that run Script and help define the scope of possible transactions. By tracking the number of opcodes through successive Bitcoin Core versions, we see that developers initially reduced functions that were deemed to be unsafe and have gradually been adding features since. The most recent opcode added was OP_CHECKSIGADD with the Taproot upgrade in 2021.

BITCOIN OPCODES OVER DEVELOPMENT HISTORY

Source: NYDIG, GitHub (Observes only opcodes that are usable in transactions on the Bitcoin network at relevant points in time)

Bitcoin Timeline

2008	Aug 18	Bitcoin.org website registered
	Oct 31	Satoshi Nakamoto publishes Bitcoin whitepaper
2009	Jan 03	Satoshi mines Bitcoin's first block, the Genesis Block
	Jan 08	Bitcoin v0.1 is released on open-source development platform SourceForge
	Jan 11	Satoshi sends Hal Finney 10 bitcoins in network's first transaction
	Aug 30	Martti Malmi creates a subversion repository (SVN) on SourceForge to better track changes to and collaborate on the Bitcoin Core code
	Oct 09	Bitcoin Internet Relay Chat (IRC) channel #bitcoin-dev registered on freenode
	Nov 22	Bitcointalk.org message board launched
2010	Jun 11	Gavin Andresen launches the Bitcoin Faucet, allowing anyone to receive 5 bitcoins for free
	Jul 14	Satoshi inserts 1MB blocksize limit into Bitcoin code, setting the stage for a later debate about scaling
	Oct 11	Gavin Andresen commits first piece of code, implying that he had received commit access to SVN
	Dec 12	Satoshi's last public message
	Dec 15	Satoshi's last code commit
	Dec 19	Andresen moves Bitcoin code from SourceForge to Github to improve the collaborative process
2011	Apr 23	Satoshi pens email to Mike Hearn that implies he is handing off the Bitcoin project to Gavin Andresen

	Apr 26	Satoshi's last private email to Andresen
2012	Apr 01	Pay-to-script-hash soft fork , a major upgrade to how bitcoin addresses are formed, is deployed on the network
	Sep 27	Gavin Andresen creates the Bitcoin Foundation, modeled on the Linux Foundation, to support the Bitcoin network
2013	Mar 12	Bitcoin blockchain splits for 6 hours following a clumsy software upgrade
	Dec 16	"Bitcoin" software program rebranded to "Bitcoin Core"
2014	Apr 07	Gavin Andresen steps down as project lead, replaced by Wladimir van der Laan
2015	Feb 28	First draft of the The Bitcoin Lightning Network white paper is circulated by Joseph Poon and Thaddeus Dryja
	Jun 22	Gavin Andresen publishes BIP 101, suggesting a roadmap for a hard fork that would allow for larger block sizes (8 MB)
2016	May 06	Wladimir van der Laan removes Gavin Andresen's commit privileges, fallout of the scaling debate
2017	Aug 01	Bitcoin Cash forks from Bitcoin with higher blocksize (8 MB)
	Aug 23	Segregated Witness (SegWit), an erstwhile proposed compromise to the blocksize debate that increased throughput, is implemented via a soft fork
2018	Mar 15	Lightning Labs' Lightning Network beta goes live on Bitcoin
2021	Jan 21	Wladimir van der Laan announces intention to step down as lead maintainer
	Sep 13	Bitcoin Core 22.0 is released, includes a new method to verify signatures that includes a series of developers
	Nov 14	Taproot soft fork activates, allowing for more complex transaction types that could improve security, privacy, and throughput

Quantifying the Development of Bitcoin

By measuring the contributions from the open-source developer community to Bitcoin's codebase, we can make quantitative assessments of its developments. In this analysis, we specifically look at code commits, which are small, generally self-contained sets of updates to a shared repository of code. Historical commit data can tell us who has been contributing most to the code over time. This helps us understand the pace of development across certain projects as well as the key players at each point in time.

We divide Bitcoin into two aspects: (1) the core protocol, also known as the Bitcoin Core software program, plus other key repositories (bitcoin/bitcoin, bitcoin-core/secp256k1, bitcoin-core/gitian.sigs, bitcoin-core/guix.sigs), and (2) the Bitcoin ecosystem consisting of 2,584 GitHub repositories, the wallets, payment processors, educational content, and other software programs that rely on and expand the Bitcoin network. Investors should think of the core protocol as the essential Bitcoin software, while the ecosystem is the surrounding infrastructure built around Bitcoin. The analysis of the ecosystem relies heavily on data and project code mapping created by Electric Capital, an early stage venture firm focused on cryptocurrencies, for their annual Developer Report. The Bitcoin Core code is the most important in the ecosystem, as it is the backbone of the Bitcoin network, but it is also useful to observe trends in the broader universe.

There are drawbacks to this type of analysis. First, more is not always better in terms of code commits (updates) or even in terms of developer activity. Commits can range from impactful updates to functionality to simple updates of documentation. This type of analysis also does not look at the differences in quality of work being done. This is especially true within the ecosystem analysis, where each project may differ by importance as well as the rules on the sizes of code commits (Bitcoin Core, for example, has a fairly consistent approach to how large commits should be). Second, this analysis only considers developer contributions that make it into Bitcoin's code and omits suggested updates that never make it into the code. Third, this analysis omits an important area of development that constitutes ecosystem building; the internal development at centralized organizations, such as what we do at NYDIG. Despite these drawbacks, we think there is value from this type of analysis.
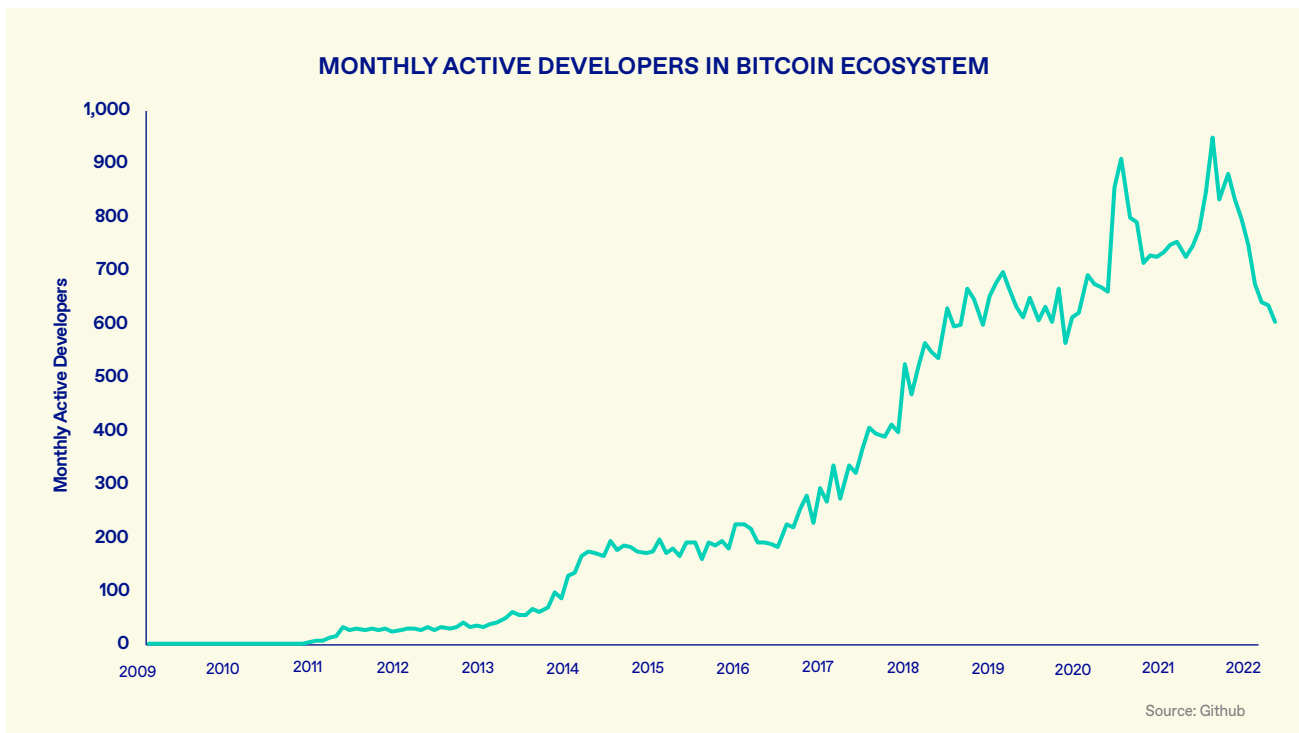
Core Protocol Development

There have been 1,140 unique developers who have contributed to Bitcoin Core. While there's been impressive growth since Bitcoin's creation 13 years ago, this is still small by some open-source project standards. Linux, which pioneered open-source development, has had nearly 100,000 contributors, for example. The broader Bitcoin ecosystem is much larger, with 13,057 unique developers, though again this excludes developers working on closed-source solutions that are not open to the public, such as the developers here at NYDIG.

Active Developers

We define an active developer as anyone who has made a commit in a given month. While that number can vary month to month, it has numbered roughly 40 - 60 for the core protocol.

MONTHLY ACTIVE DEVELOPERS IN CORE PROTOCOL

Source: Github
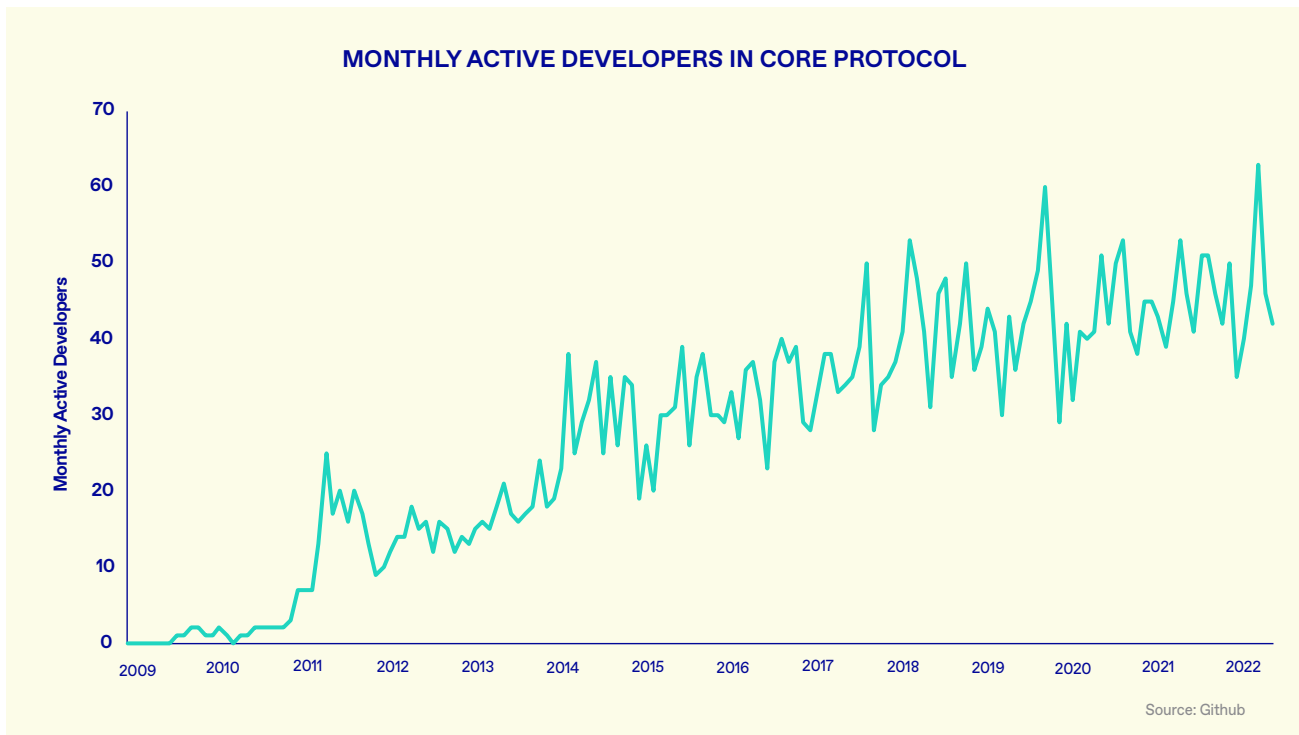
The broader ecosystem has ranged between 600-1000 monthly active developers. While growth in active ecosystem developers is a secular trend, observationally there appears to be some correlation to the 4-year price cycles that bitcoin has exhibited.

MONTHLY ACTIVE DEVELOPERS IN BITCOIN ECOSYSTEM

Source: Github

Top Bitcoin Developers by Year

Looking at the composition of top Bitcoin core protocol developers by year, a couple of things come to mind. First, Satoshi has not been in the top 10 contributors to Bitcoin's code since 2010 (in fact, Satoshi has not contributed to the code since 2010). Second, many prominent Bitcoin developers have consistently remained as top commit contributors throughout much of Bitcoin's life. That said, some developers have risen in prominence, while others have dropped off as they have moved on to other projects. Third, while some developers have adopted online pseudonyms to protect their identities, the real identity of most Bitcoin developers — each of the top ten developers in 2021 and 2022 — is publicly known. This is far from the mysterious set of anonymous coders that many believe develop Bitcoin.

2009	2010	2011	2012	2013
Satoshi Nakamoto	Satoshi Nakamoto	Wladimir J. van der Laan	Philip Kaufmann	Pieter Wuille
Martti Malmi	Gavin Andresen	Gavin Andresen	Pieter Wuille	Philip Kaufmann
	Wladimir J. van der Laan	Matt Corallo	Wladimir J. van der Laan	Gavin Andresen
	Martti Malmi	Pieter Wuille	Gavin Andresen	Wladimir J. van der Laan
		Jeff Garzik	Jeff Garzik	Matt Corallo
		Nils Schneider	Luke Jr	Jeff Garzik
		Luke Jr	Matt Corallo	Eric Lombrozo
		Giel van Schijndel	Gregory Maxwell	Cory Fields
		Jordan Lewis	Michael Ford	Gregory Maxwell
		Han Lin Yap	Giel van Schijndel	Jonas Schnelli

2014	2015	2016	2017	2018
Wladimir J. van der Laan	Wladimir J. van der Laan	Marco Falke	John Newbery	Marco Falke
Pieter Wuille	Jonas Schnelli	Wladimir J. van der Laan	Matt Corallo	Thomas J
Cory Fields	Pieter Wuille	Pieter Wuille	Thomas J	John Newbery
Philip Kaufmann	Cory Fields	Cory Fields	Wladimir J. van der Laan	Pieter Wuille
Jorge Timón	Marco Falke	Jonas Schnelli	Pieter Wuille	João Barbosa
Cozz Lovan	Gregory Maxwell	Matt Corallo	Alex Morcos	Chun Kuan Lee
Luke Jr	Philip Kaufmann	Suhas Daftuar	Russell Yanofsky	Wladimir J. van der Laan
Gavin Andresen	Matt Corallo	Luke Jr	Jonas Schnelli	Russell Yanofsky
Jeff Garzik	Luke Jr	Michael Ford	Cory Fields	Andrew Chow
Michael Ford	Suhas Daftuar	Pavel Janík	Suhas Daftuar	Ben Woosley

2019	2020	2021	2022
Marco Falke	Marco Falke	Marco Falke	Marco Falke
Hennadii Stepanov	Hennadii Stepanov	Hennadii Stepanov	Hennadii Stepanov
Andrew Chow	Andrew Chow	Michael Ford	Michael Ford
Michael Ford	Jon Atack	Carl Dong	Jon Atack
João Barbosa	Thomas J	Jon Atack	Carl Dong
Thomas J	Pieter Wuille	Andrew Chow	Andrew Chow
John Newbery	Michael Ford	Sebastian Falbesoner	Sebastian Falbesoner
Pieter Wuille	John Newbery	Pieter Wuille	Wladimir J. van der Laan
Russell Yanofsky	Russell Yanofsky	John Newbery	Vasil Dimov
Wladimir J. van der Laan	Sebastian Falbesoner	Gloria Zhao	Tim Ruffing

Bitcoin's Most Prolific Contributors

By ranking Bitcoin's developers by total number of commits, some interesting observations arise. First, Satoshi is far down in the ranking of code contributors. While one might be tempted to conclude that Bitcoin has largely been re-written by others (which it has), many of Satoshi's contributions occurred before commit tracking was made a feature for Bitcoin in October 2009. Second, while many people have contributed to the building of Bitcoin over the years, a small number are responsible for the bulk of development: the top 37 developers account for 80% of Bitcoin's total code commits, and the top 50 account for 84% of code commits. Third, looking at the breakdown of a developer's commits by year, we can track their engagement or disengagement from the project.

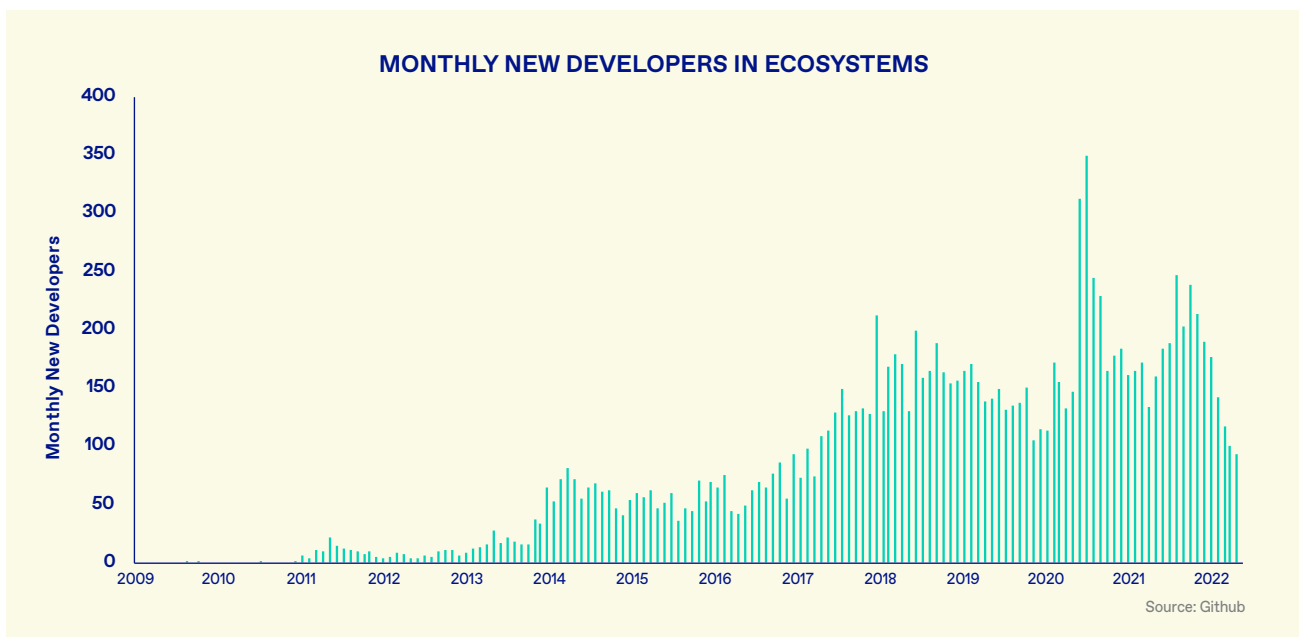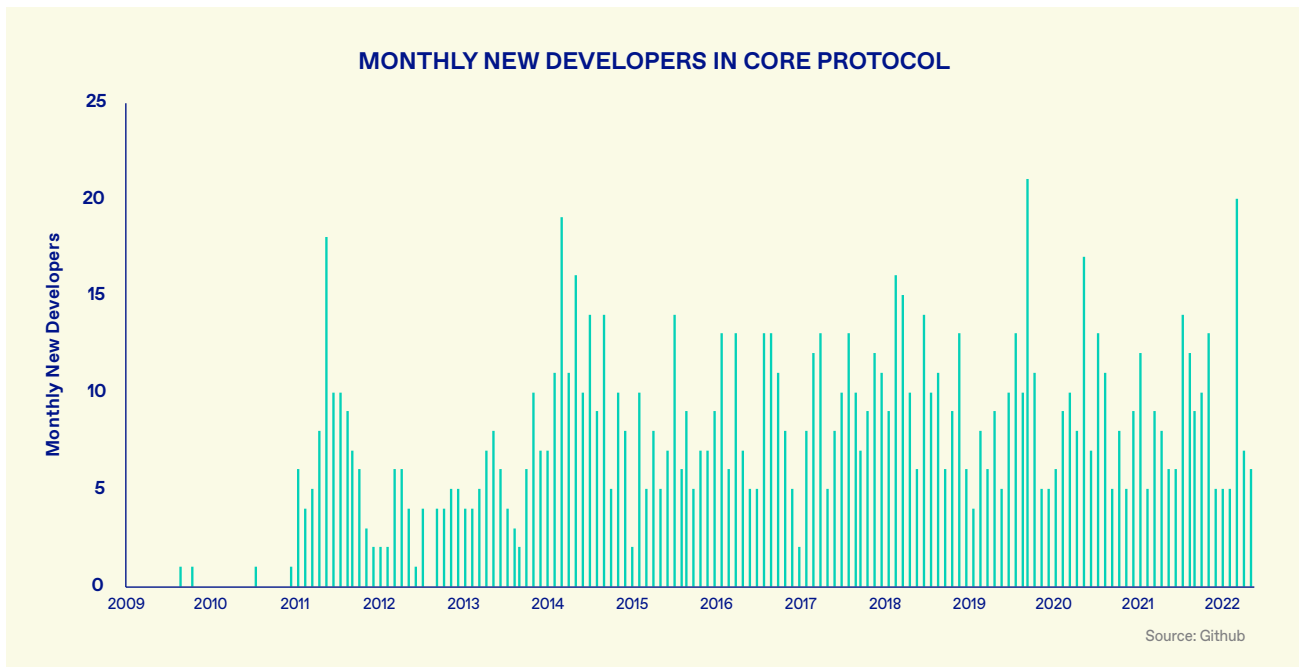| Rank	Author Name	Commits 2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total	% of Total	Cumulative Total	Location
1	Marco Falke	0	0	0	0	0	0	83	201	56	214	357	525	536	225	2197	9%	9%	Germany
2	Wladimir J. van der Laan	0	2	348	159	108	367	214	189	146	83	65	46	51	54	1832	8%	17%	Netherlands
3	Pieter Wuille	0	0	49	215	212	280	143	168	135	131	90	187	155	39	1804	8%	24%	USA
4	Hennadii Stepanov	0	0	0	0	0	0	0	0	0	35	131	301	388	209	1064	4%	29%	Ukraine
5	Michael Ford	0	0	0	20	11	41	36	49	34	45	125	153	304	175	993	4%	33%	Australia
6	John Newbery	0	0	0	0	0	0	0	2	248	158	92	115	119	39	773	3%	36%	UK
7	Andrew Chow	0	0	0	0	0	0	10	31	71	127	252	180	80	751		3%	39%	USA
8	Thomas J	0	0	0	0	0	0	0	0	181	205	106	188	40	1	721	3%	42%	Unknown
9	Matt Corallo	0	0	97	59	57	21	57	89	221	22	27	1	2	0	653	3%	45%	USA
10	Cory Fields	0	0	0	0	29	220	111	133	99	25	11	12	6	4	650	3%	48%	USA
11	Philip Kaufmann	0	0	0	218	187	165	69	0	0	0	0	0	0	0	639	3%	51%	Germany
12	Jon Atack	0	0	0	0	0	0	0	0	0	0	49	198	250	96	593	2%	53%	USA
13	Jonas Schnelli	0	0	0	0	22	31	165	106	101	46	32	16	7	0	526	2%	55%	Switzerland
14	Gavin Andresen	0	35	152	139	113	47	17	1	0	0	0	0	0	0	504	2%	57%	USA
15	Carl Dong	0	0	0	0	0	0	0	0	0	2	8	60	73	266	88	497	2%	60%	USA
16	Luke Jr	0	0	27	62	15	57	56	64	57	28	21	55	23	16	481	2%	62%	USA
17	Russell Yanofsky	0	0	0	0	0	0	0	20	102	72	81	106	52	3	436	2%	63%	USA
18	João Barbosa	0	0	0	0	0	0	2	8	34	102	108	56	21	3	334	1%	65%	Portugal
19	Sebastian Falbesoner	0	0	0	0	0	0	0	0	0	0	19	75	156	73	323	1%	66%	Austria
20	Suhas Daftuar	0	0	0	0	0	4	56	81	58	28	32	30	1	12	302	1%	67%	USA
21	Gregory Maxwell	0	0	0	23	22	40	75	43	32	3	11	9	2	0	260	1%	68%	USA
22	Jeff Garzik	0	0	38	103	38	44	11	0	0	0	0	0	0	0	234	1%	69%	USA
23	Alex Morcos	0	0	0	0	0	4	44	43	117	1	0	0	0	0	209	1%	70%	USA
24	Anthony Towns	0	0	0	0	0	0	0	1	6	38	9	32	75	36	197	1%	71%	Australia
25	Vasil Dimov	0	0	0	0	0	0	0	0	0	4	0	43	103	42	192	1%	72%	Slovenia
26	Sjors Provoost	0	0	0	0	0	0	0	0	10	21	43	48	58	11	191	1%	73%	Netherlands
27	Jorge Timón	0	0	0	0	0	71	38	16	35	8	5	0	0	0	173	1%	73%	Spain
28	Tim Ruffing	0	0	0	0	0	0	0	0	1	6	31	22	72	40	172	1%	74%	Germany
29	Karl-Johan Alm	0	0	0	0	0	0	0	7	31	47	25	40	10	0	160	1%	75%	Japan
30	Satoshi Nakamoto	28	132	0	0	0	0	0	0	0	0	0	0	0	0	160	1%	76%	Unknown
31	James O'Beirne	0	0	0	0	0	0	8	0	6	29	44	10	51	7	155	1%	76%	USA
32	Ben Woosley	0	0	0	0	0	0	0	0	0	69	37	26	4	8	144	1%	77%	USA
33	Gloria Zhao	0	0	0	0	0	0	0	0	0	0	0	3	104	35	142	1%	77%	USA
34	Amiti Uttarwar	0	0	0	0	0	0	0	0	0	0	6	73	61	0	140	1%	78%	USA
35	Samuel Dobson	0	0	0	0	0	0	0	0	46	15	14	4	60	0	139	1%	79%	New Zealand
36	Gregory Sanders	0	0	0	0	0	0	1	9	23	31	41	20	2	2	129	1%	79%	USA
37	Fabian Jahr	0	0	0	0	0	0	0	0	0	0	10	39	39	16	104	0%	80%	Germany
38	Peter Todd	0	0	0	2	17	31	40	10	2	0	0	0	0	0	102	0%	80%	Canada
39	Chun Kuan Lee	0	0	0	0	0	0	0	0	0	86	14	0	0	0	100	0%	80%	Taiwan
40	Pavel Janík	0	0	0	0	0	23	16	44	14	0	0	0	0	0	97	0%	81%	Czechia
41	Jonas Nick	0	0	0	0	0	0	0	3	6	5	13	41	23	2	93	0%	81%	Netherlands
42	Jim Posen	0	0	0	0	0	0	0	0	6	49	22	11	0	0	88	0%	82%	USA
43	Antoine Poinsot	0	0	0	0	0	0	0	0	0	0	0	10	34	30	74	0%	82%	France
44	Cozz Lovan	0	0	0	0	5	63	2	0	0	0	0	0	0	0	70	0%	82%	Unknown
45	Patrick Strateman	0	0	0	0	1	0	16	31	2	10	2	1	1	3	67	0%	82%	USA
46	Andrew Poelstra	0	0	0	0	1	1	15	20	3	11	7	3	4	0	65	0%	83%	USA
47	Aaron Clauson	0	0	0	0	0	0	0	0	5	3	17	15	12	9	61	0%	83%	Ireland
48	Jeremy Rubin	0	0	0	0	0	0	0	8	22	3	13	9	3	1	59	0%	83%	USA
49	Daniel Kraft	0	0	0	0	0	14	11	6	0	11	5	7	4	0	58	0%	83%	Switzerland
50	Martin Zumsande	0	0	0	0	0	0	0	0	0	0	5	2	32	19	58	0%	83.7%	Germany

Share of Developer Contributions by Geography

Because the real identities of most of Bitcoin's top developers are known, we can look at geographic breakdown to see which regions are home to the most active Bitcoin development. Based on our analysis, the USA is far and away home to the largest contributors to Bitcoin's code. One caveat is that open-source software development is not bound by geographical location, and developers do move around. However, we think it is safe to say that most Bitcoin development occurs in North America and Europe. Further reinforcing the point, the primary channels of Bitcoin development generally occur in English.

Monthly New Developers - Small but Steady

Every month, new developers engage with Bitcoin's core protocol or its ecosystem for the first time. For the core protocol, Bitcoin adds 5 - 20 new developers per month. While a small number on an absolute basis, this adds up over time. Meanwhile, the broader Bitcoin ecosystem has added developers at a higher monthly pace, with some correlation with price cycles.

SHARE OF TOP DEVELOPER COMMITS BY GEOGRAPHY

Region	Share of Commits
USA	35.1%
Germany	13.3%
Netherlands	8.9%
Australia	5.0%
Ukraine	4.5%
Unknown	4.0%
UK	3.2%
Switzerland	2.5%
Portugal	1.4%
Austria	1.4%
Slovenia	0.8%
Spain	0.7%
Japan	0.7%
New Zealand	0.6%
Canada	0.4%
Taiwan	0.4%
Czechia	0.4%
France	0.3%
Ireland	0.3%
Israel	0.2%
Total Top 50 Devs	**83.9%**
Share of Non-Top 50 Devs	**16.1%**

MONTHLY NEW DEVELOPERS IN CORE PROTOCOL

Source: Github

MONTHLY NEW DEVELOPERS IN ECOSYSTEMS

Source: Github

# Monthly Code Contributions Continue to Rise

Bitcoin has seen steady growth in its development as measured by monthly commits. Code contributions have reached 200-400 commits monthly. That's a significant increase since the inception of Bitcoin, when there was just a handful of monthly commits at irregular intervals.

MONTHLY COMMITS IN CORE PROTOCOL

Source: Github
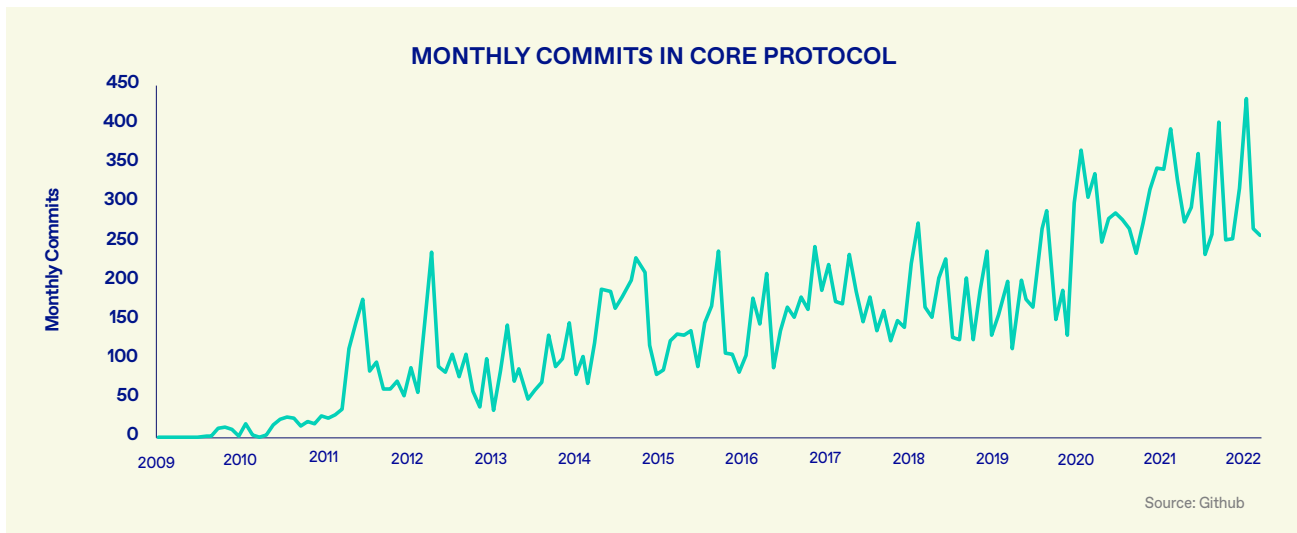
Developer Age Bands

Developer age bands, the share of Bitcoin's quarterly commits sorted by the date of a developer's first engagement with the Core Protocol, shows how its developer base has matured over the years. While some of Bitcoin's early developers continue to be active with the code, in 2021 over half the contributions have come from developers that joined since the last bull market cycle in 2017.

DEVELOPER AGE BANDS IN CORE PROTOCOL

Source: Github
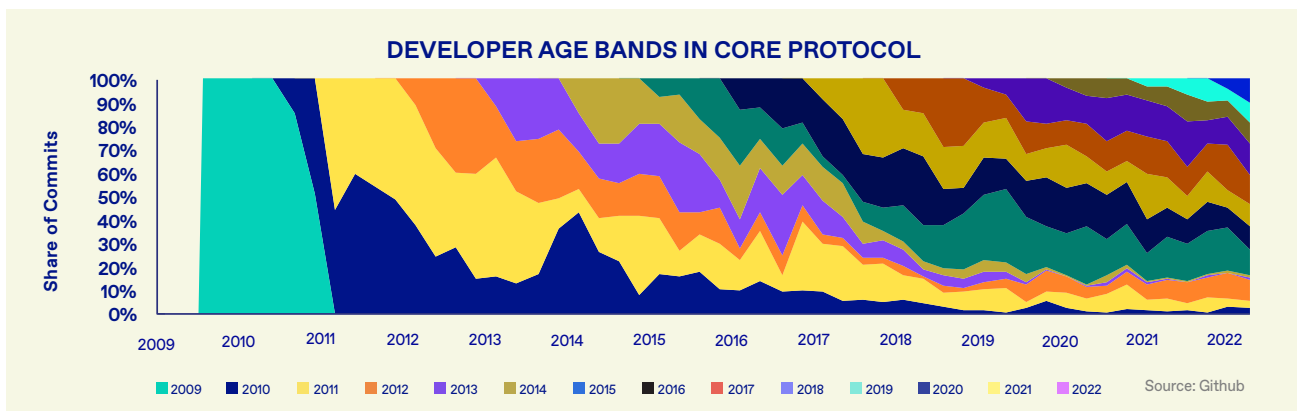
Final Words

The development of Bitcoin has seen many phases since the white paper first appeared in 2008. It has gone from closed-source development by a pseudonymous individual to one that is today truly open and decentralized, something few other digital assets can claim. We may never know the real identity of Bitcoin's creator, but today that no longer matters. Bitcoin is a collaborative effort by thousands of developers around the world, most of whom we know. At its heart, Bitcoin is a software program, with a broader ecosystem of software augmenting the core protocol. The ecosystem of applications and developers continues to grow, with contributions coming from around the world, expanding Bitcoin's reach as a global monetary system.

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